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The Uniflow Steam Engine

General Notes Including an Historical Reference, Results of Tests, its Application and a Bibliography of the Subject

E. A. Allcut, M.E.I.C.

Associate Professor of Mechanical Engineering, University of Toronto.

Paper to be presented at the Annual General Professional Meeting of The Engineering Institute of Canada, at Montreal, Que., February 14th to 16th, 1928

In this paper the principal object is to discuss from the thermal standpoint the history and development of the uniflow principle as applied to steam engines. The mechanical details will only be described, therefore, insofar as they influence the heat consumption of the engine for a given amount of work done. It is true that such items as valve gear, governing and cylinder construction are essential to the consideration of the uniflow engine as a power-producing mechanism, but an adequate discussion of all these points would transform the paper into a volume. For this reason, one part of the problem only is covered.

History

The credit for the first application of the uniflow principle to steam engine work is due to Jacob Perkins of London, England, who patented the system in 1827 after two years of working tests.* He also made a compound uniflow engine which was tested in 1828, the next example of this application being the compound uniflow engine exhibited at the Wembley Exhibition in 1924. It is interesting to note that Perkins also anticipated the recent use of high steam pressures by generating his steam at 2,000 lbs. per square inch, and this at a time when the Boulton and Watt engines used steam at pressures of 5 to 10 lbs. per square inch. By these means, Perkins was able to work a pumping engine with a fuel consumption of 1.7 lb. per pump horse power hour. The fuel used was a mixture of coal and coke. These patents, however, were impounded by the creditors of Perkins' partner, and so could not be followed up.

Further experiments along these lines were made by Eaton, (U.S.A.), in 1857, and patent No. 7301 was taken out by Todd, (England), in 1885,* the gradation of temperature from hot inlets to cold outlet and the reduction of condensation being specifically noted.

* Power, March 10th, 1925, and The Power Engineer, August 1925.

In 1849 the South Eastern Railway, (England), had a locomotive running on the uniflow principle which continued in operation for three years, but this was taken off on account of mechanical trouble in 1852.**

A Belgian patent was also taken out by Prof. A. Rateau on May 29th, 1894.*** No great commercial development took place, however, until the matter was taken up by Prof. J. Stumpf of Charlottenburg in 1908, and to him the modern development of the uniflow engine is very largely due. Since that time the application of the uniflow engine has been extending rapidly, and it is now generally recognized as having a definite and important place in the field of power generation.

It seems probable that the revival of the idea in 1885 was partly due to the work done by Sir Dugald Clerk, (1881), and others, on the two-stroke cycle gas engine, and certainly the cylinder design of the two-stroke cycle double-acting Körting gas engine bears a striking similarity to that of the uniflow steam engine.

Cylinder Condensation

One of the principal defects in the ordinary or "counterflow" type of steam engine cylinder results from the interchange of heat between the working fluid and the metallic wall which surrounds it. The Carnot and Rankine

* "The Uniflow Steam Engine," Pilling (Manchester Assoc. of Engineers, March 27th, 1920).

** Times Trade Supplement, August 19th, 1922.

*** "Discussion on the Uniflow Steam Engine."—Proc., Inst. Mech. Eng., July 1920.

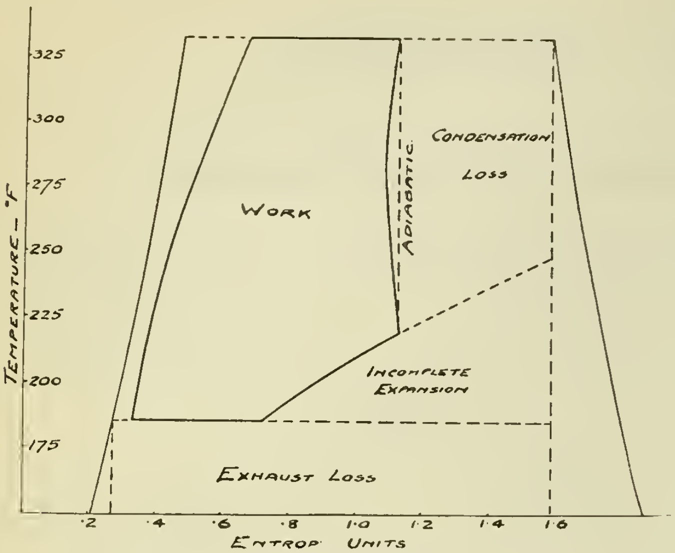

Figure No. 1.—Entropy Diagram from 50 h.p. Counterflow Engine.

cycles are both based on the assumption that the cylinder walls are non-conducting, but this condition does not, and cannot, obtain in practice, with the result that some loss of heat must necessarily take place. With steam originally superheated, this loss results in lower superheat, or none at all, in the cylinder, and if the steam is initially saturated or wet, considerable condensation takes place during the admission period. The amount of this loss naturally depends upon, (*a*) the ratio of surface to volume in the cylinder during the admission period; (*b*) the facilities for the interchange of heat between the steam and the cylinder walls.

With early cut off, the conditions for heat loss are ideal, as the ratio of surface to volume is large, so that a large ratio of expansion, desirable as it is from a thermal standpoint, may actually be a source of loss.

Apart from this, two factors contribute to a high rate of heat exchange per unit of surface, namely, (1) a large temperature difference between the incoming and exhaust steam; (2) a large percentage of water in the steam itself.

The "counterflow" type of cylinder thus contributes to low thermal efficiency by allowing the cool exhaust steam to pass over the surface of the cylinder during approximately half the cycle. This results in the condensation of 40 to 50 per cent of the incoming steam before the point of cut off, (figure No. 1), and the very fact that this steam is wet causes the heat interchange between steam and cylinder walls to be more rapid by substituting a medium of comparatively high conductivity for the previously dry steam.

The steam turbine does not suffer from this defect, as the live steam enters at one end and the exhaust steam goes out at the other. The uniflow engine is an attempt to reproduce this condition in an engine cylinder, so that the hot steam enters at each end and the cool, wet exhaust steam leaves through ports in the middle of the cylinder. The flow in all cases, therefore, is from the ends to the centre, (figure No. 2), and in place of the temperature fluctuations characteristic of the counterflow type there is a steady fall of temperature from the admission to the exhaust end of the stroke.* The ports in the middle of the cylinder through which the steam is exhausted are 1/10 stroke long, and this means that the subsequent compression must occupy 90 per cent of the return stroke. This is advantageous in keeping the ends of the cylinder hot, but has the disadvantage of reducing the mean effective pressure and of producing a dangerously high compression pressure in non-condensing engines or in cases where the vacuum falls. The uniflow engine is thus essentially a high vacuum engine, but in small installations the attainment of this condition is not always feasible. There are two ways of avoiding the difficulty. One is to provide a large clearance volume, permanently or temporarily, but this is always uneconomical. The other is to delay the start of compression by the use of automatic or mechanically operated auxiliary exhaust valves. This is a departure from the uniflow principle and really makes the engine a counter-uniflow engine, with a consequent loss of economy. The position in which these auxiliary exhaust valves are placed determines the extent to which the hot surfaces are cooled by the passage over them of exhaust steam, and, other things being equal, the further these valves are placed from the end of the cylinder, the better.**

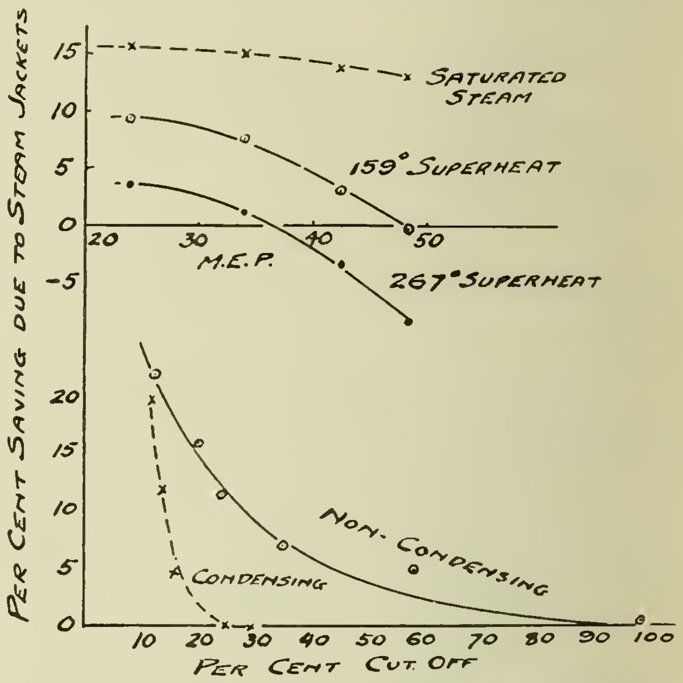

Figure No. 3.—Curves showing Gain Due to Steam Jacketing (Counterflow Engine).

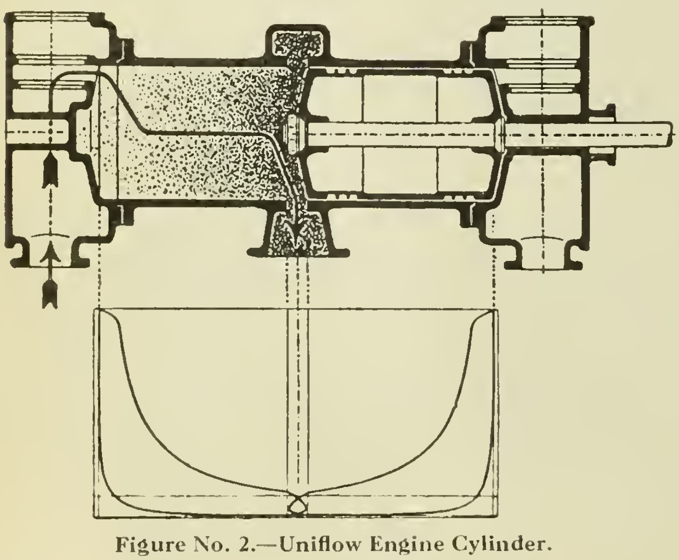

Figure No. 2.—Uniflow Engine Cylinder.

* This was investigated experimentally by Prof. Dr. Nägel, of Dresden, (Z.V.D.I., July 5th, 1913, and the "Una-flow Steam Engine," by J. Stumpf).

** For a full discussion of this factor, see Power, August 29th, 1922.

The influence of wet steam on heat transmission has already been referred to, but another means of reducing the amount of water in the cylinder is to heat it externally by means of a steam jacket. Uniflow engine cylinders are usually steam jacketed, so that in the following pages considerable attention will be given to the action of the jacket.

Factors Influencing Cycle Efficiency

In addition to cylinder condensation there are other factors which need to be balanced up so that losses may be reduced to a minimum. These are steam pressure, back pressure, clearance volume, compression ratio and mean effective pressure. An exhaustive analysis of the interaction of these was made by Professor Stumpf,* and among his conclusions may be noted the following:—

(1) With proper proportioning of the length of compression, the clearance volume must be kept as small as possible.

(2) For given steam pressure, back pressure, m.e.p. and length of compression, the clearance volume must be such that the change of pressure during expansion is equal to the change of pressure during compression.

(3) Change of compression in case of high vacuum has no material effect upon the steam consumption.

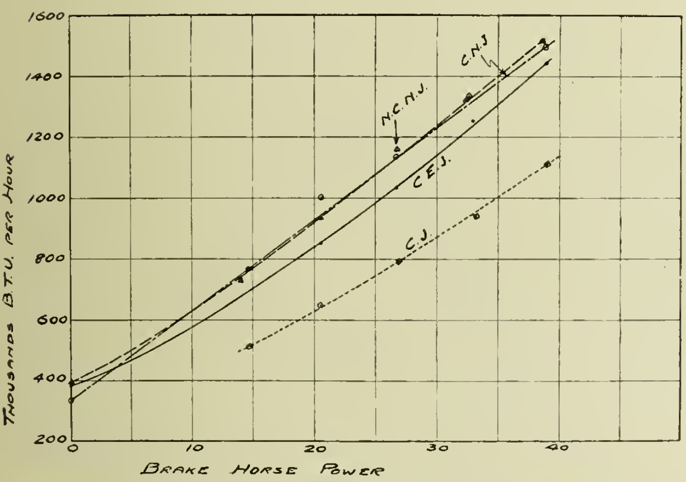

Figure No. 4.—Heat Consumptions of 40 h.p. Uniflow Engine.

It has already been stated, and the statement is susceptible to proof, that large clearance volumes are uneconomical, and the principles enumerated above show that different clearance volumes are required for best economy at different steam pressures, exhaust pressures and expansion ratios. It is evident, therefore, that a compromise must be made in practice whereby the minimum compression volume may be used and the compression ratio either adjusted to suit the conditions of working or chosen to give the best economy at the normal working load. Both systems are used in commercial engines, and both have disadvantages. A further method is that of compressing the steam to a pressure higher than that in the steam chest and delivering the excess through a spring loaded valve back to the steam pipe, but the desirability of generally applying this arrangement is doubtful.** Another engine uses a double compression curve. The compression volume is in two parts, both of which are used during the first part of the stroke. At a predetermined point communication between these is cut off by a valve and compression is completed in the small cylinder clearance. The "spill over" in the auxiliary clearance volume is then allowed to re-expand on the other side of the piston. A special design of uniflow engine has two sets of exhaust ports and a director valve, so that each set may be used alternately to delay the point of compression.* An analysis of twenty of the principal makes of American and European uniflow engines is given in table No. 1.

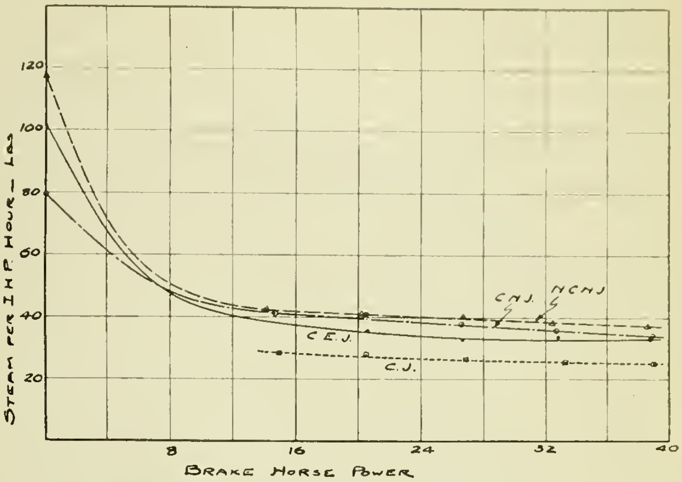

Figure No. 5.—Steam Consumption per I.H.P. Hour of 40-h.p. Uniflow Engine.

Table No. 1—Analysis of Twenty of the Principal Makes of American and European Uniflow Engines.

Steam admission valves	Drop	15
	Piston drop	3
	Piston	3
Jackets	End only	16
	End and body	4

Auxiliary clearance volume with automatic relief valves in most condensing engines. Mechanically operated exhaust valves with most non-condensing engines.

The question of valve leakage is important in all engines, but is particularly so in the uniflow engine, in view of the early cut off and large pressure differences employed.

* For description, see Power Plant Engineering, December 1st, 1922.

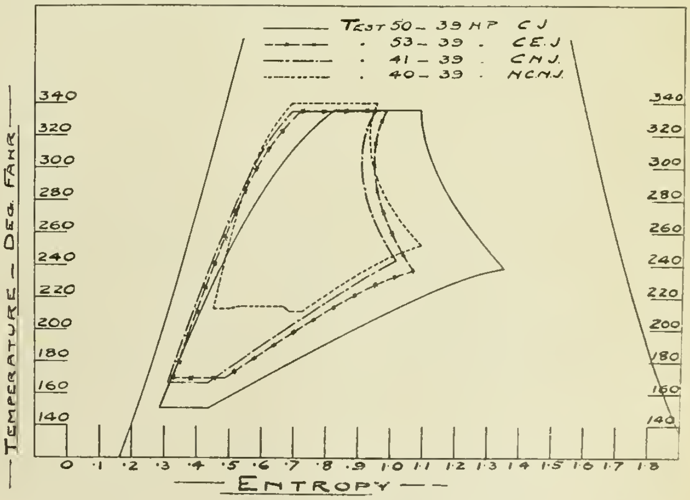

Figure No. 6.—Temperature Entropy Diagrams showing Influence of Steam Jackets.

* "The Una-flow Steam Engine," Second Edition, p. 13-43.

** It has been adopted, however, in a 30- x 60-inch four-cylinder mill engine, but in this case auxiliary exhaust valves are also provided as a safety device. Power, June 22nd, 1926.

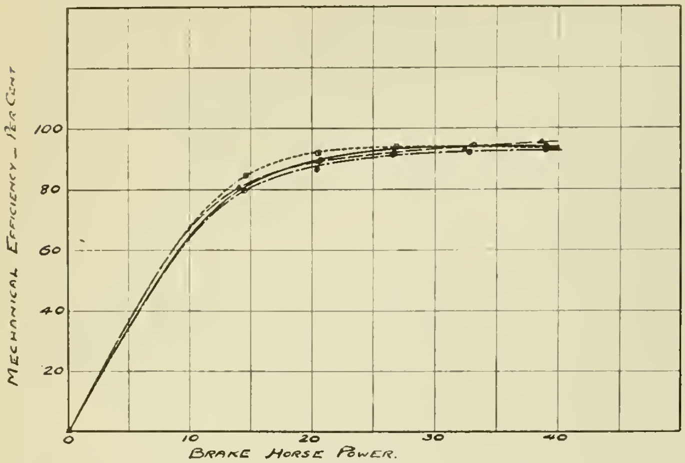

Figure No. 7.—Mechanical Efficiency Curves of 40-h.p. Engine.

This explains the almost universal use of the drop or poppet valve for large engines, the piston valve being only employed in small sizes. The double beat drop valve, however, can only be made tight for one set of pressure and temperature conditions, and therefore some form of automatic adjustment, usually of the spring type, must be provided in the valve or valve seat when high temperatures or pressures are used. Piston and Corliss valves are usually leaky, and their use results in lower thermal efficiencies.

Increased speeds of rotation tend to diminish the amount of surface condensation by reducing the time of the temperature cycle, and therefore the amount of heat passing through the surface. As the uniflow engine uses drop valves, heavy reciprocating parts and high ratios of expansion, it is usually a slow speed engine. Few uniflow engines of large size run at speeds exceeding 200 r.p.m., but some small engines are constructed for speeds up to 400 r.p.m.

Steam Jacketing

Perhaps the most important of James Watt's many contributions to steam engine theory and practice was his statement of the principle that the engine cylinder must at all times be kept as hot as possible, and that cold bodies must be kept away from it. The design of the uniflow cylinder itself may be considered as a natural application of this law, not only because it produces a minimum of temperature fluctuation at each point in the cylinder, but also because it conserves the driest steam for compression. The wettest steam is usually that near the piston, and therefore is the first to be exhausted. As a direct consequence, the heat loss during compression is reduced by the lower heat conductivity of the fluid, and the steam compressed is frequently in the superheated state when the admission point is reached.

Another method of keeping the cylinder hot is to surround it wholly or partly with a steam jacket. Table No. 1 shows that every uniflow engine is supplied with end jackets and that many of them, (chiefly the smaller engines), have also jackets surrounding some part of the cylinder body. The jackets do not usually extend beyond the point of cut off because cylinder condensation is practically complete at that point, and also because a long body jacket entails a constant and considerable heat leakage to the exhaust. The inefficiency of the theoretical steam jacketing cycle is indicated by figure No. 10, where the efficiency of the Rankine cycle is represented by $\frac{ABCD}{ABCEF}$. If it be assumed that the steam jacketing is such as to keep the steam dry during expansion, the extra work done is CDG, but the extra heat loss is $DGHE$, so that the resulting efficiency $\frac{ABCG}{ABCGHF}$ is lower. The work done per pound of steam is increased, but the heat loss is relatively much greater.

In practice, however, the steam jacket is frequently beneficial in transferring condensation from the inside to the outside of the cylinder. The influence of the steam jacket in reducing steam consumption naturally varies with the type of engine and condition of the steam. Tests made by Delafond, (1883),* indicate the saving in the case of low pressure steam in a slow speed horizontal Corliss engine at Creusot. Some of these results are plotted in the form of a curve in figure No. 3. Other tests made on an engine at the Massachusetts Institute of Technology indicate the saving in compound and triple expansion engines.** The experiments of Callendar and Nicolson*** at McGill University also indicate the importance of the piston face in promoting condensation. This is a factor which cannot be controlled by outside jacketing, but an attempt has recently been made in the "Prosser" engine to make the inside of the piston a steam pocket. This is not a uniflow engine, and so will not be described in detail, but is interesting as indicating what results can be obtained with complete steam

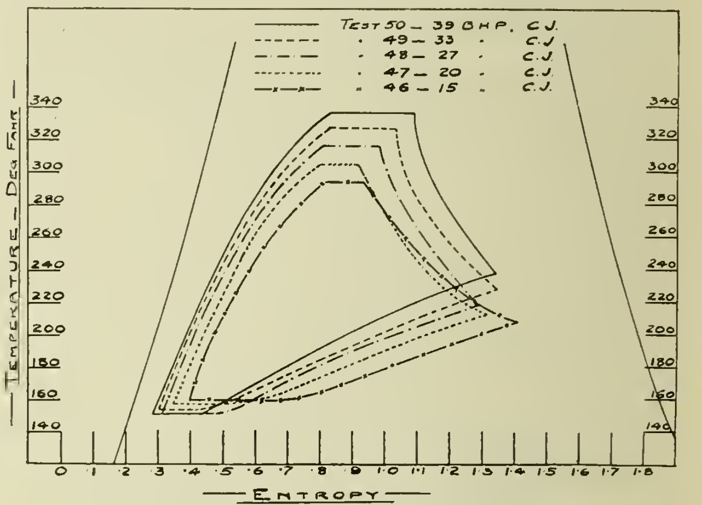

Figure No. 9.—Temperature Entropy Diagrams for Jacketed Tests at Different Loads.

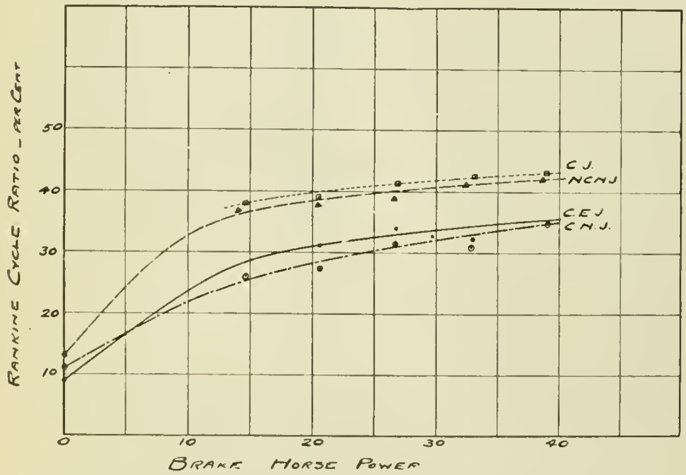

Figure No. 8.—Rankine Cycle Ratios of 40-h.p. Engine.

* "Thermodynamics of the Steam Engine," Peabody, p. 248-256.
** Trans., A.S.M.E., 1892-94, and Peabody, p. 261-268.
*** Proc., Inst. C.E., vol. 132.

Table No. 2.—Prof. Stumpf's Results on a 23.6" x 31.5" Sulzer Uniflow Engine Running at 155 r.p.m. on a Steam Pressure of 120 lbs. per Square Inch Gauge.

Mean Effective Pressure lbs. per sq. in.	Saving (per cent) due to use of Steam Jackets		
	Saturated Steam (350° F.)	159° Superheat Steam temp. 509° F.	267° Superheat Steam temp. 617° F.
24	15.7	9.4	3.5
34	15.1	7.5	1.2
42.6	13.8	3.0	—3 5
48.3	13.0	0	—8.5

jacketing of all surfaces.* Rankine cycle efficiency ratios, (non-condensing), of 82 to 92 per cent are claimed for this engine, and it is stated that tests made in 1916 with and without jackets showed Rankine cycle ratios of 83.7 and 64.7 per cent, respectively, under the same test conditions.

An examination of the various test results obtained under different conditions, and of the opinions of various

* For test results, see Mechanical Engineering, April 1925.

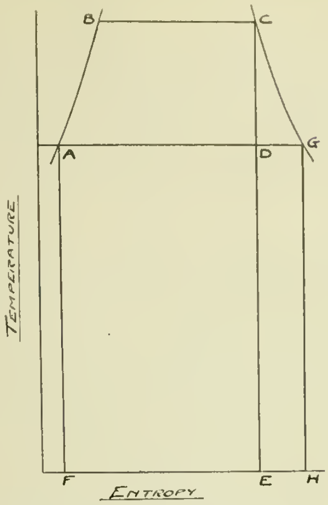

Figure No. 10.—Temperature Entropy Diagram for Steam Jacketing Cycle.

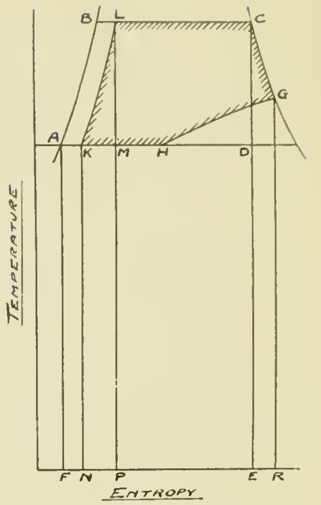

Figure No. 11.—Temperature Entropy Diagram with Restricted Expansion.

Table No. 3.—Test Results on 10 by 15 inch Uniflow Engine.

Test No.	36	37	38	39	40	58	45	44	43	42	41	59
Speed r.p.m.	171.2	171.6	171.5	169.2	169.5	173.7	171.3	171.8	171.0	170.4	170.8	175
B.H.P.	14.1	20.4	26.7	32.5	38.7	0	14.6	20.4	26.6	32.7	38.9	0
I.H.P.	17.47	23.0	28.9	34.8	40.6	3.37	18.12	23.5	29.1	35.5	42.2	3.19
Mechanical Efficiency (per cent)	80.6	88.9	92.3	93.4	95.1	0	80.5	86.9	91.4	92.1	92.4	0
Steam press. lbs. per sq. in. gauge	121.3	120.2	119.6	119.5	119.3	120.4	122	118.6	118.4	118.2	119.4	120.4
Dryness Fraction	0.964	0.969	0.965	0.964	0.962	0.973	0.975	0.961	0.962	0.960	0.961	0.977
Steam per I.H.P. hour—lbs.	42.4	41.3	40.8	38.7	37.9	117.5	41.6	41.2	38.8	36.4	34.5	79.6
Steam per B.H.P. hour—lbs.	52.55	46.6	44.2	41.4	39.9	....	51.1	47.5	42.4	39.5	37.4	....
Vacuum at engine—ins.	2.0	2.0	1.8	1.0	1.2	2.8	21.7	21.8	20.3	21.6	20.0	13.3
Rankine cycle eff'y ratio	0.37	0.38	0.39	0.414	0.422	0.165	0.26	0.275	0.32	0.31	0.35	0.10
Jacket steam per cent of total consumption	....	....	....	....	....	....	....	....	....	....	....	....
Condition of test	Non-condensing non-jacketed (N.C.N.J.)						Condensing—non-jacketed (C.N.J.)					

Test No.	55	54	52	53	57	46	47	48	49	50
Speed r.p.m.	172.6	172.6	171.4	170	176	172.3	172.1	172.6	173.1	171
B.H.P.	20.5	26.8	32.8	38.8	0	14.7	20.5	26.8	33.2	39.0
I.H.P.	23.0	30.6	35.0	41.4	3.06	17.3	22.3	28.6	35.2	41.9
Mechanical efficiency (per cent)	89.0	87.5	94.0	93.7	0	84.6	92.0	93.7	94.4	93.1
Steam press. lbs. per sq. in. gauge	120.0	120.0	120.0	120.0	116.8	121.6	120.8	120.9	120.3	119.8
Dryness Fraction	0.967	0.967	0.967	0.962	0.973	0.974	0.972	0.972	0.972	0.974
Steam per I.H.P. hour—lbs.	36.0	33.4	34.7	33.9	110.5	28.9	28.5	26.9	25.9	25.6
Steam per B.H.P. hour—lbs.	40.5	37.4	37.0	36.2	....	34.1	30.9	28.7	27.5	27.5
Vacuum at engine—ins.	21.6	21.4	21.4	20.7	13.6	22.3	21.7	21.9	22.0	21.8
Rankine cycle eff'y ratio	0.313	0.34	0.325	0.354	0.09	0.38	0.39	0.41	0.43	0.43
Jacket steam per cent of total consumption	3.1	2.47	2.18	1.6	7.33	14.0	11.0	9.2	7.8	6.6
Condition of Test	Condensing end jacket only (C.E.J.)					Condensing—Jacketed (C.J.)				

designers and makers of uniflow engines, indicates that apart from the fact that all recommend the use of end jackets, (and produce test results to justify this), there are considerable divergencies of opinion on the subject of jacketing. Generally, it is agreed that the gain due to jacketing decreases as the cut off is made later, and that saturated steam shows more gain than superheated steam, (table No. 2).

The latter is to be expected, as the heat conductivity of superheated steam is lower than that of saturated steam. Also, it may be expected that the gain due to jacketing will decrease with increasing cylinder diameter, due to the smaller ratio of surface to volume in large engines. The practically unanimous adoption of the steam chest as an end jacket seems peculiar, in view of the fact that it has generally been held as axiomatic that the steam should not pass through the jacket on its way to the engine, as the beneficial effects of transferring the condensation from the inside to the outside of the cylinder would thereby be lost. It is true that these jackets may be drained to remove the water before the steam enters the cylinder, but it is questionable whether the steam can be completely dried by this means, as it must be in a state of turbulence during the admission period.*

To shed some light on these and other questions, a series of 60 tests was made on the 10- by 15-inch uniflow engine in the mechanical engineering laboratory at the University of Toronto. Different loads and jacket conditions were taken, and the results are summarized in table No. 3 and figures Nos. 4 to 9. The actual figures obtained are of no particular significance, but their relative values indicate a large saving due to the body jackets, and the relative unimportance of the end jackets under these conditions. This is indicated by the curves in figures Nos. 4 and 5, which give the hourly heat consumption and steam used per i.h.p. hour, respectively, at different loads. The saving is shown still more clearly by figure No. 6, which gives the temperature-entropy diagrams under the four conditions with the same load on the engine in each case. Figure No. 7 shows that none of these changes has an appreciable effect on the mechanical efficiency, and figure No. 8 indicates that the use of jackets, when running under condensing conditions, raised the Rankine cycle efficiency ratio to a value approximately to that in non-condensing non-jacketed operation. Figure No. 9 is a temperature entropy diagram showing the effect of jacketing, (condensing operation), when the load was reduced from 39 to 15 b.h.p. The increased amount of re-evaporation due to the heat received from the jackets at light loads is clearly shown, so that the dryness fraction of the steam at the end of expansion varies little at different loads.

* This is confirmed by Barrus, (A.S.M.E. paper no. 1968, May 1925) in tests on a 4-cylinder vertical uniflow engine (para. 3).

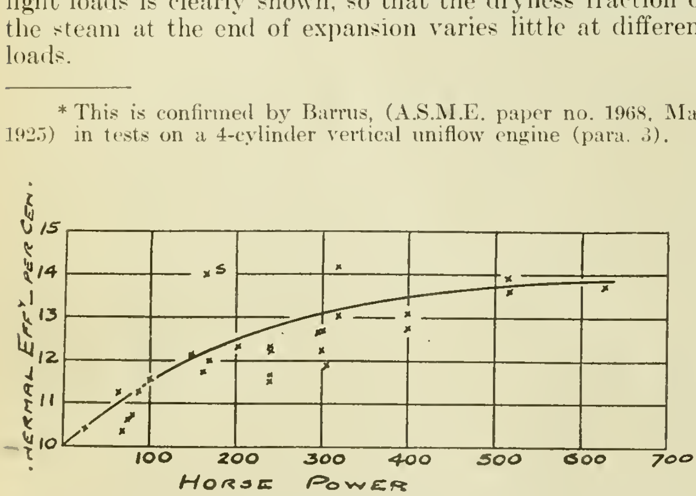

Figure No. 12.—Thermal Efficiencies of Non-condensing Uniflow Engines.

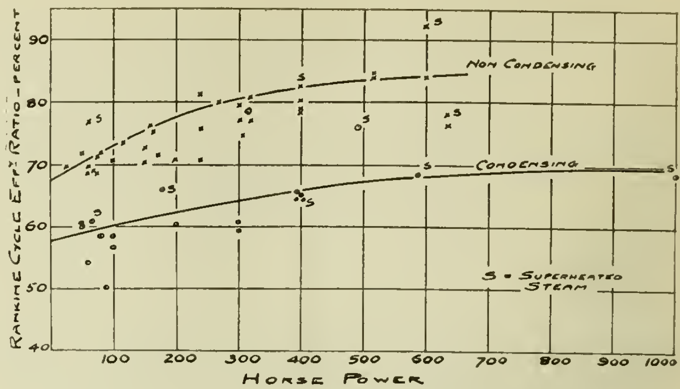

Figure No. 13.—Rankine Cycle Efficiency Ratios of Uniflow Engines.

Test Results and Efficiencies

An analysis of a large number of tests on uniflow engines of different makes and sizes confirms generally the claim that high efficiencies can be obtained, and the steam consumption curves at different loads in most cases are very flat. This clearly indicates the fact that this type of engine is well suited to varying load conditions, as the economy is usually not greatly affected when the engine is run at light loads for comparatively long periods. Practically all the tests referred to were made at steam pressures between 100 and 160 lbs. per square inch gauge, and, in view of the present tendency towards the use of higher pressures, it would be interesting to have some results on the performance of these engines under such conditions. Consumptions as low as 10 lbs. steam per i.h.p. hour with 250° F. superheat and 28 inches vacuum have been obtained on large engines, (500 h.p. and over), but the number of test results available under condensing conditions and their variable natures do not justify any general conclusions on this point beyond the general observation that thermal efficiencies up to 20 per cent have been obtained. (See table No. 4.)

Figure No. 12 shows the thermal efficiencies obtained on a large number of engines using saturated steam and running non-condensing, the limit being about 14 per cent in such cases. Piston speeds range from about 600 feet per minute for cylinders of 15 inches diameter to 800 feet per minute for 43-inch cylinders.

The ratio of the thermal efficiency actually obtained to that of the Rankine cycle under the same conditions, (called the Rankine cycle efficiency ratio), gives a better idea of the relative performance of such engines, particularly as far as their success in reducing cylinder condensation is concerned. The test results for engines of various sizes are plotted in figure No. 13, showing that under non-condensing conditions efficiency ratios of 70 to 85 per cent may be expected and under condensing conditions efficiencies varying from 60 to 70 per cent are usual. In this connection it is interesting to sum up the possibilities of the steam jacketing cycle with different clearance volumes. In figure No. 11 the Rankine cycle $ABCD$ and its efficiency $\frac{ABCD}{ABCEF}$ are again indicated. Assuming that the steam remains dry during expansion, (due to the action of the steam jackets), the expansion line is CG. At G release takes place, followed by the exhaust line GHK. The line KL is taken as roughly parallel with the water line, its position varying with the clearance assumed, so that the work done is $LCGHK$ and the efficiency $\frac{LCGHK}{LCGRNK}$. Plotting these efficiencies on the basis of clearance percentages gives the line marked "actual cycle" in

Table No. 4.—High Thermal Efficiencies Obtained on Uniflow Engines Using Superheated Steam and High Vacua.

I.H.P.	R.P.M.	Steam Press. lbs. sq. in. gauge	Steam Temp. °F.	Vacuum Ins. Mercury	Steam Consumption lbs. I.H.P. hr.	Thermal Efficiency per cent.
300	155	135	617	26	8 8	23 3
317	129	157	387	26	11 0	20 8
500	121	185	627	28	10 1	19 9
492	...	140	487	26 3	10 8	20 0
588	...	142	580	26 7	10 9	19 0
1109	126	168	590	27	10 4	19 8

figure No. 14.* If it be assumed that compression is adiabatic along ML, the cycle efficiency is increased and follows the line marked "adiabatic cycle" in figure No. 14. These lines indicate the fall of efficiency as the clearance volume increases, and also show the closeness with which the efficiency ratio of the actual uniflow engine approaches that of the ideal cycle.

The influence of superheat in reducing steam consumption and raising thermal efficiencies has already been referred to, and under these conditions the effect of the jacketing is reduced.

Application to Practice

The uniflow engine is generally adopted in cases where moderate amounts of power are required, and the usual limit is about 1,000 to 1,200 h.p., but within recent years large units capable of generating up to 14,000 h.p. have been installed for rolling mill work.** For fluctuating loads of this nature, the flat steam consumption curve of the uniflow engine would seem to be very suitable, particularly as the time of the load cycle is very short, (2 to 3 minutes). It is claimed that the engine will take up to 100 per cent overload, and this flexibility is a decided asset for such work, particularly as a low speed must necessarily be used in any case.

The application of the uniflow engine to locomotive work hardly comes within the scope of this paper, but it is interesting to note that many experiments have been made along these lines by Professor Stumpf and others.*** Tests on the Prussian State Railways showed an economy of 19 per cent over piston valve engines and 28 per cent over Lentz valve locomotives. A steam wagon using a vertical uniflow engine in which the admission valves consist of stainless steel balls is also being made in England. The three cylinders are each 6¾ inches diameter and the stroke is 10 inches. The speed of the engine is 200 r.p.m.*

A single acting vertical engine with two cylinders each 4 inches diameter by 5 inches stroke is made by the Babcock-Wilcox and Goldie-McCulloch Company of Galt, Ont., for driving stokers, blowers, centrifugal pumps, etc., and on account of its simple construction, (32 working parts), is claimed to be very suitable for such purposes where long hours of service and little attention are inevitable. This engine has a plain piston valve, and its maximum rating is 7.8 b.h.p. at 700 r.p.m.

Recently** a 1,500-h.p. three-cylinder marine engine has been put into service on the lake of Geneva. In this engine the mechanical construction of the cylinder is new and the valves are operated by oil pressure.

Multiple cylinder engines of this type have not been adopted to any considerable extent, but they offer the possible advantage of using the exhaust from one cylinder to produce suction in another. It is claimed that as much as 18 inches of vacuum can be produced in this way.

A number of compound uniflow engines have also been made, but in such cases the high pressure cylinder is usually of the counterflow type and the low pressure is uniflow.*** Such engines are usually combined with a heat extraction or bleeding system, and where uniflow engines are used in connection with process work using bled or exhaust steam, remarkably low steam consumptions can be obtained. A new type of compound uniflow engine has recently been developed by Professor Stumpf† for the purpose of avoid-

* The figures for this study were taken from the acceptance tests of a 500-h.p. engine, 140 lbs. steam pressure, atmospheric exhaust, 200 r.p.m.

** See Power, July 28th, 1925, and June 22nd, 1926.

*** "The Una Flow Steam Engine," by Prof. J. Stumpf, 2nd ed., and Times Trade Supplement, August 10th, 1922.

* British Engineers Export Journal, August 1927.

** Mechanical Engineering, September 1927.

*** Power Plant Engineering, November 1st, 1926; Engineering, November 10th, 1922, etc.

† Werft Reederei Hafen, June 22nd, 1927, and Appendix.

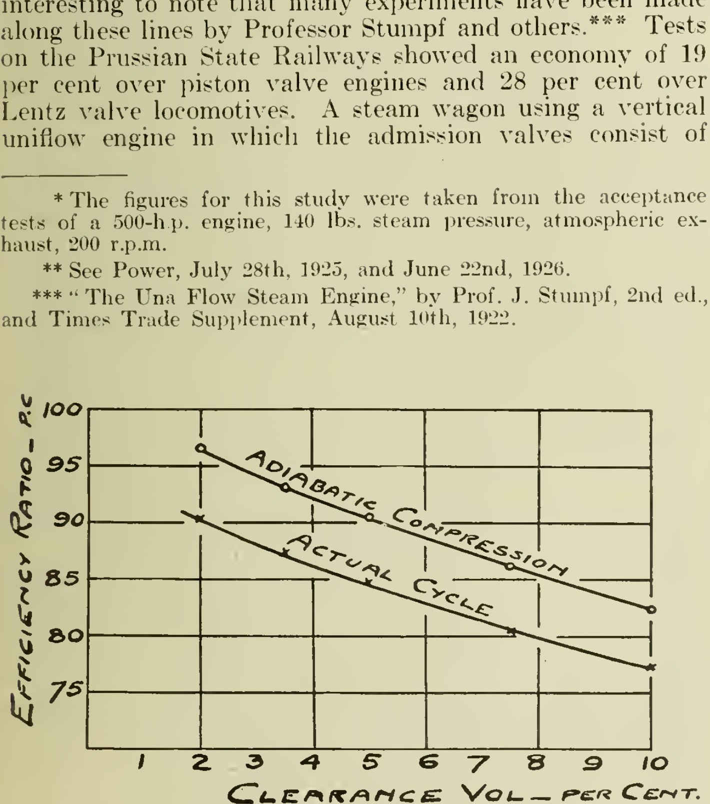

Figure No. 14.—Influence of Clearance on Possible Efficiency Ratios.

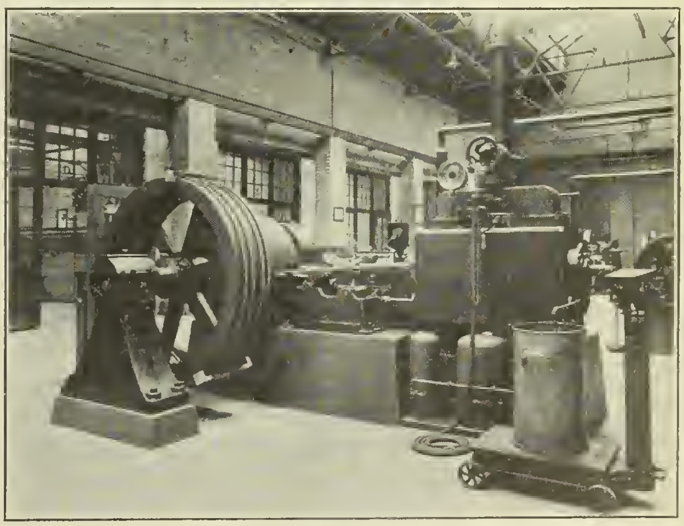

Figure No. 15.—40-h.p. Uniflow Engine at the University of Toronto.

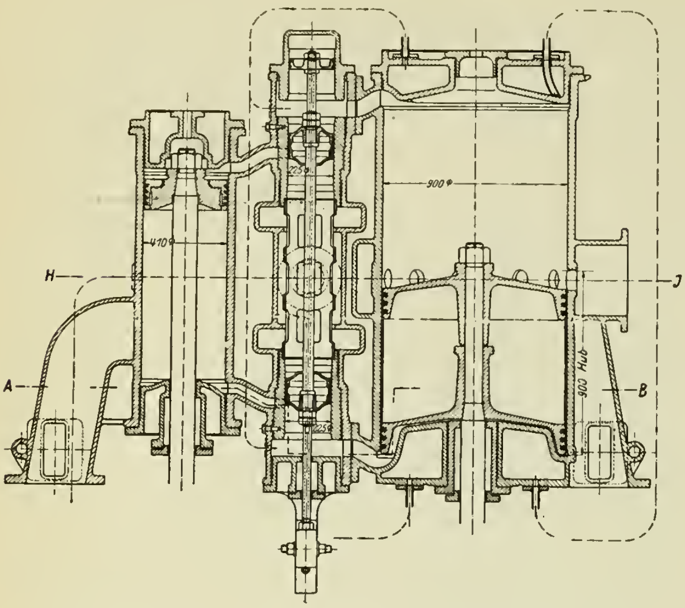

Figure No. 16.—Compound Marine Engine (Stumpf).

ing the high crank pin pressures obtained with large single cylinder engines. This engine has an uncommon arrangement of crank angles and it is claimed to give a very uniform torque curve and better balancing than is usually obtained in such engines.

The other disadvantages of the uniflow engine are due primarily to the heavy reciprocating parts which introduce large inertia forces and to the long piston, which necessitates a long cylinder or a short stroke, or both. The reduction of mean effective pressure due to the large amount of power used for compression also necessitates the use of larger cylinder diameters than are customary in counterflow engines producing the same powers.

In spite of these disadvantages, however, the reduced fuel consumption of the uniflow engine is so important a factor that this engine is likely to find a considerable market among small power users.

The thanks of the author are due to the authorities of the University of Toronto and to Professor R. W. Angus M.E.I.C., for providing facilities and assistance for the tests made at the University of Toronto. Also to Messrs. G. H. Harlow, S.E.I.C., B.A.Sc., H. E. Saunders, B.A.Sc., and G. L. DeLaplante, B.A.Sc., for their help in carrying out the tests and in making the necessary calculations.

Appendix

The latest type of compound uniflow engine designed by Professor Stumpf for marine work contains several features of interest, so that the following description may be useful. Several three-cylinder uniflow marine engines have been made by Messrs. Burmeister and Wain, and it is claimed that their steam consumption is lower than that of the ordinary triple expansion type. In single-cylinder expansion, however, particularly when the steam pressure is high, the crankpin pressure per cylinder tends to become excessive, and for this reason, and also to avoid heavy losses due to incomplete expansion, the compound system is used in the new engine.* (See figure No. 16.)

The diameters of the high and low pressure cylinders are 16.1 and 35.4 inches respectively and the stroke is 35.4 inches. The high pressure cylinders are made counterflow on account of the higher superheat used and the low pressure cylinders are uniflow. The steam is controlled by a single piston valve between the two cylinders, the Woolf system of compounding being used. It is claimed that the piston valve can be made as tight as the drop valve if properly designed and manufactured, and also has the advantages of simplicity, rapid motion at admission and cut off and less throttling loss.

The valve is perfectly balanced, receives live steam for the high pressure cylinder inside and exhausts to the low pressure cylinder outside the pistons. Four cylinders are used to produce 1,250 h.p., and the arrangement is so compact that the overall length of the cylinders is twelve feet. The high pressure clearance volume is eight per cent and that of the low pressure cylinder six per cent of the stroke volume. Cylinder volume ratios of one to five and one to seven are advised for different exhaust pressures. It is claimed that under these conditions the small pressure drops at the end of expansion in the high pressure and low pressure cylinders, respectively, produce little throttling loss and allow high vacua to be used, so that the steam consumption is expected to be below that of a combined triple expansion engine and exhaust steam turbine.

The arrangement of the cranks is also unusual. The high pressure cranks are spaced 90° apart and the respective low pressure cranks are placed 150° behind them. This arrangement is claimed to give better balancing and a more even crank effort curve than when the cranks are 180° apart. Specimen curves are drawn to substantiate this.

Another smaller engine is also described in which the piston valve is placed before the high pressure cylinder and free exhaust takes place to the low pressure cylinder, the cranks in this case being 120° apart.

The tiials of these engines will be watched with interest, particularly as piston valves have generally been held to be inferior in economy to drop valves.

* Werft Reederei Hafen, June 22nd, 1927.

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The Vacuum Paper Machine Dryer

Its Design, Construction and Operation with Special Reference to the Vacuum Dryer Installed at Kenogami, Que.

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For the benefit of those unfamiliar with the vacuum dryer, a brief description follows. It comprises a series of standard dryers together with dryer felts, felt carrying rolls, hand and automatic guide rolls for the felt and an automatic stretch roll for the felt, all of which may be made exactly like those used on a standard paper drying unit. The entire drying unit, however, is enclosed in an air-tight box or chamber, usually made of cast iron, suitably ribbed and strengthened to withstand the pressure of the atmosphere. At the front end of this chamber there is a seal which allows the wet paper to enter but does not allow air to enter. Similarly, at the rear or dry end there is another seal which allows the dry paper to pass out of the chamber but also prevents air from entering. Connected to the bottom of the chamber there is a condenser, either of the surface, jet or barometric type, and connected to the condenser is a dry vacuum pump. The operation of this dryer differs from the standard type in that the air is pumped out of the chamber and the paper is dried under a vacuum of approximately 28 inches of mercury.

In December 1926, a vacuum dryer was installed in the paper mill of Price Brothers and Company, Limited, at Kenogami, Que., on their No. 1 machine. This dryer contains twenty dryers, 5 feet in diameter, with a face of 152 inches. It was built at the plant of Charles Walmsley and Company, (Canada), Limited, at Longueuil, Que. To this dryer was attached a suitable condenser, dry vacuum pump, air cooler, etc., a full description of which is given later. This vacuum dryer is now in regular 24-hour production, at a speed of 700 feet per minute, drying standard newsprint paper. This was the first vacuum dryer to be installed drying newsprint and very much the largest ever constructed. Prior to the installation of this vacuum dryer there was little or no data on what might be expected from it, from an operating standpoint. There was a good deal of experimental data available and much also in the form of theoretical considerations. Before this there had not been any vacuum dryer operated at a speed in excess of about 200 feet per minute or any that had taken paper direct from the last wet press of a paper machine and dried it. There was much doubt in the minds of many of the best paper mill engineers as to the results to be obtained, and there was considerable doubt as to the parts of so large a piece of machinery being correctly designed in the first large size machine.

Casing

The casing of the dryer was built up of cast iron plates carefully ribbed for strength. Where these bolt together the surfaces were planed. These surfaces were then covered with a thick mixture of white lead and machine oil and bolted together. This makes an air-tight joint. The castings were made of semi-steel, and care was taken to get this as close grained as possible and free from blow or pin holes. Test bars were frequently taken and tested for strength and texture, with the result that little trouble has been found due to leaks. Holding a vacuum of 28 inches of mercury, however, is no small task and the slightest porosity of the castings will cause serious leaks. After the dryer was assembled it was painted while under a slight vacuum, and the porous spots were thus filled with paint and eliminated. It should be borne in mind here that this vacuum chamber is very much the largest of any type ever constructed, being several times larger than anything heretofore attempted.

In designing the various castings, great care was taken to check each part for strength and deflection and a liberal factor of safety used in every case. While a vacuum of 28 inches only exerts a force of approximately 14 lbs. per square inch, this amounts to about 2,000 lbs. per square foot and on some of the long spans the total pressure runs up into many tons' pressure. Because of certain facts of the design, it was necessary in some cases to limit the deflection of some of these castings to very small amounts, and this called for a great deal of thought, care and ingenuity on the part of the designers in ribbing the castings for stiffness and still not using an excessive amount of cast iron. It is not a simple designing task to take a complicated ribbed cast iron plate subjected to a vacuum load, and often to other loads from adjoining castings, rolls, etc., and calculate its exact deflection. A great deal of satisfaction was felt when the vacuum was first pulled in this dryer and the deflections measured and found to check with the calculations previously made. It was surprising how close they all did check, often within a few thousands of an inch.

All of these castings were doweled together with steel dowel pins as well as bolted, and it is possible to remove any casting and replace it and the steel dowel pins insure it going together again just as it came apart. The entire casing has been made sectional of standardized sections, so that dryers can be added to or taken from it should the need ever come. Special attention was given to the castings where they joined together to insure that the joint would not work and eventually leak. Doors and windows were located where they would be of most use and fitted with special gaskets and in some cases hinged so that they can be quickly opened and closed. Openings were left for the felt carrying rolls so that they may readily be unbolted and pulled out the front of the dryer. The felt carrying rolls were also mounted on roller bearings and the housing for these doweled with special steel dowel pins to the main side castings, insuring that these rolls would be parallel with the dryers and, if removed for any reason, they must of necessity go back in exactly the same location.

The dowel pins locating these rolls were made with a threaded end and a nut so that they may be quickly and easily removed. In fact, this type of dowel pin has been used throughout the whole vacuum dryer. The rear bearings of the felt carrying rolls are held in place by the housing, but the front bearings are left free to slip to take care of contraction and expansion, just as was done in the case of the bearings on the dryer journals. The housings are filled with oil to a predetermined level and will run for a very long time without attention of any kind. Oil grooves have been carefully designed and made a part of the housing to prevent oil running out along the shaft, and thus getting on the felt. The bearings themselves are SKF self-aligning roller bearings, and over-size bearings were used to insure long life and freedom from bearing troubles. After a period of over six months these bearings, like all the rest of the bearings in this dryer, have given no trouble whatever. The housings, however, are so designed and attached to the main casting that, should bearing trouble arise, the bearings can quickly and easily be removed and new bearings substituted. Doors at the dry end of the machine have been conveniently located for putting on dryer felts. Automatic felt stretches of conventional type, hand guide and Moore and White automatic felt guides are used to guide and stretch the dryer felt.

Mechanical Details

It was decided for various reasons to install roller bearings on all the rolls contained in this dryer. Heretofore, engineers have hesitated about installing ball or roller bearings on the dryer journals because of the high temperature of these journals, especially the rear dryer journal, which is hollow and through which the steam is fed into the dryer. Nevertheless, after careful consideration, it was decided to use roller bearings and a bearing was selected with a capacity considerably greater than necessary to carry the load. The size of the journal was, of necessity, large in order to give sufficient area for the steam inlet through the rear journal, and this in reality settled the size of the bearing that would have to be used. For the sake of standardizations, the front dryer bearings were made the same size as the rear bearings. SKF self-aligning roller bearings were selected, and the outer races were slightly freed out to allow for expansion. The bearings were fitted to the shafts on taper sleeve split bushings to insure a good tight fit on the shafts and also to make it easier to take out a bearing if found necessary. The rear bearings were held in the housings to locate the dryer, but the front bearings were left free to slip in the housings to allow for contraction and expansion of the dryer when heating up or cooling off. This construction also definitely locates the rear shafts so that the drive unit is not subject to the contraction and expansion of the dryers.

On the rear bearings an automatic lubricating system was installed to insure a constant supply of lubricant at all times. This system comprises a small pump that pumps the oil to a tank set on top of the dryer, from which tank the oil runs to the stuffing boxes on the rear dryer journals and into a spacer ring set between the packing rings which makes an oil seal for the stuffing box, keeps the packing

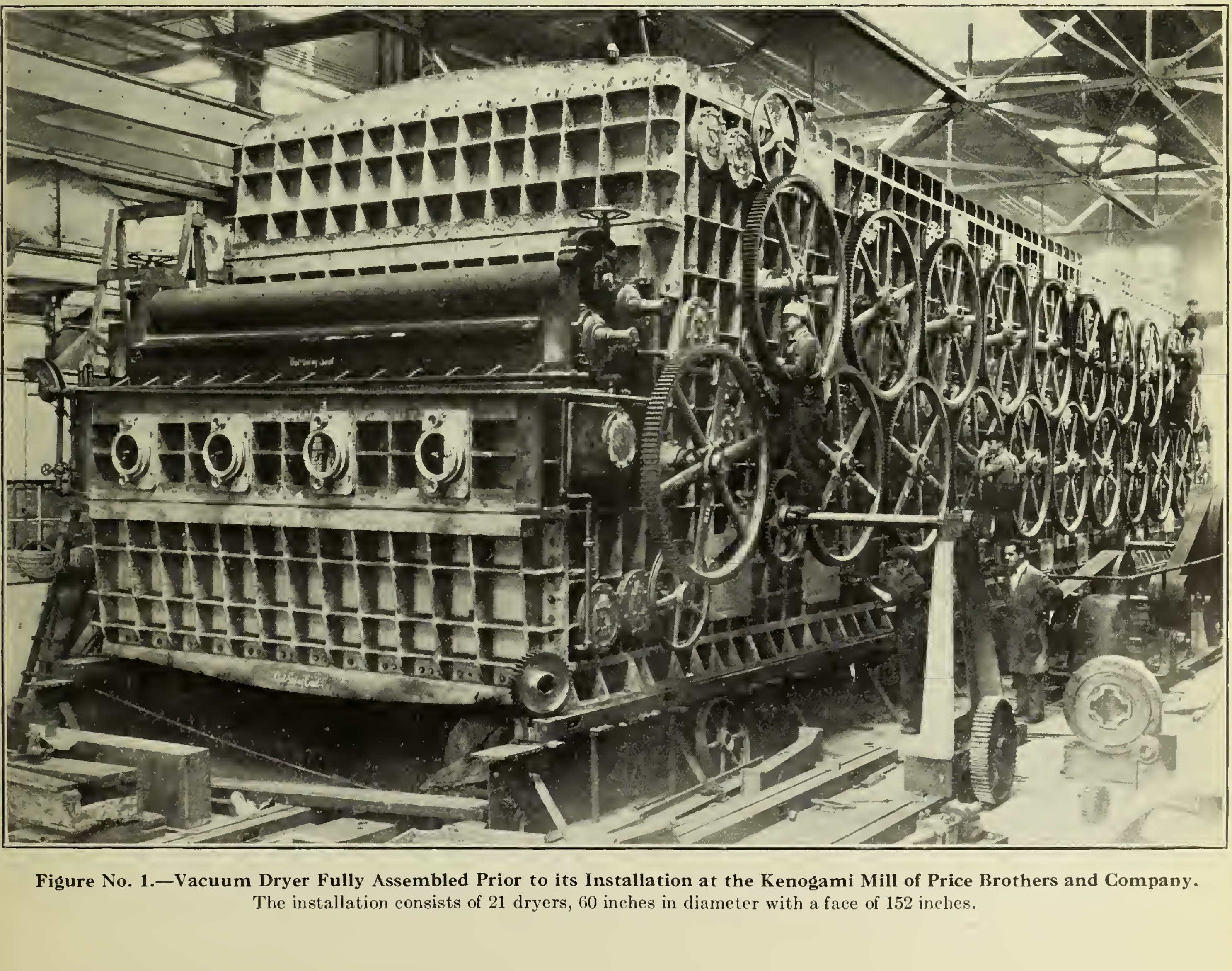


Figure No. 1.—Vacuum Dryer Fully Assembled Prior to its Installation at the Kenogami Mill of Price Brothers and Company.
The installation consists of 21 dryers, 60 inches in diameter with a face of 152 inches.

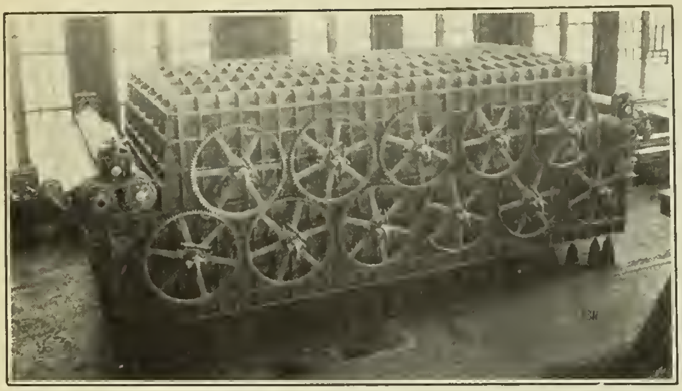


Figure No. 2.—Back View of Vacuum Dryer showing Roof Construction and Gearing.

This dryer was built for Armstrong Cork Company and consists of 11 dryers, 48 inches in diameter with a face of 154 inches.

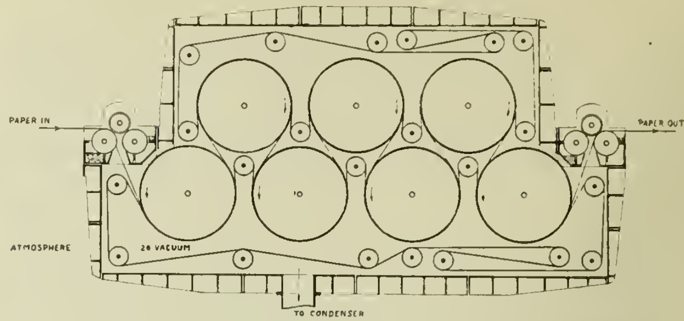


Figure No. 3.—Diagrammatic Cross-section showing a 7-Dryer Vacuum Dryer.

This diagram shows the seals, the course of the paper through the dryer and the dryer felts together with felt carrying rolls, felt take-up rolls and felt guide rolls.

rings always lubricated, and the oil leaking into the vacuum runs directly into the roller bearings. At the correct height there is a small overflow drain in the bearing housing from which the oil runs back to a tank under the dryer and is taken by the pump back to the feeding tank on the top of the dryer. A filter is also included in this oiling system to filter out any impurities or foreign matter from the oil. The front dryer bearings merely have a constant level of oil in which they run and which is so designed that these bearings when filled must always be filled to just the correct height. Suitable oil catching housings are installed and the whole bearing mounted in a substantial and rigid manner.

One of the problems was to determine the correct kind of oil to use. The makers of the bearings specified a long list of things that this oil should not contain as well as a long list of qualities it should have. Added to this was the fact that this oil would be heated up to the temperature of the steam in the rear dryer journal and also would be under a vacuum of 28 inches of mercury. At this temperature and this vacuum, the oil must not vapourize out its lighter components and thereby change its characteristics. Much research was called for, and, after careful considerations of all the requirements, several grades of oil were selected and then tested under the temperature and vacuum conditions, and a suitable oil was found.

The bearings and the oil have now run for a sufficiently long time to vindicate the selection of this type of bearing and oil. There has not been one minute of lost time due to bearings, and the quantity of oil used has been negligible. Actually, these bearings will run for months with one filling of oil and no outside attention.

Paper machine dryer bearings have been noted for giving trouble. It is impossible to make the journals of a dryer turn and stay true. Temperature changes in the dryer and dryer head seem to warp the dryer head just a trifle, and this causes the journal to wobble and has been the cause of no little trouble to paper makers. The self-aligning feature of the roller bearings used have compensated for inaccuracies of the journal movements and eliminating this source of trouble. The cost of this type of bearing is only a little more than a good type of plain bearing. They have a calculated life of twenty years and are easily and quickly replaced when necessary. The wear in this type of bearing is very small and the dryers turn on their correct centres, stay in line and level and run very much easier. Also, the dryer gears run on their true pitch circles, making for smooth running gears with longer life and less noise and vibration. The starting load of dryers mounted on plain bearings has always been large and a serious drawback. When they are stopped, the oil is forced out of the bearings and considerable power is needed to start them, which in turn has called for large and expensive clutches and often causes an overload on the engine or motor in starting.

The Seals

For the sake of those who are not familiar with the operation of the seals, a brief description follows. Reference should here be made to the accompanying illustrations showing the seals. The paper passes into the seal between a rubber covered roll and the lower of two bronze covered rolls. The rubber roll is held tight against the bronze rolls by the pull of the vacuum from within the chamber, or, to speak technically, by the air pressure from outside the chamber, thus forming a rolling seal at this point. The surface of the rubber roll, however, gives enough to allow the paper to pass and yet seal against the air. The ends of all three rolls are fitted with a special form of sealing ring excluding the air at the ends. The bronze covered rolls run on roller bearings and are located in the main seal

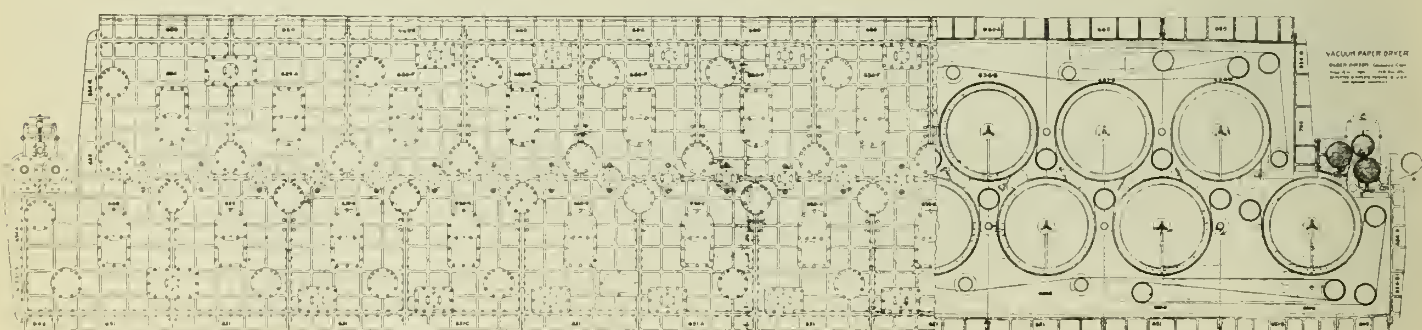


Figure No. 4.—Elevation of Vacuum Dryer Installed in the Kenogami Mill of Price Brothers and Company.

casting, as shown in figure No. 16. In this casting are grooves into which the sealing and wiping rubbers are placed by pulling these rubbers through from the front or back of the dryer. The rubber tube is then drawn through and the ends plugged with special plugs and water is put in the tube to push the sealing and wiping rubbers up against the bronze rolls. A pressure of approximately five pounds per square inch is maintained in these tubes. A small pond of water is supplied, as shown, in front of these rubber strips and some leaks past them into the vacuum, where it is led away to waste or to the condenser. The rubber strips, however, allow only a small amount of this water to leak in. The second rubber in each case acts merely as a wiper to wipe the surface of the bronze covered rolls dry before coming in contact with the paper or the rubber roll, as the case may be. Water makes almost a perfect lubricant for rubber under these conditions, and the resulting friction is very small. Air cannot leak into the vacuum chamber, because it must displace the water ahead of it, which, of course, it cannot do as long as a constant supply of water is kept in the opening and maintained at the same level. This level is maintained by additional water running in slightly faster than needed, the excess flowing to waste or to the condenser over a small weir. The rings on the ends of the rolls are backed up by sponge rubber rings which take care of contraction and expansion of the rolls themselves or the castings in which they are fitted.

The ingoing and outgoing seals on the vacuum dryer at Kenogami are much the same as the earlier type of seals used for this purpose. They comprise two bronze covered rolls 16 inches in diameter and a rubber covered roll 14 inches in diameter. The accompanying illustrations, figures Nos. 11 and 12, show these two seals plainly. Unlike the earlier type of seals, the ingoing seal has the two bronze rolls set at an angle. This was done to allow the paper to draw into the seal better from the third press felt and to lower the paper at this point. The outgoing seal likewise has the two bronze rolls set at an angle and also has the rubber roll underneath, thus making what is termed an inverted seal. This was done to improve the passing of the paper around the 24-inch sweat dryer and up over the 5-foot sweat dryer and into the calendar stack. This arrangement also eliminated the vertical pass from the last dryer up to the nip between the bronze and rubber covered seal rolls, which was necessary with the old type of seal. Now, the paper is doctored off the last top dryer and falls directly down into the nip of the inverted seal, and this pass cannot fail. The sealing rubbers have been made larger than heretofore, being 1¼ inch wide. This makes the rubber tube 1¼ inch in diameter and makes the method of plugging the ends easier, as there is more room available and the parts are not so small and delicate. The accompanying sketch, figure No. 15, shows the form and shape of these rubbers plainly.

A very rare and interesting engineering phenomenon took place recently in connection with these wiping and sealing rubbers. For some reason, these rubbers commenced to fail. They apparently would run hot, partially melt, then seize and be pulled all out of shape. Before the dryer could be stopped, the rubbers would be so mutilated that nothing much could be learned by examining them. A new rubber would be put in, the dryer started up, and there might or might not be any more trouble for a long time. An identical rubber from the same lot would run for weeks and another rubber just exactly like it would run for perhaps only fifteen minutes. No reason could be found for failure of these rubbers. Finally, by stopping the dryer and pulling out the rubbers *before* they failed it was discovered that the rubbers were softening or melting from the underneath side, the side next to the rubber tube and not the side

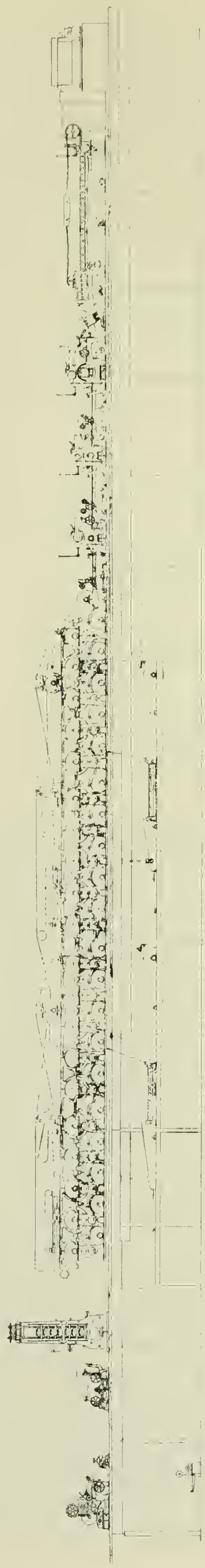


Figure No. 5.—(a) High Speed, 234-inch, News Paper Machine Equipped with Standard Type of Dryers.

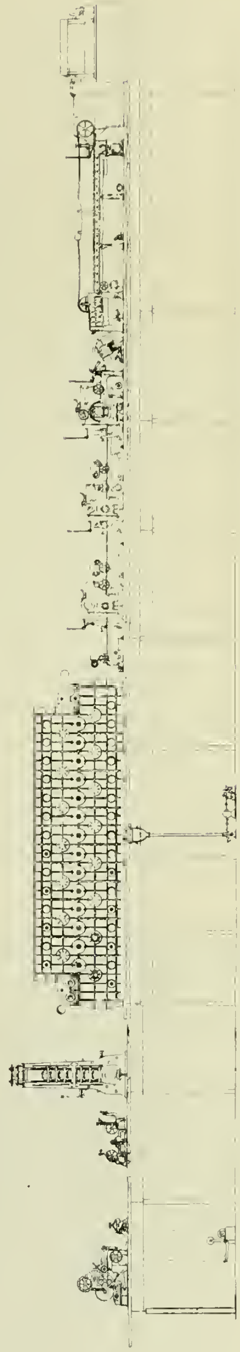


Figure No. 5.—(b) Same Machine as above with Vacuum Dryer Drawn to Same Scale showing the Floor Space Saved by Using Vacuum Dryer.

running in contact with the bronze roll, where friction might have been great and where trouble might be expected.

At about this time it was learned that a certain company had manufactured some special fire hose and that when they were testing this hose, with 150 lbs. of water pressure in it, the hose actually started to melt and smoke with the water flowing inside of it. This was explained as due to the impulses of the fire pump setting up a vibration which caused the rubber and the canvas of the fire hose to rub and enough friction was generated within the wall of the hose to cause it to melt and smoke. With this in mind, a careful analysis of the sealing rubbers showed that the cause of the failure was due to a chattering of the rubber, which set up a vibration, which in turn set up internal friction and generated enough internal heat to destroy the rubber. A rubber was substituted having a different period of vibration, and there was no more trouble from this source. Careful inquiry among the rubber manufacturers has failed to bring to light any other cases of this kind. All of this trouble was traced to one lot of rubbers.

Dryer Felts

The ordinary standard dryer felt is, as a rule, made of cotton duck or canvas. There are many different types, each manufacturer claiming some advantage for his particular variety, either as to weave, texture, flexibility, freedom from wrinkling, small amount of stretch, length of life, etc. Woollen dryer felts are often used in European countries and have many advantages over cotton felts, but are very expensive. They are as a rule put on endless, which on a large dryer section is a long tedious job. However, they run for a long time, often two or three years, and the change does not often have to be made. They have one property that is very superior to the canvas felts, in that they are very porous. In recent years a new type of dryer felt has come on the market known as the asbestos dryer felt. This is a cotton felt with a very open weave on the back and the face is made of asbestos strands woven into the cotton and is finished to give a very smooth surface next to the sheet of paper. This felt is quite porous.

Dryer felts often meet with accidents and are torn, run ashore or wrinkle, after which they must be replaced. Even the cheaper ones are expensive, and the cost of dryer felts per ton of paper is a real item to be considered by the paper maker. Some paper makers prefer to buy cheaper felts, due to the risk involved, in that a very expensive felt may be ruined long before it is worn out. Others buy a more expensive felt with a longer life and then try to protect it against accidents. In the vacuum dryer, tell-tale lights have been installed to warn the paper machine crew if a felt starts to leave the dryers for any reason and is in danger of wrinkling or running ashore.

A thermodynamic consideration of the vapourization of water is necessary to appreciate the task imposed on dryer felts. Lack of appreciation of the above fact was the cause of no little trouble with the vacuum dryer at Kenogami.

In the early types of the vacuum dryer, endless woollen dryer felts were used, principally because high grade bond and ledger paper were being dried and it was desired to keep the surface of such paper very smooth. Later, asbestos felts were substituted. This change was made because the number of dryers was changed and a different felt arrangement made it necessary to get new felts, and it was desired to try this type of felt. Cotton felts were tried for only a very short period of time and practically no experience was had with them. It should be remembered that this early vacuum dryer ran at a very slow speed and was used to dry paper of low moisture content and great strength.

When the vacuum dryer was installed at Kenogami, standard cotton dryer felts were put on and the machine

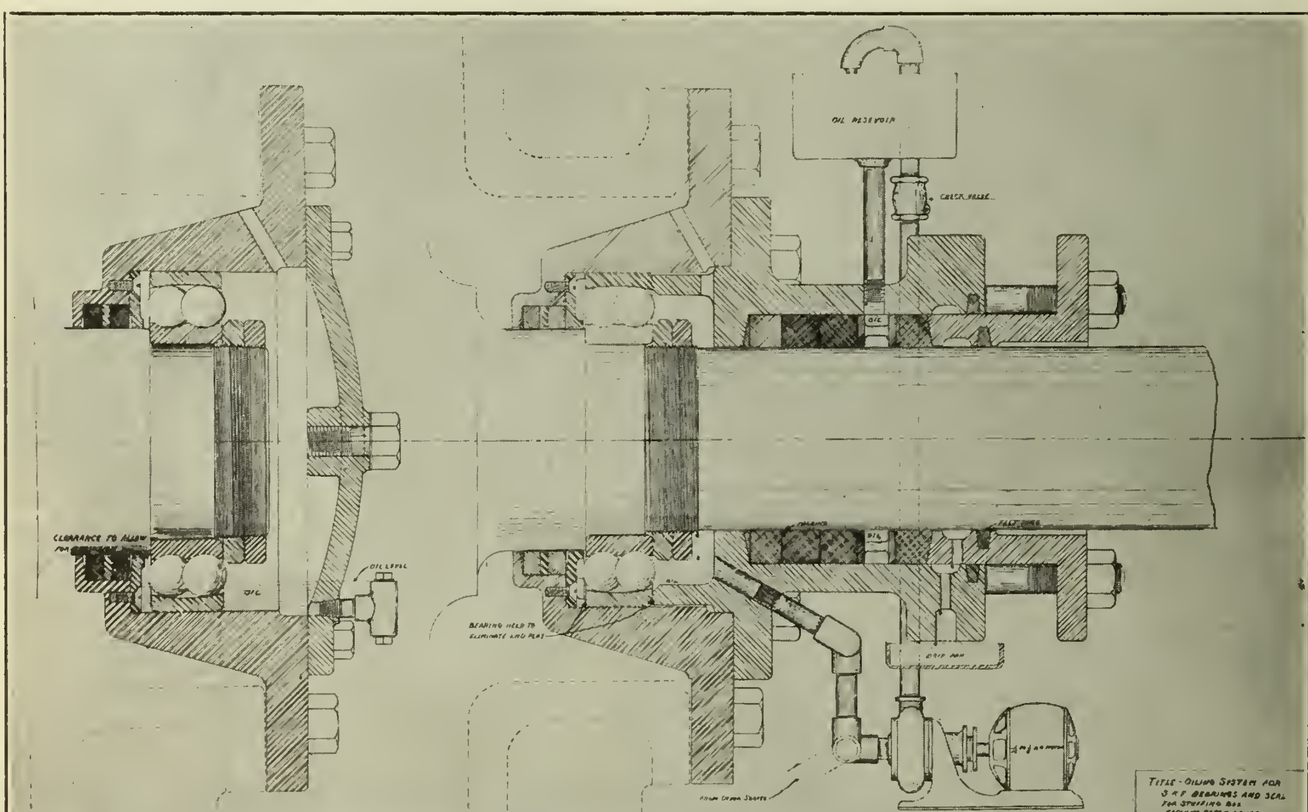


Figure No. 6.—Method Used in Mounting Ball Bearings on Front and Rear Dryers.
The rear dryer bearing is held and the front bearing is allowed to slide to take care of expansion of the dryer when the temperature is raised.

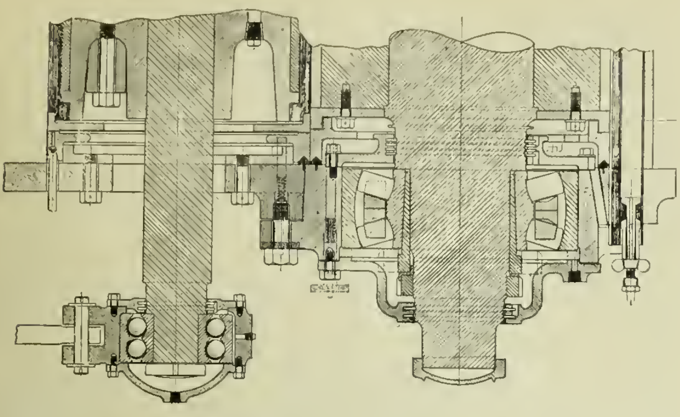


Figure No. 7.—Vacuum Dryer Type 20-60-152, Cross-section of Outgoing Seal Rolls showing End Sealing Rings and Bearings.

started up. This was a news machine running at 700 feet per minute and the paper coming to the dryer at about 72 per cent wet. The wet end of this machine was a standard Fourdrinier with couch roll and three wet presses of standard make. The sheet was 148 inches wide.

There was no difficulty experienced in drying the sheet other than that a serious wet wrinkle appeared about 12 inches in from the front and back edges of the sheet. The sheet was decidedly damper on the front and back edges than it was in the middle. The wet wrinkle was often so bad that it would cut in the calender stack, and at times plugged the stack. Regrinding and recrowning the press rolls to change the moisture content of the incoming sheet of paper did not help matters materially. No reason could be found to cause this condition. Tests of the moisture content of the incoming sheet were taken frequently. Many suggestions were made and were tried out with no results, so far as correcting the wet wrinkle and wet edges. At certain times and under certain conditions the wrinkles would just about disappear of their own accord, only to come back again in a few hours time. Leaky dryer heads were suspected, but were found not to be leaking. Distorted or unevenly woven felts were suspected, but when these same felts were put on one of the standard dryer sections in the same mill they functioned perfectly. Everything anyone could possibly think of was tried to correct the trouble, but without the slightest success. All of the dryers, felt carrying rolls and seal rolls were checked for alignment, and this was found to be perfect. The felts guided perfectly when there was no paper going over the machine, but difficulty was experienced in guiding them when the paper was on the machine. Rubber covered automatic guide rolls corrected this. It finally occurred to someone that the difficulty in guiding the felts was due to the fact that the felts were riding on a film of steam and that this made them hard to guide. If the felts were riding on a film of steam, then the felts were not letting the vapour through and a more porous felt would help.

The early experience with vacuum dryers was called to mind, and asbestos dryer felts substituted for the cotton felt. The felts then guided easily and the wet wrinkles disappeared, and it was then possible to make commercial paper. Carload after carload of this paper has been shipped and there has not been one complaint from the publishers regarding the paper. A careful record was kept of where this paper went, and it was mixed with paper from the other machines in the mill. The publishers were not told how the paper was made or that it was vacuum dried paper.

During test runs when the rate of evaporation was very high there was still a tendency for the edges of the sheet to come slightly wet, and the asbestos felts were suspected of not being porous enough. A very interesting experiment was tried to prove this and other things. This experiment disclosed a remarkable phenomenon. The two top dryer gears were removed. This left the first dryer and the small baby dryer ahead of it geared together and the two top and bottom dryers not connected in any way, other than that the dryer felt was around them and they had to be driven by the dryer felt. As they were mounted on roller bearings and turned very freely, this did not impose any great load on the dryer felt. This change was made over a Sunday. At midnight Sunday the machine was started up and the paper passed through it without difficulty and was put through the calender stack and on the reel. The only difference noted was that the first few draws of the paper from one dryer to the next were more loose. As they had been too tight before, this was considered an improvement. The writer was personally present in the mill. At eight o'clock the next morning the writer returned to the mill, and was told by the machine crew that the paper had broken on the wet end of the machine at about six o'clock, and that they repassed the paper, put it on the reel and no trouble was experienced. About two minutes later one of the machine crew passing the back of the vacuum dryer noticed that No. 1 bottom dryer was not turning, yet the paper was still on the reel and running perfectly. Two of the crew started it turning again and the paper did not break and there was not any sign of trouble from then on. This meant that the paper had been passing over the baby dryer, which was stationary, around the bottom dryer, which was also stationary, yet under the moving felt. How wet paper could do this without breaking was not easily comprehended. At first it was thought that something else must have happened and that the machine crew had reported the circumstances wrongly. However, shortly after nine o'clock the same thing happened again, and this time several engineers were present, and later it happened a third time and was witnessed by the writer. After the phenomenon, a fact was definitely established and it did not take long to analyze the situation.

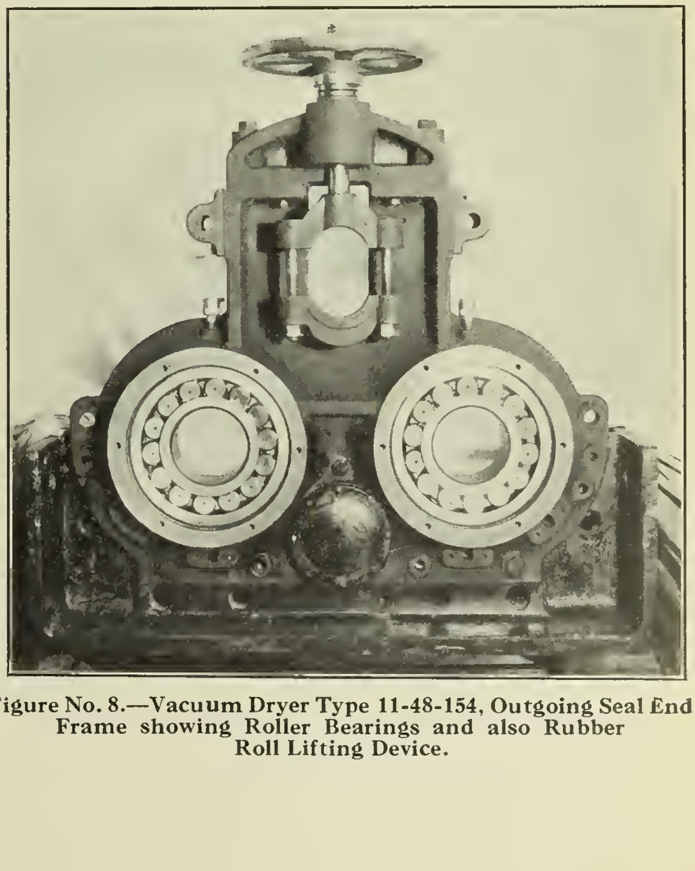


Figure No. 8.—Vacuum Dryer Type 11-48-154, Outgoing Seal End Frame showing Roller Bearings and also Rubber Roll Lifting Device.

Table No. 1.—Properties of Saturated Steam.
(From Steam Tables)

Absolute Pres. lbs. per sq. in.	Vacuum in inches of Mercury	Temperature Degrees Fahr.	Volume in cu. ft. for 1 lb. of steam
0.946	28.00	100.	350.8
1.	27.88	101.83	333.0
2.	25.85	126.15	173.5
3.	23.81	141.52	118.5
4.	21.78	153.01	90.5
5.	19.74	162.28	73.33
6.	17.70	170.06	61.89
7.	15.67	176.85	53.56
8.	13.63	182.86	47.27
9.	11.60	188.27	42.36
10.	9.56	193.22	38.38
11.	7.52	197.75	35.10
12.	5.49	201.96	32.36
13.	3.45	205.87	30.03
14.	1.42	209.55	28.02
14.7	0.	212.	26.79

The paper actually was not touching the dryer. It was riding on a film of steam, much the same as water acts when spilled on a very hot stove. Sufficient steam pressure was being developed between the paper and the dryer to force the paper and the dryer felt away from the dryer. It should be noted here that after even a short period without the wet paper on them the dryers heat quite rapidly, and this first dryer had come to a high temperature after the paper broke on the wet press. Because of the method of piping the steam to the various drying cylinders, the temperature of this first dryer comes up to the maximum temperature of any of the dryers soon after the paper is off the machine.

This temperature was sufficient to form the steam film when the paper was repassed after the break had occurred and caused the paper and dryer felt to leave the surface of the first dryer, and, there being nothing to drive it, it stopping turning. Like everything else, when it is understood it is perfectly simple.

A careful investigation was then started on the subject of dryer felts, and the accompanying chart, figure No. 19, of dryer felt tension was worked out. The asbestos felts were operated to best advantage at a felt tension of about 6 lbs. per inch of width, and from the chart where $R = 30$ inches, (the radius of a 5-foot dryer), it is seen that the pressure of the felt against the dryer is only 0.2 lbs. per square inch. In other words, the pressure of the felt against the paper and the dryer under the paper is a very small amount. Steam generated under the felt or paper has to exert only a force of 0.2 lbs. per square inch to lift the paper, or the paper and felt, off the dryer entirely. This is only one-fifth of a pound of steam pressure. The vapour formed from the evaporation of water in the wet sheet of paper must either pass through the felt or else leave the paper while the paper is passing from one dryer to the next. Probably both take place. However, if the felt is not porous enough to allow the vapour to get away steam pressure will be built up and lift the felt away from the dryer, as mentioned above.

Table No. 1, showing some of the properties of saturated steam at pressures less than atmospheric pressure, is shown for reference purposes. The standard paper machine dryer evaporates water at a temperature approximating, say, 170.06° F. From the chart it will be seen that one pound of vapour at this temperature occupies 61.89 cubic feet. In the vacuum dryer, however, with a vacuum of 28 inches of mercury, one pound of vapour occupies 350.8 cubic feet, or a little more than 5½ times as much volume. It should be remembered that in the vacuum dryer the pounds of vapour liberated per square foot of dryer surface are twice the amount they are with a standard paper machine dryer, hence the volume of vapour that actually has to pass through the felt is not 5½ but 11 times as great. This volume of vapour must pass through the felts or else a pressure will be built up under the felts and the felts lifted off the surface of the dryers; hence the need for a very porous felt. This lifting of the felt can be offset to some extent by increasing the tension in the felts, but high tension does not help the length of life of felts and may result in marking the paper. Also, this tension has to be very high to get any real pressure of the felt against the paper, as a study of the chart of dryer felt tension clearly shows. When the paper is wettest the evaporation is greatest. As the sheet

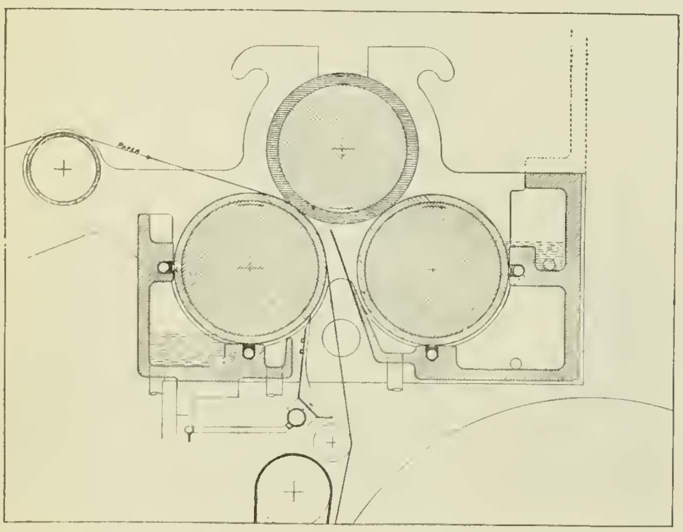


Figure No. 9.—Diagrammatic Drawing of Ingoing Seal for Vacuum Dryer.

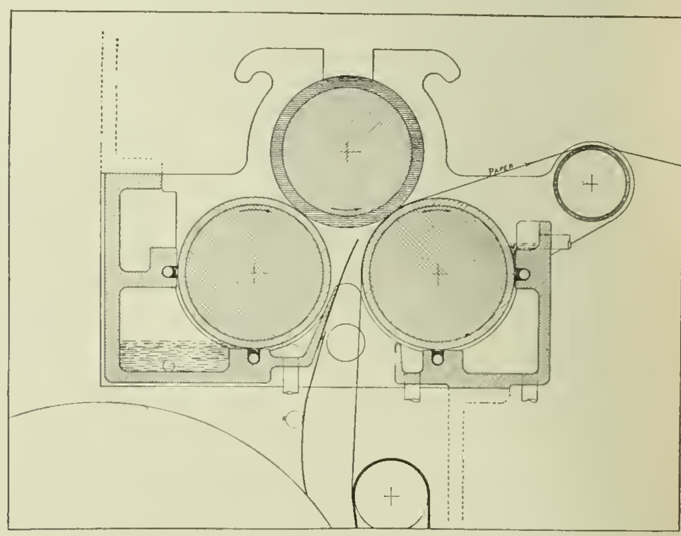
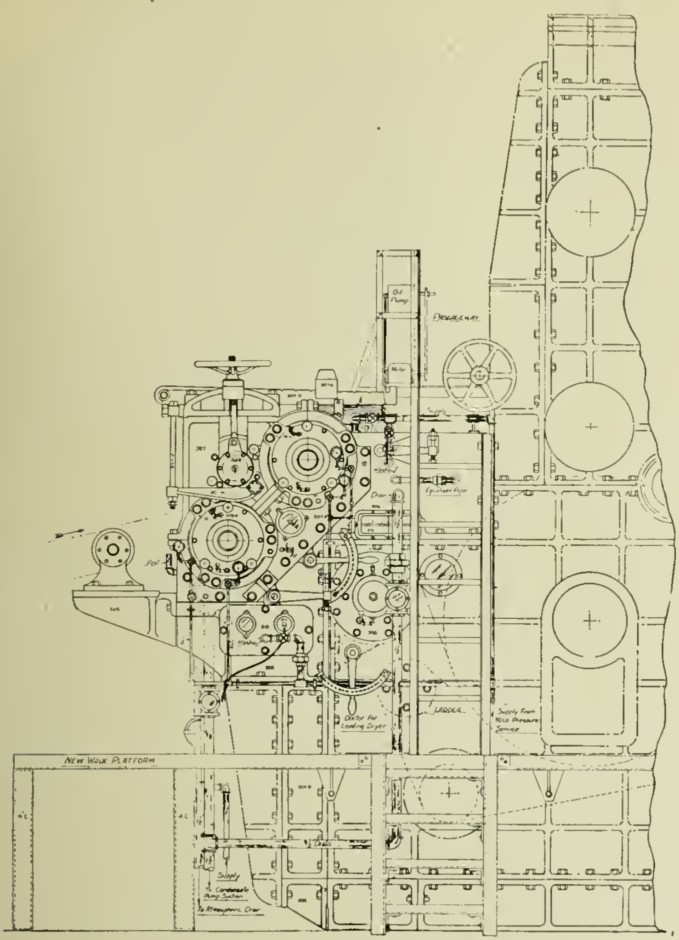


Figure No. 10.—Diagrammatic Drawing of Outgoing Seal for Vacuum Dryer.



ELEVATION

Figure No. 11.—Vacuum Dryer Type 20-60-152, Elevation of Ingoing Seal.

commences to dry, while passing from dryer to dryer, the rate of evaporation is reduced, and hence the first few dryers of a bank are the worst offenders so far as lifting the paper and felt off the dryers.

While this condition imposes a serious task on the felts in a vacuum dryer, the same thing, to a less extent, takes place in every type of dryer using felts, and in both cases the paper maker should look for a porous felt. It will be found that a very porous felt can be run with very little tension, and where you find it necessary to carry high felt tension you will find a more or less non-porous felt.

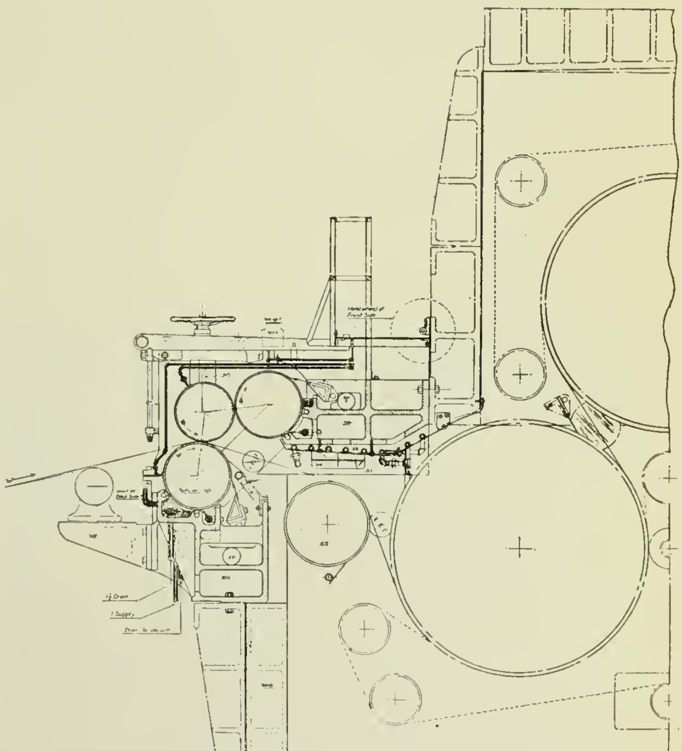
A set of curves showing the properties of saturated steam has been plotted, and is shown in figure No. 20. A study of these curves will show that by lowering the vacuum, even slightly, there is a large drop in the volume of one pound of steam. In fact, if the vacuum were dropped to 17.70 inches of mecury we would have a temperature and volume of one pound of steam just exactly the same as in the case previously cited of the standard paper machine. However, the value of a vacuum dryer lies in carrying high vacuum, which raises the rate of evaporation and shortens the length of the dryer and reduces the evaporating temperature of the water in the paper, all of which work for economy of operation and better and stronger paper.

Before learning that there was pressure being formed under the felt and that the evaporation was taking place at this pressure, and not at the vacuum in the chamber, it had been impossible to account for a few extra degrees of superheat in the vapour going to the condenser. The vapour in the vacuum dryer is slightly heated by the surfaces of the dryer over which there is no paper and also by the ends of the dryers, but this had always been found to be a small amount until the vacuum dryer was installed at Kenogami. The fact that this vapour is formed under a slightly greater pressure than the vacuum properly checked with the superheat, that could not be accounted for otherwise.

Condensing Equipment

The condensing equipment used with the vacuum dryer at Kenogami consists of a surface condenser, an air cooler, two dry vacuum pumps and two condensate pumps. Two pumps of each kind were installed, one of each to be held in reserve as a stand-by in case of accident to the other. The surface condenser at the present time is connected in one of the mill lines and the water simply flows through it just as though it was an elbow in the line. The temperature of the water is raised only about 4° F. under ordinary working conditions. This was installed as a temporary hook-up, but it has worked so satisfactorily that it probably will not be changed. The few degrees change in the water is beneficial to the mill supply line, and the cold water certainly is beneficial to the operation of the condenser. Following is given a full description of this equipment:—

1 Ingersoll-Rand surface condenser No. 11...	
1 Ingersoll-Rand air cooler, size C..........	
Steam capacity, lbs. per hour...............	18,000
Vacuum referred to 30" barometer...........	28 inches
Designed for circulating water at............	70° F.
Gallons per minute, circulating water........	1,500 gals.
Water velocity through tubes...............	7.4 ft. per sec.
Condenser friction in feet of water..........	15 feet
Condenser water temperature discharge (theoretical)	93° F.
Square feet of tube surface..................	1,280 sq. ft.
600 Admiralty metal tubes, 13 ft. long, ⅝-inch O.D. No. 18 B.W.G.	



CROSS SECTION

Figure No. 12.—Vacuum Dryer Type 20-60-152, Cross-section showing General Arrangement of Ingoing Seal.

Two pass construction and maximum pressures on tubes not to exceed 40 lbs. per sq. inch.
Shipping weight, 15,000 lbs.
Two No. XB Ingersoll-Rand dry vacuum pumps.
These are two-cylinder, double acting pumps and are belt driven from a 75-h.p. motor.

Bore	23 inches
Stroke	12 inches
Rated speed	190 r.p.m.
Capacity (piston displacement)	2,188 cu. ft. per minute
B.h.p. at pulley for peak intake load	82 b.h.p.
B.h.p. at pulley for 28-inch vacuum	39 b.h.p.

The condensate pumps are Cameron pumps furnished by Ingersoll-Rand Company.
2 pumps—No. 2 LV centrifugal condensate pumps.

Capacity each	27,000 lbs. per hr.
R.p.m.	1,750
B.h.p.	2.9 each

The dry vacuum pumps have valves so arranged that they can be run at the same time or singly. The same is true of the condensate pumps. Actually, the dry vacuum pumps are operating at a speed of 144 r.p.m., as there was an error made in getting the pulleys for the motors, and these have not been changed, as it was thought best to run these pumps in at this lower speed. Both vacuum pumps are ordinarily operated together. The air cooler was added to this equipment to reduce the temperature of the air going to the dry vacuum pumps, and thus relieve them of some extra work.

When this equipment was selected there was very little data available as to air leaks, and the selection was more or less of a guess. The incoming paper brings in a small amount of entrained air, and the amount of leaks in the casing could, of course, only be estimated very roughly. This guess turned out to be fairly accurate, as operating conditions have shown, and in a new design under the same conditions this same vacuum equipment would again be specified. It should be borne in mind that the type of vacuum equipment depends to a great extent upon conditions at the mill where the equipment is to be used. In some cases, a jet or barometric type of condenser might be preferable. There is a 10-inch piston operated vacuum breaker valve installed in the line running to the vacuum pumps. This can be operated by an air valve in the machine room located in front of the dryer, and it is only a matter of a minute and a half to break the vacuum. Also, switches are located on the front of the dryer to stop the vacuum pump. This vacuum equipment has not given trouble of any kind and has functioned perfectly.

Passing the Paper

It was not anticipated that there would be any difficulty in passing the paper, and it was assumed that the method used on former dryers would apply in this case. This method had been to feed the streamer into the ingoing seal with the end lapped over a piece of cardboard about 10 inches wide and 5 feet long. This would thread its way through the dryer of its own accord, aided only by the doctors on the drying cylinders. When the dryer at Kenogami was started up it was fitted out for this type of feeding. The first time it was turned over it ran at a speed of about 500 feet per minute, and the cardboard streamer, called a *go-devil,* functioned perfectly and no trouble was anticipated. However, the speed of the machine was soon raised to 700 feet per minute and the *go-devil* just would not function. It went everwhere but where it was desired to have it go, and this method of feeding had to be abandoned and a new method devised.

This was accomplished by means of two small air jets

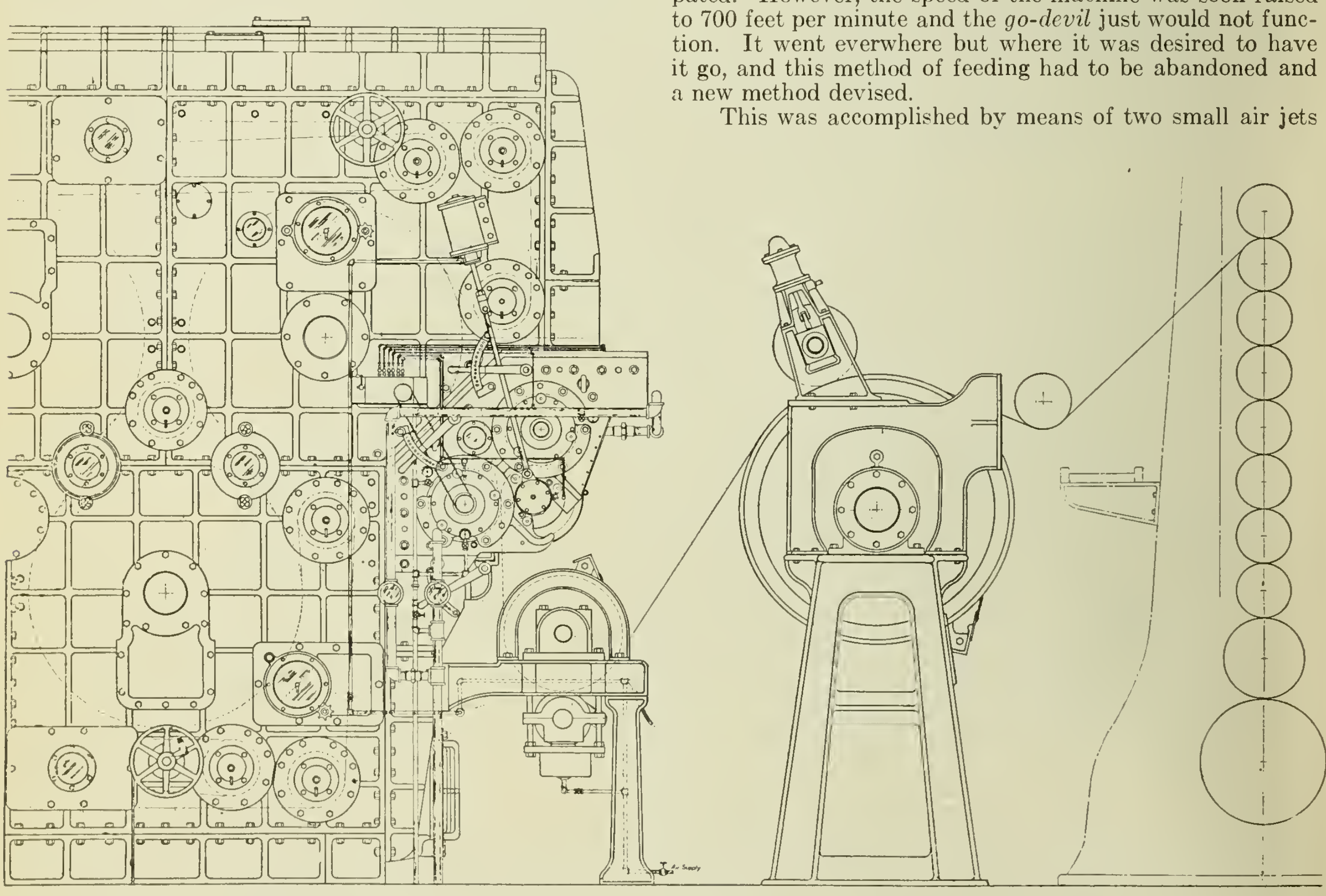


Figure No. 13.—Vacuum Dryer Type 20-60-152, General Arrangement of Outgoing Seal and showing Sweat Dryers.

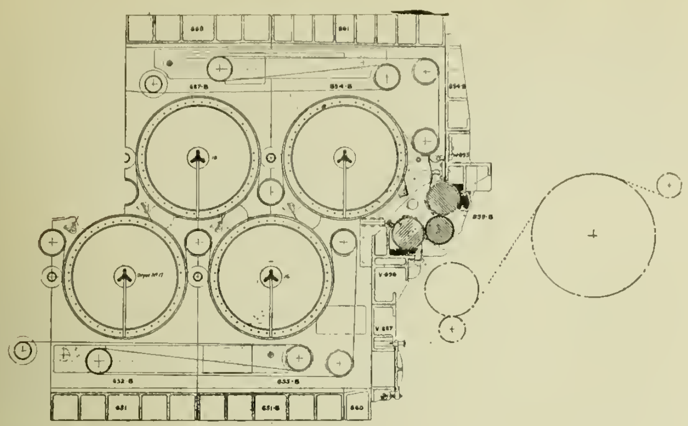


Figure No. 14.—Vacuum Dryer, Type 20-60-152, Cross-section showing General Arrangement of Outgoing Seal.

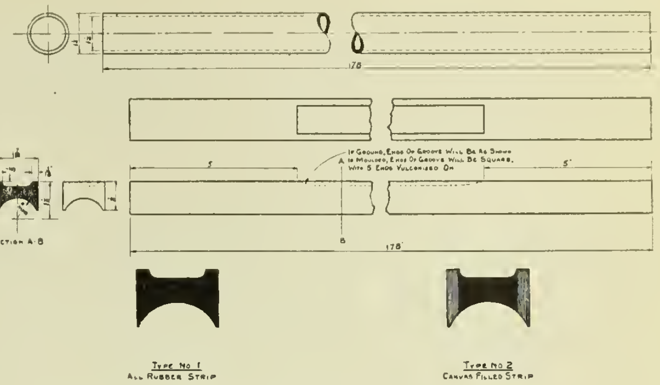


Figure No. 15.—Sealing and Wiping Rubbers.

which were arranged to strike the paper just before it came to the doctor on each bottom dryer. These jets consist of a small pipe with two nozzles. These nozzles were directed to strike the edges of the streamer as the streamer approached the doctor blade on each dryer. The other end of the pipe from these nozzles was brought out through the side of the vacuum dryer and a quick opening valve put on. This in reality was a standard ⅜-inch air or gas cock. When this valve is opened the outside air rushes into the vacuum and the two air jets strike the paper and blow it from the dryer into the nip, (above), between the dryer felt and the next following drying cylinder. A second pipe and valve are placed at each of these upward passes of the paper so that it blows straight across the machine when the valve is opened. The purpose of this is to blow out small pieces of paper that may lodge at this point. These are not often used, but are a great help at times.

The paper is picked up off the third press felt and thrown into the ingoing seal, and the air valves described above are opened. The man passing the paper walks down and closes the valves after the streamer passes each air jet. Paper has repeatedly been put back on the reel within two minutes after a break on the wet end of the machine. This method of passing the paper gives very little trouble. It should be remembered here that passing paper in a vacuum is comparatively simple as there are no air currents to deflect it. The old physics experiment in which the feather and the penny fall at the same speed in a vacuum should be recalled to mind. The paper has sufficient momentum to pass of its own accord, and after passing the first few dryers it actually will do so. Before passing the first few dryers it is so wet and limp that it has to be helped.

It is not at all difficult to fit a Sheehan paper carrier to a vacuum dryer, and this type of carrier would work perfectly. The extra complication of ropes and pulleys, however, is not desirable. At slow speed, the *go-devil* is a perfect method of feeding, while at high speed the air jets accomplish all that is desired.

Breaks

To the best of the writer's knowledge, paper has never broken in a vacuum dryer unless there has been some very good and obvious reason. Paper coming from the third press badly torn on the back edge has at times passed into the dryer and piled up, but as a rule even in this case it will pass on through and out the outgoing seal. Instances of the paper piling up in the dryer have been rare, not over five or six times, including all the experimental period, when many experiments were being tried out. When it does pile up, it is not a serious matter. The vacuum is broken, the doors or windows opened and the paper removed just

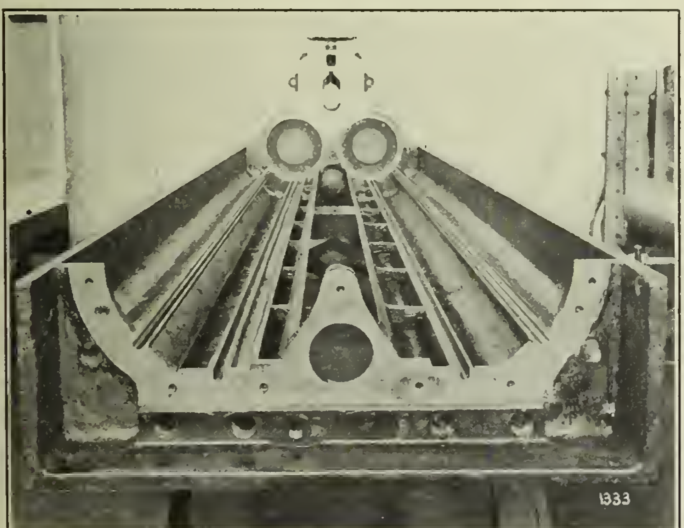


Figure No. 16.—Vacuum Dryer Type 11-48-154, Outgoing Seal Casting—showing Grooves for Rubbers and in the Rear is shown End Frame with Roller Bearings in Place Ready to Receive the Two Bronze Covered Rolls and the Rubber Covered Roll.

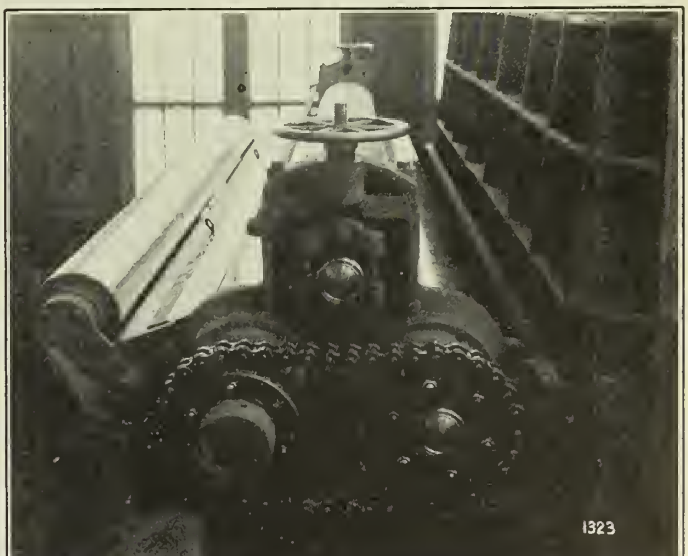


Figure No. 17.—Vacuum Dryer Type 11-48-154, Outgoing Seal Assembled in Place—showing End Frame, Two Bronze Covered Rolls and Rubber Covered Roll with Lifting Device.

as on any other type of dryer. The delay is not long. This vacuum dryer at Kenogami has run for a period of 37 hours without a break of any kind, and whole weeks have been run when there has not been any break or lost time traceable to the dryer. An over-all machine efficiency of 95 per cent was maintained for a full week's run.

Steam Efficiency

A carefully calibrated flow meter has been installed and measures the steam to the vacuum dryer, and test runs showing as high as 97 per cent thermal efficiency have been made. This is calculated from the formula given in the writer's previous paper, "Thermodynamic Comparison of Paper Drying Methods."* This means a higher efficiency than 97 per cent when compared against the standard paper machine dryer. It is regretted that an official steam test cannot be included herewith. It had been planned to run such a test, but paper was needed by the mill and as yet this test has not been made. In making such a test, samples of paper from both the wet and dry end have to be taken, and the paper has to be broken when the wet samples are taken. To get an accurate test, these samples have to be taken frequently, and the production of the machine suffers accordingly.

Just before the vacuum dryer was installed, an official, carefully run, test was made using the original dryer section so that a comparison could be made of the performance of the paper machine before and after the installation of the vacuum dryer. This test was run for a period of two weeks, and the average pounds of steam from and at 212° F. to dry one ton of paper was 9,540. A similar calculation based on readings from the steam flow meter show the vacuum dryer to be using only 5,370 lbs. of steam to do the same work. Or

9,540−5,370=4,170 lbs. of steam saved per ton of paper dried.

4,170÷9,540=43.8 per cent saving in steam.

These figures, as stated above, are only approximate in the case of the vacuum dryer, as no official test has as yet been run and the condensate from the dryers was not weighed. The steam was, however, measured by two steam flow meters in series on the line of steam going to the vacuum dryer and the average readings assumed to be correct. The two readings varied only slightly, and there is every reason to believe that the average of these very nearly represents the actual steam going to the vacuum dryer.

Another indication of the saving of steam is shown by the fact that with the old dryer section all the exhaust steam from the engine, plus 35 per cent of live steam, were used to dry the paper. With the vacuum dryer, all of the exhaust steam could not be used, and some of it is blown to the hot well and no live steam is used. The old dryer section was also supplied with a large quantity of heated air from the machine room, while the vacuum dryer does not use any heated air.

* Presented at Convention of Technical Association of the Pulp and Paper Industry, in New York City, in February 1926.

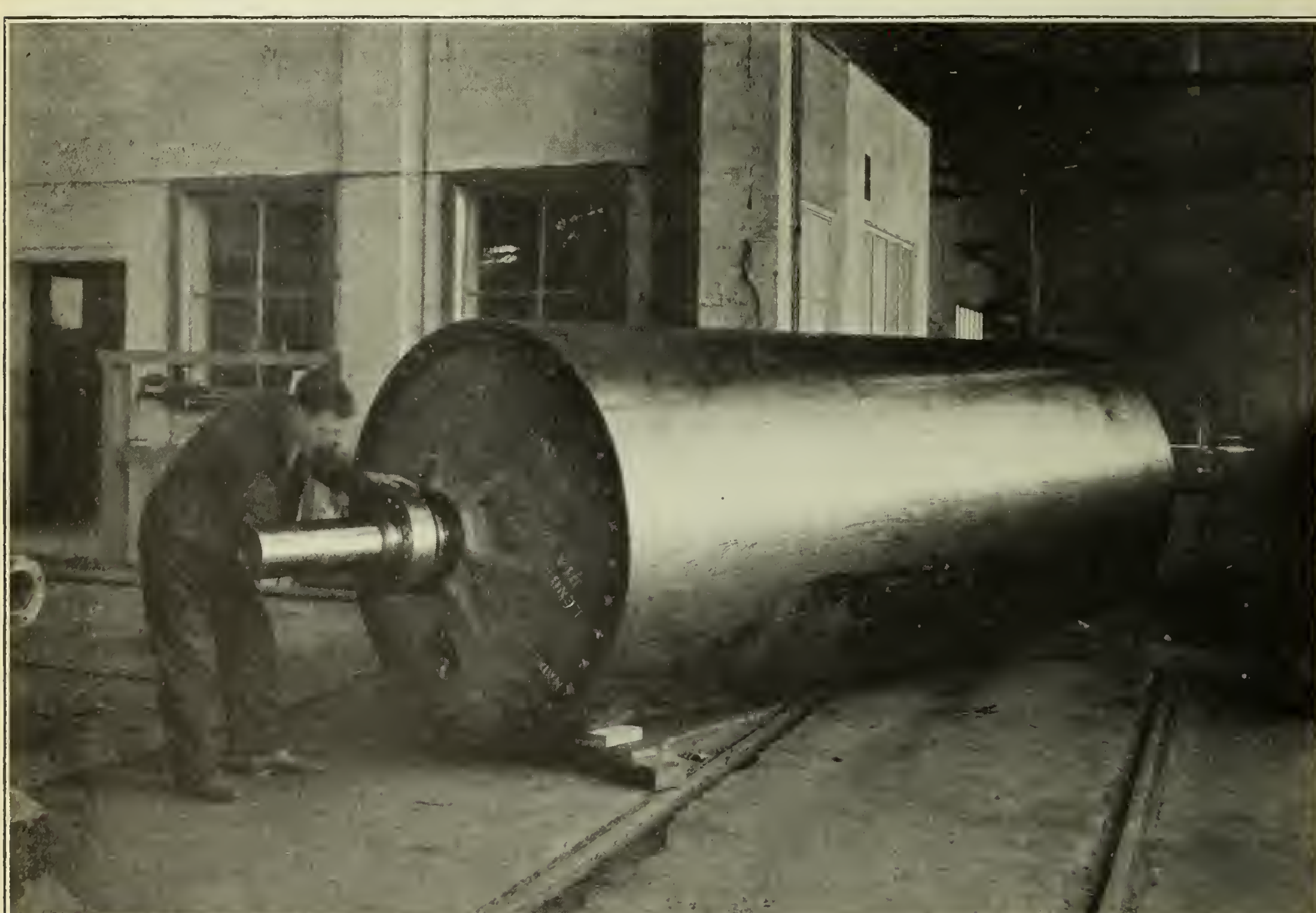


Figure No. 18.—Dryer Cylinder for Vacuum Dryer Type 21-60-152.

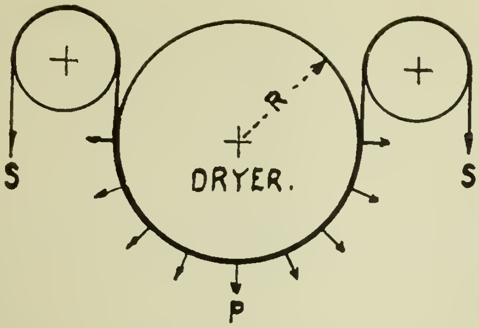


Figure No. 19.—Dryer Felt Tension.

$$P = \frac{S}{R}$$

P = lbs. per square inch pressure of felt against dryer.
R = radius of dryer in inches.
S = felt tension,—lbs. per inch width.

When	$R = 24$	$R = 30$	$R = 36$
S	P	P	P
1	0.0416	0.0333	0.0277
2	0.0833	0.0666	0.0555
3	0.1250	0.1000	0.0833
4	0.1666	0.1333	0.1111
5	0.2083	0.1666	0.1388
6	0.2500	0.2	0.1666
7	0.2916	0.2333	0.1944
8	0.3333	0.2666	0.2222
9	0.3750	0.3000	0.2500
10	0.4166	0.3333	0.2777

The old machine ventilators over the dryer sections have been boarded up and practically no ventilation is used since the installation of the vacuum dryer.

In preparation for an official test of the vacuum dryer, a motor has been installed to run the entire paper machine, and it is proposed to weigh all the condensate and thus get accurate data rather than trust to steam flow meters. With the engine driving the machine the quantity of exhaust blown to the hot well would have to be condensed and weighed, to get accurate results, and this would be difficult to accomplish.

Power

The power required, when all things are taken into consideration, is just about the same as before the installation of the vacuum dryer. The vacuum pumps take about 40 horse power and the condensate pump 2 horse power. To offset this, there was considerable power being used to operate fans to move the air in the ventilating system required when the old bank of dryers were being used. The exact amount of power will be shown as soon as the official test is run.

Space

The old drying section contained thirty-three dryers, each 5 feet in diameter, while the vacuum dryer contains twenty of the same size dryers spaced on slightly closer centres. Also, the original dryer section and the vacuum dryer have a baby dryer and a sweat dryer, in addition to the above. The speed of this particular machine is limited by the wet end to not over 750 feet per minute. The vacuum dryer was designed for and is capable of running at a speed of 1,000 feet per minute. It was made this size so that if at any time later on the wet end was changed the vacuum dryer would be large enough to take care of any additional speed resulting from the change.

Shrinkage of the Paper

Before the installation of the vacuum dryer, the paper shrank just slightly over two inches in width in going from the last press to the calendar stack. Since the installation of the vacuum dyer, this shrinkage is just slightly under one inch, or almost exactly one-half of what it shrank before. This should produce a stronger and better sheet of paper.

In the design of this particular vacuum dryer, only one top and one bottom dryer felt were included. The dryers were all connected together with standard dryer gears and no provision made for any adjustment of the draws of the sheet of paper between dryers. A new type of drive has been since brought out, a good example of which is the drive used on the dryer sections of the Ste. Anne Paper Company, Limited. In their design an individual motor drives only the first two dryers, and the torque supplied to the following dryers can be varied by a rheostat on separate motors that again each drive only the next two following dryers. In another design of the vacuum dryer there will be an individual motor for each dryer. The dryer section will be split into two sections, with two top and two bottom dryer felts and felt dryers put on the first top and first bottom dryer felts. This will allow the paper to pass through the dryer without being drawn so tight between the dryers. These draws can then be adjusted and a much better condition will exist, in that the paper will be stretched less and made still stronger. Where the dryer sections are split, slack can definitely be put into that draw as well as a control of each draw by the rheostats on the individual motors.

The ideal drive would be to have individual felts on each dryer cylinder and an individual drive on each dryer, and then control could absolutely be had of each draw.

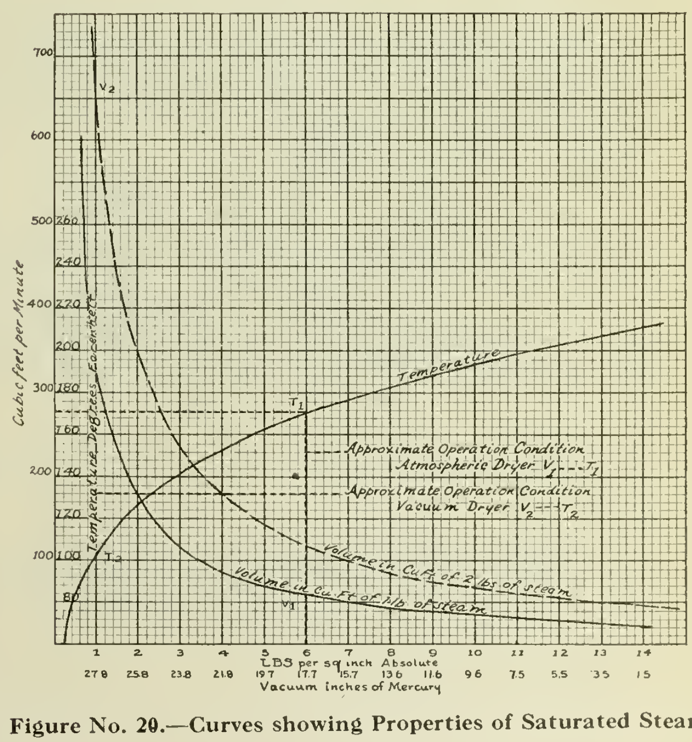


Figure No. 20.—Curves showing Properties of Saturated Steam.

This, however, is much too complicated and out of the question in the case of a modern high speed newspaper machine.

In the vacuum dryer at Kenogami, the draws are tighter than necessary. In the opinion of the writer, this is definitely reducing the strength of the sheet of paper. The paper should test considerably stronger than paper dried in the older dryer sections. At the present time, work is being done on this particular phase of the drying operation. The paper is now testing just about the same as the rest of the paper in the mill, but results so far obtained give good assurance that eventually the vacuum dried paper will be considerably stronger than paper dried in the standard manner.

A very compact worm gear drive has been designed for future installations of vacuum dryers. This comprises a separate motor driving through a worm gear direct to each dryer. The motors are solidly mounted on the back main side frame of the vacuum dryer and the worm drive so located that the back side of the dryer is available for opening windows opposite *all* the draws of the paper from dryer to dryer. This drive does away with the large gears on the present drive which, at the high speeds contemplated in future dryers are not safe due to the peripheral speed of these gears being too high. Also, the new drive is entirely enclosed and it is possible to work around the back side of the dryer without danger. The drive is so designed that the various motors and worm gears can be coupled together in any combination desired. All the bottom gears can be direct connected, or the top gears if so desired, in which case the motors act as boosters for the first motor on the line which is electrically interlocked with the main drive. Some engineers and paper makers will say that this is carrying the flexibility of the drive too far, but the writer is of the opinion that this is not true. Before the advent of high speeds, any drive was good enough, but to-day, when high speed and efficiency are demanded, too much attention cannot be given to matters of this kind. Worms and gears of extreme accuracy must be used, and if these are properly mounted and originally designed for a large overload they will not give any trouble and make the drive as smooth and quiet as possible. A ratio of worm and gear must, of course, be selected that will over-run or coast.

A preliminary drawing of such a drive is shown to more fully explain what is meant. Incidentally, every other motor on either the top or bottom line of the drive may be omitted and a piece of shafting with coupling on each end substituted for the motor if desired.

Results obtained from the dryer drive on the paper machines at the Ste. Anne Pulp and Paper Company, Limited, fully justify a drive such as has been described above. It should be remembered that a vacuum dryer of equivalent capacity to their dryer would only require half as many dryers, and with one motor for each dryer there would only be the same total number of motors that they now use and obtain twice the flexibility.

The writer prefers worm gears rather than small spur gears, not only because of their compactness and silence, but because it is possible to clean up the back of the machine and make it possible for the machine crew to make some use of the back side of the dryer in the ordinary operation; such, for instance, as removing broke.

While refinements, such as this type of drive, the use of modern type of roller bearings, etc., add considerably to the cost of paper machines, they are nevertheless justified by the modern demands made by the paper makers. Paper machines capable of running 1,200 and 1,400 feet per minute are now regularly specified, and if the machinery builder is going to meet this demand he must resort to refinements of this nature. The purchaser must in turn expect to pay the additional cost. Speed has always been an expensive article to purchase, and speed in a paper machine is no exception to this rule.

It is an expensive matter to have to shut down a modern high speed paper machine to make repairs or adjustments. The product, namely, 110 tons of paper at $65 per ton, is worth $7,150 per day, or approximately $298 per hour. Also, a large amount of capital investment and labour charges are continuing at their regular rate and no paper is being produced. With these things in mind, the machine builder is forced to more modern designs, which are more expensive. Still, the paper maker objects to the additional cost of the paper machine, particularly so when business is not good and profits are small. Economies of operation, therefore, become more and more important and the paper maker now, more than ever, is searching for machinery that will make economies possible.

Conclusion

This paper has shown the saving of steam in one particular case brought about by the use of the vacuum dryer. The paper machine at Kenogami was better than the average paper machine before the installation of the vacuum dryer, and still a saving of steam of 43.8 per cent is indicated by the substitution of the vacuum dryer. Savings due to the cost of felts can only be estimated. In a vacuum dryer, the felts are only half as long as on a standard dryer section of the same capacity, and they operate at an average temperature of less than 110° F. against, say, 170° F. on a standard dryer. They run dry, not wet, due to the fact that vapour formed under them is always slightly superheated. It is estimated that dryer felt costs per ton of paper in the case of the vacuum dryer will be one-fourth to one-third of the cost in the case of the standard dryer section. Actual data on this subject will be available only after sufficient time has elapsed to get such data at Kenogami.

Considerably less floor space, hence building cost, is required for a vacuum dryer. The distance from the wet end to the dry end of the paper machine is much less, making the machine easier for the machine crew to operate. The humidity and heat of the machine room is eliminated and working conditions very greatly improved.

Study of the Flow of Gases in Reverberatory Furnaces

With a Short Account of the Chemistry of the Reverberatory Smelting of Copper Concentrates

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Paper to be presented at the Annual General Professional Meeting of The Engineering Institute of Canada, at Montreal, Que., February 14th to 16th, 1928

The object of this paper is to present methods of investigation into the manner of working of reverberatory furnaces.

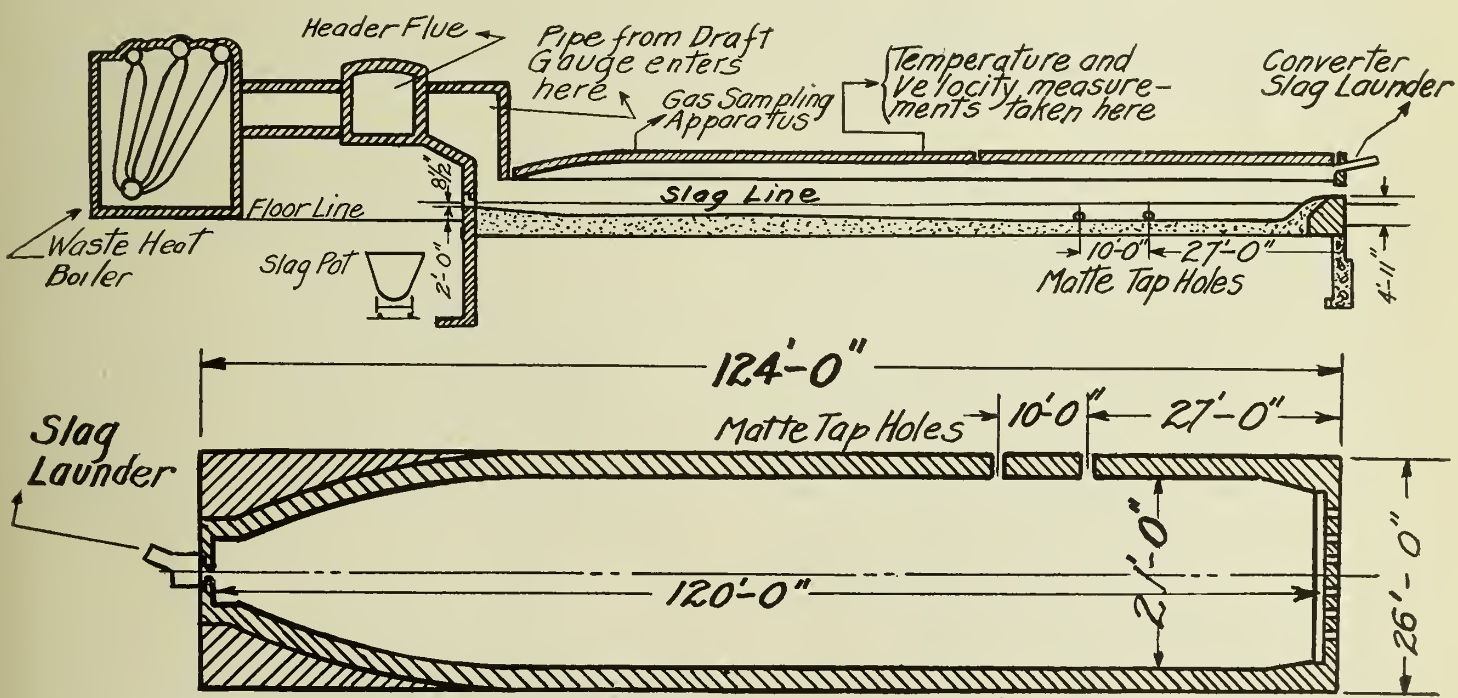
The type of furnace studied is a long furnace, shown in plan and vertical section by figures Nos. 1 and 2. This form of furnace is the standard type used in western American copper smelters. In considering the gaseous atmosphere of a furnace of this type, regard must be taken of the gas evolved from the charge on the hearth. Some who read this may not bear this fact in mind and may be puzzled at the difference in the products of combustion of fuel oil and the exit gases of copper smelting furnaces. Everything set forth below is directly traced back to first principles. Any blind reliance on formula tends to distort the judgment and gives rise to error. A correspondent in one of the recent issues of " Power " cites the case of a consultant who rejected certain gas analyses because their total contents of CO_2, O_2 and CO did not total to 20 per cent. The fuel used happened to be fuel oil and not coal.

As principles are always better understood when referred to concrete examples illustrating their operation, in endeavoring to describe the movement or circulation of gases in a furnace results of actual measurements will be given.

In the design of a furnace of the type shown in figures Nos. 1 and 2, as regards the interior shape, there are two things to consider: (1) a proper size of combustion chamber at one end of the furnace, and (2) the correct ratio of furnace width to depth at the discharge end or waste gas port, that is, the proper height for a given width of furnace, so that a lively flow of gas may take place along the hearth. This will be discussed under the head of " Reverberatory furnaces considered as hydraulic reservoirs " below.

Chemistry of Reverberatory Smelting

For the better understanding of the computations which follow, as well as for its general interest, an explanation of the smelting process itself is given. Coarse ore is suitable for blast furnaces, but fine ores have to be treated in reverberatory furnaces. In the former, fine ores or furnace products have been smelted as briquets or sintered with coarser ore. Generally, fine ores are smelted in reverberatory furnaces. Flotation concentrates previously dried or roasted in Wedge mechanically rabbled furnaces are charged to the reverberatories at a temperature of 450° F. when the material has only been dried, or 850° F. when it has been roasted. The furnaces were not originally intended to serve as roasters, consequently the charge is not



Figures Nos. 1, and 2.—Longitudinal Section and Plan of Reverberatory Furnaces Nos. 1, 2 and 3.

Furnace No. 4 is 24 x 120 feet. Cross-sectional areas above slag line are as follows:—

	Furnace No. 1283	Furnace No. 4
Near bridge wall	126 sq. ft.	149 sq. ft.
Centre of furnace	101 "	135 "
At verb arch	38 "	58 "
Uptake	42 "	52 "
Head flue	78 "	78 "

Material Charged	Weight in Pounds	Composition Per Cent (Gold and Silver in oz. per ton)							
		Silver	Gold	Copper	Silica	Alumina	Iron	Lime	Sulphur
"Calcines"	2,462,500	1.15	0.03	30.15	9.4	2.7	24.0	2.5	21.5
Flue Dust—(Custom)	32,170	1.42	0.036	8.28	20.78	6.42	24.0	3.0	10.48
Flue Dust—Reverberatory	11,165	1.50	0.030	20.06	11.35	4.17	14.78	1.03	8.52
Flue Dust—Converter Cottrell	12,450	2.76	0.015	43.5	14.6	3.8	7.1	0.9	10.6
Liquid Converter Slag	920,644	0.125	trace	3.20	21.4	3.4	FeO, 66.5	....	1.7
Material Produced									
Flue Dust	11,450	1.45	0.027	19.46	13.62	4.57	15.93	0.88	7.55
Matte	1,882,870	1.79	0.04	42.76	....	....	28.8	....	25.1
Slag	1,609,000	0.022	trace	0.60	33.0	7.6	FeO, 47.0	6.5	0.6

as thoroughly rabbled as is usual in Wedge roasters. The fuel consumption is 3.93 gallons of oil per ton of calcine produced, and when drying only is carried on more fuel is required. As the charge is fine, the sulphur is oxidized at the surface only, hence when the fire is shut off the charge cools rapidly. Electrically driven cars convey the hot concentrate or " calcine " to the furnaces. These cars have a capacity of about 20 tons. The cars dump into hoppers near the bridge wall of the furnace. The material charged into the furnace is dropped through the roof at intervals along the sidewalls. A drag chain operating in a rectangular housing, (see figure No. 3), conveys the " calcine " to the various charge pipes through which it drops. The " calcine " lies in a bank against both sidewalls, and as it smelts

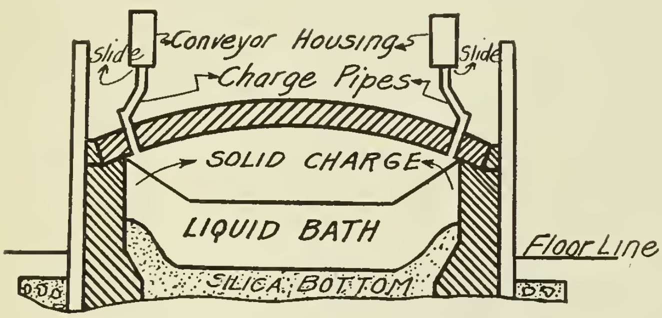


Figure No. 3.—Cross-section near Bridge Wall.

it runs down to the centre of the furnace, forming a liquid bath of two layers. The top layer is the slag and the bottom layer the matte. The chemical composition of a typical " calcine " is, copper 31 per cent, silica 11 per cent, alumina 5 per cent, iron 21 per cent, lime 1.5 per cent and sulphur 23 per cent. The upper layer of the liquid bath, the slag, has the following composition:—copper 0.59 per cent, silica 33.8 per cent, alumina 10.3 per cent, lime 7.4 per cent, sulphur 0.4 per cent, ferrous oxide 43.9 per cent. The matte layer of the bath contains practically all of the copper, its composition being, copper 41 per cent, iron 31 per cent, sulphur 25 per cent. Thus it will be seen that the non-metallic minerals have been formed into a slag carrying with it a certain quantity of iron. A concentration of the copper bearing minerals has taken place by virtue of a partial elimination of sulphur and oxidized iron entering the slag.

The material balance, using monthly figures and reducing them to a daily basis, is given below:—

The above charges and products represent the work of two furnaces.

A typical converter slag has the following composition:—Cu_2S 3.75 per cent,* FeS 2.07 per cent,* FeO 45.00 per cent,* Fe_3O_4 20.7 per cent, AL_2O_3 5.40 per cent, SiO_2 22.40 per cent. The specific gravity of converter slag is 4.24.

* Calculated.

Mattes contain about 7 per cent Fe_3O_4 and furnace slags about 5 per cent. Matte has a specific gravity of 4.92 and furnace slag 3.27. Magnetite† may contribute to the loss of copper in the slag, for it appears to aid in forming a blanket on top of the matte and under the slag, thus preventing the suspended matte particles in the slag from penetrating to the matte bath.

The slag, being a waste product, is skimmed off and conveyed to the dump. The matte is tapped from the furnace into ladles and poured into Bessemer converters. Silica is added for a flux and the charge is blown to an impure bullion known as " blister copper." During the Bessemerizing, iron and silica form a slag. As this slag carried 2 to 3 per cent copper, it is poured in the liquid state into the reverberatory furnaces for settling out the values. This Bessemer slag provides iron for fluxing the siliceous portion of the solid charge in the furnaces.

In the smelting process, 30 per cent of the sulphur in the charge is oxidized or about 138 pounds per ton of " calcine " treated. Most of the sulphur oxidized is first distilled from the charge and then combines with oxygen according to the reaction:—

$$S + O_2 = SO_2 \ (1)$$

After the distillation of the volatile sulphur, we have the following reaction:—

$$14\ FeS + 21\ O_2 = 14\ FeO + 14SO_2 \ (2)$$

The ferrous oxide formed in reaction (2) enters the slag.

Metallurgical calculations indicate that 65 per cent of the sulphur oxidized is accounted for by equation (1) and

† Specimen taken from a furnace bottom contained 8 per cent insoluble matter and had a specific gravity of 4.99.

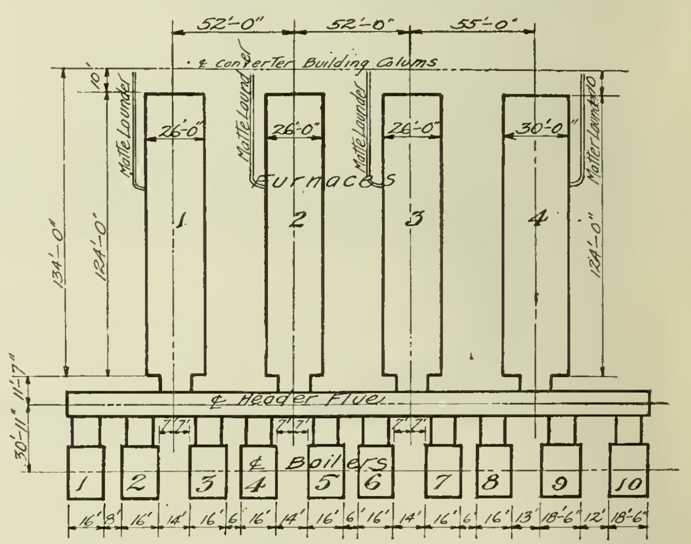
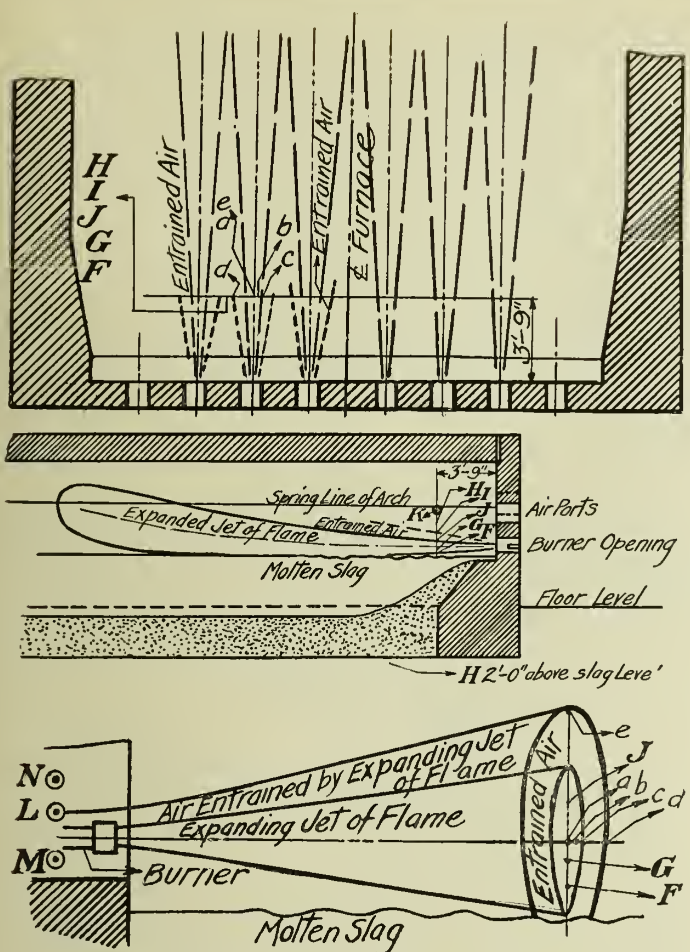


Figure No. 4.—General Plan showing Reverberatory Furnaces and Boilers.



Figures Nos. 5, 6 and 7.—Extended Jets of Flame.

35 per cent by equation (2). The amount of oxygen required is 1.17 pounds per pound of sulphur oxidized. Small amounts of iron are expelled possibly as ferric sulphate and pass off as fume.

When the concentrate is merely dried before smelting, 30 per cent of the sulphur in the charge is oxidized. When the concentrate is partially roasted, less oxidation of sulphur takes place in the reverberatory furnaces.

Combustion of Oil

The furnaces are oil fired. About 35 per cent of the heat value of the oil is recovered as usable steam in waste heat boilers. The oil used has the following composition:—hydrogen 10.2 per cent, carbon 84 per cent, sulphur 3.22 per cent, oxygen 1.29 per cent, nitrogen 0.3 per cent, ash 0.06 per cent, moisture 0.93 per cent. This oil, when burned in the furnace, gives the following products per pound, including the gas evolved from the charge:—

Water vapour	18.3 cu. ft.
Carbon dioxide	25.94 " "
Sulphur dioxide	4.69 " "
Nitrogen	156.29 " "
Total	205.22 cu. ft.

The volumes are given under standard conditions, i.e., 0°C and 760 mm. of mercury pressure.

The figures obtained by an evaporation test are here quoted. They are not typical of present conditions, for the heat recovered as usable steam is slightly over 40 per cent of the heating value of the oil burned in the furnace. The results are for an eight-hour test. The exit gas from the furnace tested* passed into two waste heat boilers.

* No. 1 Furnace. (See figure No. 4.)

Temperatures—Degrees F.

Gases Leaving Reverberatory Uptake	Gases Entering Waste Heat Boiler No. 2	Gases Entering Waste Heat Boiler No. 3
2212°	1731°	1783°
Gases leaving	665°	685°

Composition of the Gases.

	$CO_2 + SO_2$	O_2	CO
Entering boiler No. 2	11.41	7.20	—
" " No. 3	12.02	6.32	—
Leaving boiler No. 2	9.86	9.16	—
" " No. 3	10.86	7.38	—
" reverberatory uptake	13.62	4.53	—

Oil consumed at 60° F., 39,032 pounds. The total water Air openings at bridge wall, 10.4 square feet.

Oil consumed at 60° F., 39,032 lbs. The total water evaporated was 269,915 pounds from and at 212° *F.* or 7.75 pounds per pound of oil burned in the furnace. The water actually evaporated per pound of oil at boiler pressure was 6.92 pounds.

Tonnage smelted—"Calcines"	144.4 tons
Dust	7.0 "
Total	151.4 "

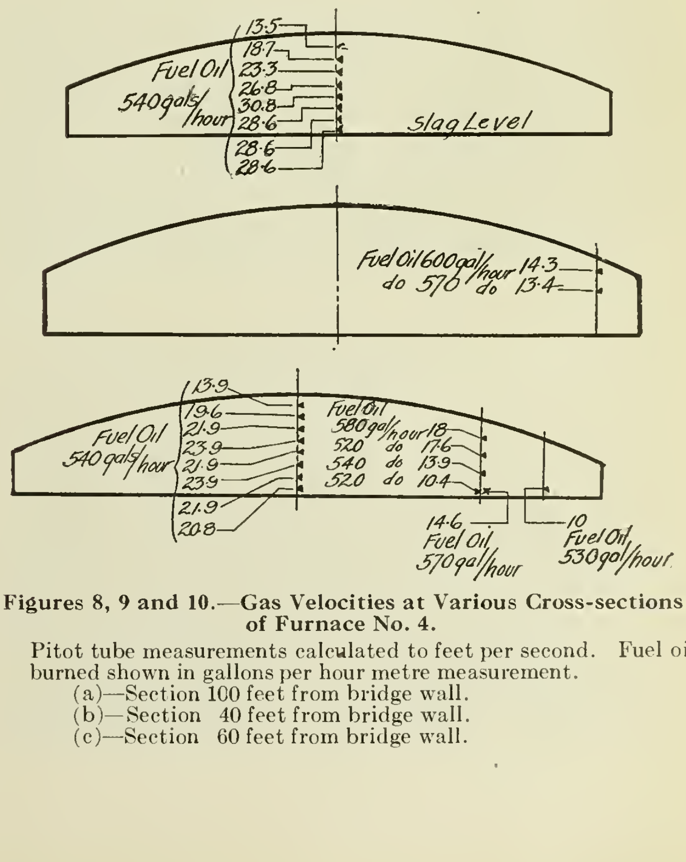
Comparison of Volume of Air Consumed per Pound of Fuel, and Products of Combustion

If just enough air be used to burn completely one pound of oil of the composition stated above, the gaseous products will occupy a volume which is 9.1 cubic feet in excess of that of the air consumed. Bearing in mind that the oil contains 0.102 pounds of hydrogen, occupying in the gaseous state 18.2 cubic feet, (at 0°C and 760 mm. pressure), we have,—

$$2 \text{ volumes} + 1 \text{ volume} = 2 \text{ volumes}$$
$$2H_2 + O_2 = 2H_2O$$
$$18.2 \text{ cu. ft.} + 9.1 \text{ cu. ft.} = 18.2 \text{ cu. ft.}$$

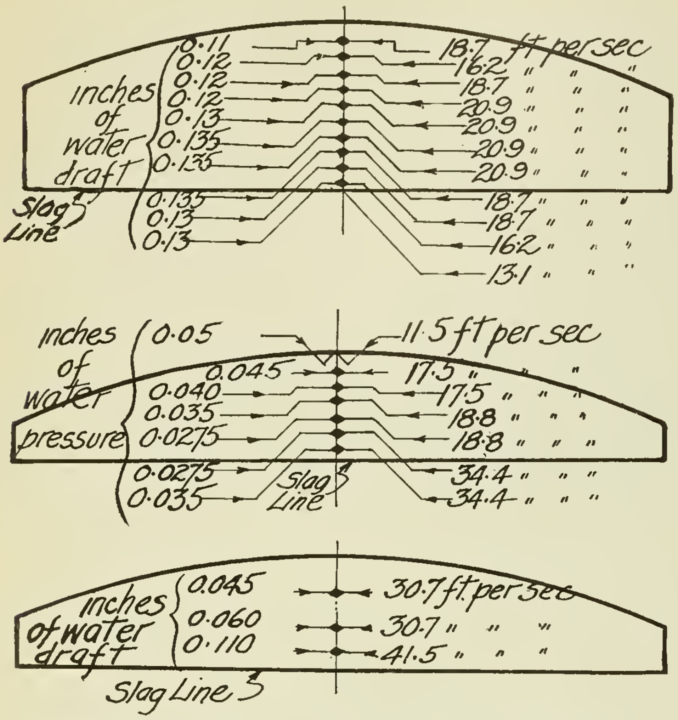
and the increase in volume as between air and products of combustion is evident.

In making analyses of furnace gases the total percentage of the oxide gases does not come to 20.7. Owing to the presence of hydrogen in fuels, there is an apparent



Figures 8, 9 and 10.—Gas Velocities at Various Cross-sections of Furnace No. 4.

Pitot tube measurements calculated to feet per second. Fuel oil burned shown in gallons per hour metre measurement.
(a)—Section 100 feet from bridge wall.
(b)—Section 40 feet from bridge wall.
(c)—Section 60 feet from bridge wall.



Figures 11, 12 and 13.—Gas Velocities and Pressures at Various Depths 100 feet from Bridge Wall.

Depth 100 feet from bridge wall.
Furnace No. 3—(a)
" " 2—(b)
" " 1—(c)

shrinkage, bringing the total below 20.7 per cent. In figure No. 19 are shown different analyses by the Orsat-Muencke apparatus corresponding to different percentages of excess air. Numerical values in cubic feet per pound of fuel are given in table No. I.

High Pressure Air for Atomizing Oil and Secondary Air for Combustion

For atomizing oil, air at a pressure of 12 pounds per square inch is used. The volume consumed is about 2,000 cubic feet per minute. If 70 pounds of oil be burned per minute, 11,600 cubic feet of secondary air per minute are necessary for combustion. This air is admitted through ports in the bridge wall. The air flow inward through these openings is not primarily a function of the furnace draught, but rather of the displacement. This, of course, does not mean that more air will not enter ports of a given area when the furnace draught is increased, but that the air will enter the ports whether there be a draught in the furnace or a small pressure.

Reverberatory Furnaces Considered as Hydraulic Reservoirs

An entirely new conception of furnaces in general has been stated by Professor Groume-Grjimailo of Petrograd. He considers a furnace as a hydraulic reservoir, the flow of the furnace gases being an inverted stream, bounded on the three sides by the roof and two sidewalls. An illustration of this theory is shown by figure No. 21. A model of a copper reverberatory furnace, made on a scale of 9/16 inch to the foot, having a glass side along a plane through the centre, was placed in a glass tank nearly filled with water. After expelling imprisoned air in the high portion of the model, a stream of kerosene, (coloured red by saturating it with iodine), was injected through three nozzles under a pressure of three inches of mercury. The kerosene displaces the water, flowing through the model and out by virtue of its difference in density as compared to water. The lower surface is free and its position depends on the shape of the furnace and the volume of fluid flowing. The water below the kerosene represents stagnant gas in the furnace. However, it does not of necessity follow that the inert gas has an essentially different chemical composition from the other portions of the furnace atmosphere, but rather that it is cooler. Thus, an up draught furnace is not the most efficient type where circulation of the gases is a matter of first importance, for there is always a tendency for the cooler gases to collect along the hearth. The reverberatory furnace with a drooping arch to some extent overcomes the above defect, for by sufficiently constricting the outlet the gas velocity can be made greater along the hearth. This is shown by figure No. 13.

Flow of Air Through Ports in the Bridge Wall and Its Distribution

The velocity of air flowing through ports and burner openings varies over the cross-section. In a port the velocity is greatest at the centre and smallest just at the wall. In a burner opening, the velocity is greatest just above the

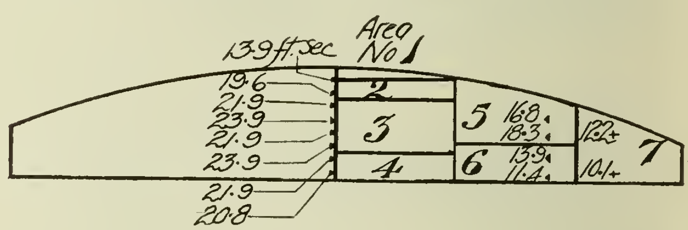


Figure No. 14.

burner. In measuring the velocities in ports and burner openings the central velocity only is read and a coefficient applied to obtain the average velocity. The coefficient of velocity for a burner opening is 0.955 and for the ports and slag openings 0.88.

The velocities of air flowing through different parts of ports and burner openings are shown in figures Nos. 16 and 17 and table No. 2.

Readings were taken inside the furnace with a Pitot tube of the form shown in figure No. 22. A different type of tube was used in the air ports. In taking readings in the furnace, two men work together, one reads the draught gauge and the other handles the tube. The man holding the Pitot tube must wear blue glasses to protect his eyes against the glare. These tubes stand up fairly well; however, they are not held in the furnace long enough to burn up.

The readings were taken in a vertical plane about 3 feet 9 inches inside the furnace from the bridge wall and parallel to it. Unfortunately, temperatures could not be obtained for obvious reasons. The centre of the flame will be cooler than the periphery, as will also be the entrained air. Hence, the velocities cannot be computed, but must be given as inches of water pressure.

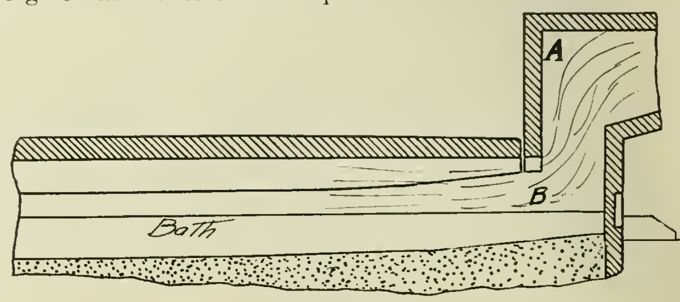
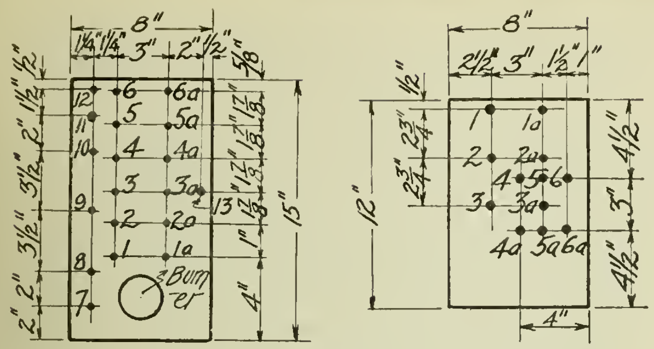


Figure No. 15.



Figures Nos. 16 and 17.—Velocities in Ports and Burner Openings.

After the air enters the furnace the distribution is shown in figures Nos. 5, 6 and 7 and table No. 3. The values shown in columns 2 and 3 of table No. 3 were obtained with Pitot tubes. A study of figures Nos. 5, 6 and 7 and of table No. 3 shows that the air lies as a fluid in a reservoir inside the bridge wall. It moves slowly, wrapping itself around the expanding jet of flame.

At the plane of measurement, (see figure No. 5), the maximum air movement is at the bath or slightly above it. Higher up the movement is somewhat sluggish. The point of lowest pressure in the whole furnace is the centre of the flame.

Measurement of Volume of Gases Flowing Through the Furnace

The discharge of gas at a furnace cross-section is comparable in volume to that of an ordinary river at its flood time. The measurements of velocity can be made with a fair degree of accuracy. This is hot and trying work. Pitot tubes made up of 1/8-inch pipe were used, being inserted in the furnace through openings cut in the arch. These Pitot tubes were compared with a tube obtained from the manufacturers, which was used as a standard. The home made type gave readings corresponding to velocities 1.24 times those obtained by the manufacturer's tube.* The latter was one of the forms that Mr. W. C. Rowse compared with a Thomas electric gas meter.† This particular form gave results 96.8 per cent of the values obtained by the meter.

* Comparison made in cooler gases, with temperatures not greater than 650° F.

† Trans., A.S.M.E., vol. 35, 1913, p. 633.

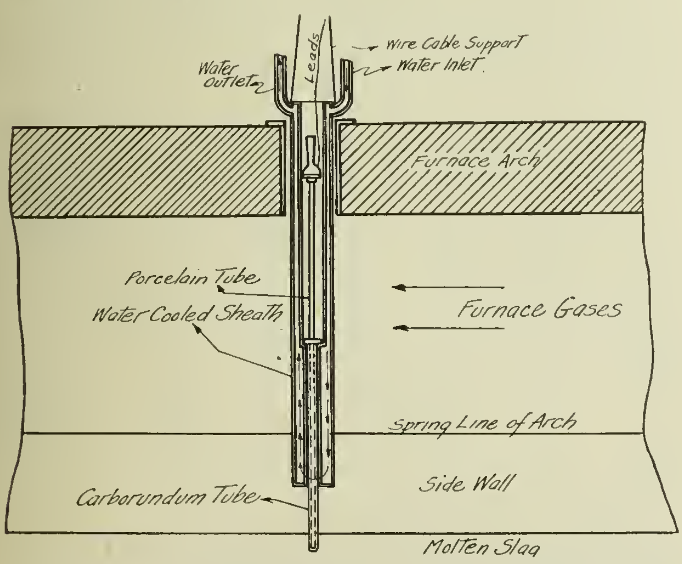


Figure No. 18.—Thermo couple Installation Furnace No. 4.

Now, the rough tube made from 1/8-inch pipe would have a coefficient of $\frac{1}{0.968 \times 1.24} = 0.83$.

The velocities given in figures Nos. 8, 9, 10, 11, 12, 13 and 14 have been corrected by this factor. The form of tube calibrated is shown in figure No. 22. On computing the discharge, (see figure No. 14), the flow is found to be 1,480 cubic feet per second at 670 mm. pressure,‡ and 2,250° F. temperature. Reduced to standard conditions, the discharge is 236 cubic feet per second, (0° C and 760 mm.).

To check this figure, let us calculate the volume of gas flowing from the known rate of fuel consumption. In case the different value here assigned to the volume of the products of combustion of one pound of oil, compared to the value given elsewhere in this article, are confusing, it may be pointed out that the difference consists in the amount of gas evolved from the charge. At the time these velocity measurements were taken the volume of gas produced by burning one pound of oil was 197.73 cubic feet, (0° C and 760 mm.). Of course, a greater volume of gas would exist with the presence of excess air. The fuel consumption was 1.1 lbs. oil per second and the gas contained one per cent of oxygen.* With this amount of free oxygen present there

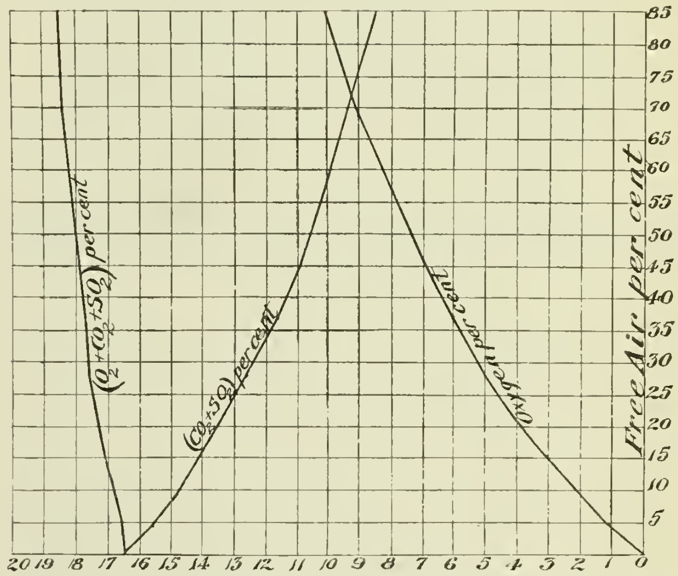


Figure No. 19.—Composition of Furnace Gases with Varying Amounts of Free Air.

Calculated Orsat values based on a fuel ratio of 0.906 barrels oil per ton of solid charge and sulphur oxidation of 30 per cent. These values will vary somewhat with the fuel ratio, lime rock in the charge oxidation of sulphur in the furnace and composition of the fuel oil.

are 197.73 plus 9.05, (excess air), or 206.78 cubic feet of gas produced from burning one pound of oil. Hence 1.1 pound of oil when burned would produce 227.5 cubic feet of gaseous products, which at the furnace temperature and pressure would occupy 1,425 cubic feet.

Flow of Air Into the Furnace

The flow of air into the furnace is confined to the bridge wall. We have not any evidence of air infiltration in the furnace, simultaneous gas analyses in two different locations revealing identical results. This is due to a crust-

‡ At the altitude of the furnaces, atmospheric pressure is 670 mm.

* This figure was obtained by the Orsat-Muencke apparatus. It is higher than the actual value because of the condensation of water vapour in the apparatus.

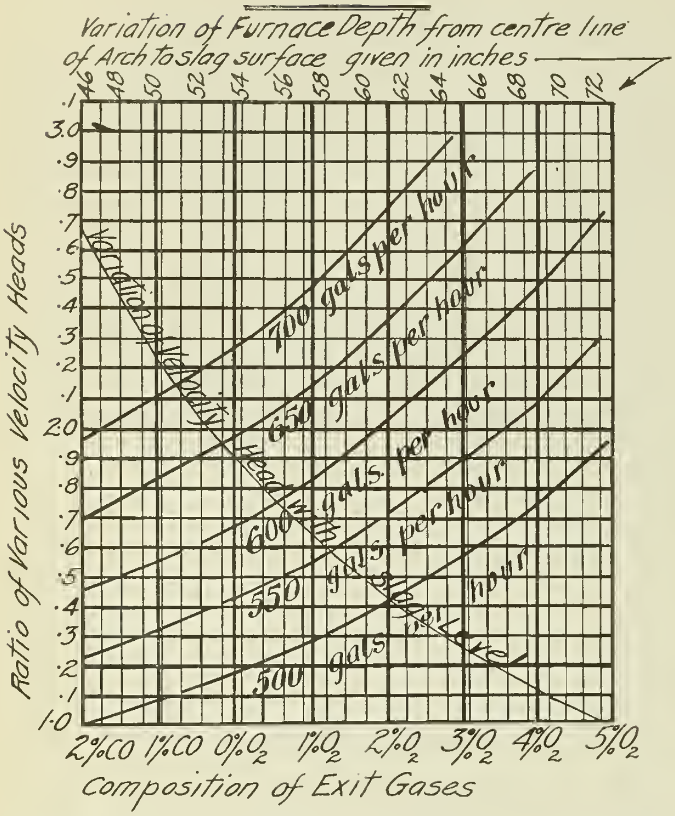


Figure No. 20.—Chart showing Variations of the Force of Velocity Head Required to Remove Furnace Gases Corresponding to Variations in Furnace Depth, Fuel Consumption and Chemical Composition.

ing over of the interior surface of the furnace and the small draught depression within. In general, some leakage at charge pipes in the roof has been found to exist, but it is negligible as to volume. The measurements were taken with a Pitot tube, and the form of tube used was later compared to a standard form and a factor determined, (see figure No. 23). To insure flexibility, a larger number of air ports was provided in the furnace bridge wall than was needed for the existing fuel consumption. The air flow into the furnace is controlled by partially closing up the ports by loose brick or removing them as desired. The opening for the introduction of converter slag has been changed from the furnace roof to the bridge wall.

The volumes given below are computed to standard conditions, viz., 0°C and 760 mm. pressure.

6 burner openings..............	4.85 sq. ft.	103.5 cu. ft. air per sec.
Airports	2.24 " "	34.6 " " " " "
Opening in bridge wall for converter slag launder..........	3.98 " "	54.3 " " " " "
Blast for atomizing the oil....		32.2 " " " " "
Total volume of air entering furnace through the bridge wall		224.6 " " " " "

The measurement of air temperatures in the ports and burner openings presented some difficulty. Approximate data were secured by a base metal thermocouple surrounded by a metal housing covered by asbestos. The air flow into the port was not seriously impeded by the housing, which served to protect the thermo couple from the radiant heat of the flame. The device is shown in figure No. 25. The form of Pitot tube used in the blast pipe is shown in figure No. 24. The tube extends across the whole internal diameter of the pipe. The average velocity pressure over the whole cross-section will be read on the manometer.

Furnace Temperatures

The apparatus used is shown by figure No. 18, and the results are given in table No. 4. The heat transfer at this point is by convection of the hot gases. The difference between the temperature of the slag and the gas stream was 120° F. At this point, a reading with the Fery total radiation pyrometer on the slag, sighting through the roof, was 2,130° F., while the reading with the thermocouple was 2,125° F. Probably heat transfer by radiation takes place from the roof to the slag bath at this point.

Temperatures have been observed with a Fery total radiation pyrometer on the interior walls of the furnace at three different positions.

Sighting through an Opening in the Side Wall		Sighting through an Opening in Uptake Wall	Bath 100 ft. from The Bridge Wall*
37 ft. from Bridge Wall	73 ft. from Bridge Wall		
2480°F	2360°F	2185°F	2210°F

Furnace conditions at the time of making the observations were:—fuel burned, 430 barrels per day, (1 bbl. = 335 lbs.); solid charge smelted, 638 tons; composition of the gas stream, (sample taken 100 feet from the bridge wall), CO_2 and SO_2 16.2 per cent, O_2 0.8 per cent, CO none. The furnace at this time was being forced.

The temperatures taken with the Fery pyrometer are the temperatures of the furnace walls. It is probable that the differences in temperature between the walls and the gas stream at the three positions given above, viz., 37 feet, 73 feet from the bridge wall, and the furnace uptake are 130°F., 115° F. and 75° F. respectively.

Draught Depression Necessary to Remove the Products of Combustion

By reference to figure No. 1, longitudinal section, it will be seen that the gases in leaving the furnaces pass through vertical uptakes. *Here it has been noted by the writer that the velocity head of the flowing gas, (as computed in inches of water pressure), equals about 70 per cent of the draught depression. Within limits, the draught can be adjusted to changed conditions by applying the factors given in figure No. 20.*‡ In applying these ratios, the press-

Observed Data				Computed Data	
Example No.	Per cent Oxygen in Exit Gases	Draft in Inches of Water	Oil Burned in Gallons per Hour	Per cent that velocity Head is of Draft	Draft required when 1% O_2 is desired in exit gas and 600 gallons of oil per hour are burned.
Col. 1	Col. 2	Col. 3	Col. 4	Col. 5	Col. 6
1	1.7	0.130	600	74.4	0.100
2	1.0	0.120	600	75.3	0.099
3	2.4	0.090	550	79.8	0.093
4	2.0	0.105	590	75.8	0.099
5	1.1	0.080	520	70.6	0.105

* Sighted through the furnace roof.

‡ The factors given in figure No. 20 are ratios of velocity heads. Since the draught is 1.43 times the velocity head of the gases, we can use the factors of figure No. 20 as draught ratios also.

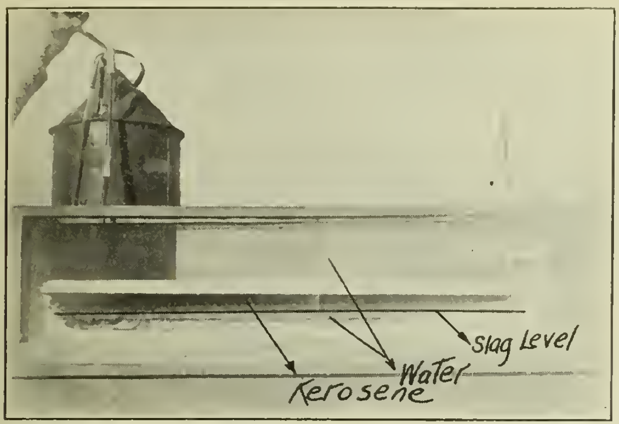


Figure No. 21.

ure of the fuel oil, volume of atomizing air and area of ports in the bridge wall must be kept constant. A few examples are given below from a series of observations extending over thirty days:—

The values listed in column 6 should be constant. For instance, let us take example No. 3 and calculate a draught to give an exit gas containing one per cent oxygen for a fuel consumption of 600 gallons of oil per hour. More gas will be generated, and from figure No. 20 we find that the increase in velocity head will be $\frac{1.77}{2.11}$. If one per cent oxygen be present, as the computation calls for, the velocity head will be less. This decrease is expressed by the ratio $\frac{1.82}{2.11}$. The computation is completed by multiplying the observed draught by the two factors,—

$$0.090 \times \frac{2.11}{1.77} \times \frac{1.82}{2.11} = 0.093$$

The method of computation assumes a constant relationship between draught and velocity head. The assumption is a rough approximation, as will be seen by referring to column 5 of the table above. The relation between draught and velocity head will vary with differences in level of the furnace bath. For a pronounced decrease in the cross-sectional area of the furnace at the verb arch, i.e., just under the uptake, more draught depression will be necessary. If this area be less than the uptake, the flowing gas stream will probably be smaller in cross-section than the uptake shaft. If it were possible to record the difference in draught between points *A* and *B*, figure No. 15, the ratios in figure No. 20 would apply directly. The draught difference between these two points is approximately equal to the velocity head of the flowing gases.*

The author has heard of a case where the throat of the furnace, (opening at entrance to the uptake), was enlarged by radically increasing the depth from arch to the bath. The roof was given an upward slope towards the uptake. The experiment had the disastrous result of freezing the furnace at the end so that slag could not be tapped. This result can be explained as due to stagnant cooled gases collecting at this part of the hearth.

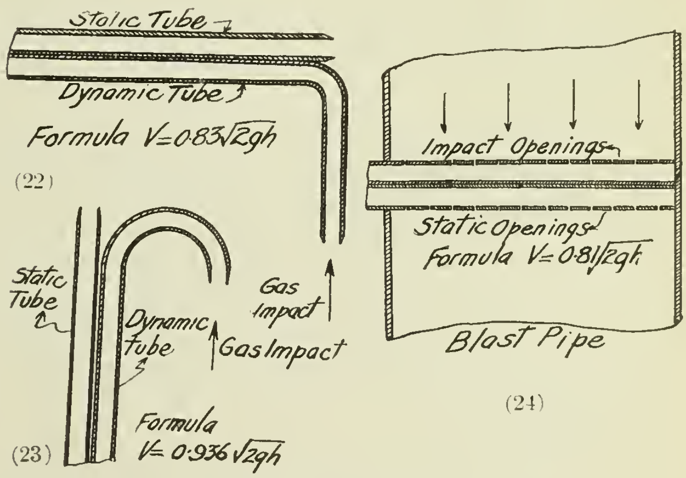
Some metallurgists are of the opinion that a longer flame increases the smelting zone of the furnaces. Generally, however, the practice has been to carry a flame about one-quarter to one-third the length of the furnace. In the case of the longer flame, the temperature of the flame will be lower than that which would be obtained with a shorter flame, i.e., for equal fuel consumption. Some means of determining directly the heat radiated by a flame would be of great benefit in solving such problems.

Figure No. 11 shows the velocities in a furnace operated with a relatively high draught. It will be noticed that the maximum velocity lies well above the slag level. In figure No. 12 the furnace, owing to a shortage of draught, was working under a pressure, and the maximum velocity of the gases lies along the slag. Similarly, in figure No. 13, the maximum velocity lies along the hearth, although the furnace is working under an ample draught. In the case of the furnace shown in figure No. 13 the velocity distribution is due to constriction.

In connection with heat transfer, if we might assume the same temperature difference between roof and slag surface and between slag surface and flowing gases in the case of, say, figures Nos. 11 and 13, the heat transfer will be greater in figure No. 13 than in figure No. 11, the transfers being approximately in the ratio 1.19 to 1 as regards the heat transmissions by convection from the gases to the bath in the two furnaces.

Most of the charge smelted in the furnace is consumed in the first 35 feet of the furnace length. While the matte and slag formed, say, from a pound of charge contain 795 B.t.u., we know from temperature measurements that the heat absorbed from the hot gases in the remaining portion is only 49 B.t.u. per pound of charge smelted. During the process, chemical reactions occur which liberate a large amount of heat. This amounts to 367 B.t.u. per pound of charge, leaving 428 B.t.u. to be supplied by the combustion of fuel. Evidently $\frac{428 - 49}{428} \times 100 = 88$ per cent of the heat is received by the charge in the first 35 feet of furnace

*This is merely another way of saying that the rate of gas flow is proportional to the difference in hydrostatic head between points *A* and *B*.



Figures Nos. 22, 23 and 24.—Measurement of Velocity Pressure.

Velocity pressure is the differential pressure between the static and dynamic tubes of the Pitot tube.
Pitot tubes $V = c\sqrt{gh}$

$h = 5.2\,\frac{p}{w}$ where p = velocity pressure in inches of water.

c = a coefficient, w = weight 1 cubic foot gas. The weight of 144 cubic inches of water is 5.2 pounds.

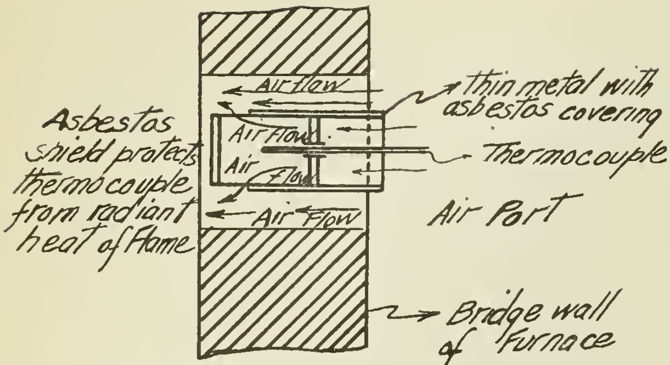


Figure No. 25.—Measurement of Secondary Air Temperature at Bridge Wall.

length. This is the flame swept portion. The approximate overall thermal efficiency of the furnace may be arrived at as follows:—heat value of oil used per pound of charge, 2,360 B.t.u., (0.127 pound of oil at 18,500 B.t.u. per pound); heat received by the charge 428 B.t.u.; hence thermal efficiency is $\frac{428}{2360} \times 100 = 18$ per cent. This comparatively small utilization of heat is due to the high working temperature within the furnace. The temperature difference between the hot gas or flame and the liquid bath is not great, consequently, the gases leave the furnace carrying away practically all the heat generated.

Conclusions

(1) The reverberatory furnace as at present operating consists of two zones: a smelting zone and a settling zone.

(2) No draught depression is necessary in the uptake. The products of combustion will of themselves flow out of the furnace. The author, in operating a small reverberatory furnace which was not connected to a stack, has noticed a perfect evacuation of gas while a pressure existed in the upper portion of the furnace. The plane of atmospheric pressure in this experimental furnace was very close to the hearth.

(3) A high gas velocity along the hearth means a high rate of heat transmission there. An objection to high draught is the fact that the gases flow with greatest rapidity in the centre of the furnace, (see figure No. 11), and the cooler gases move at a lower speed along the hearth.

(4) The increased rate of smelting of hot calcine is not solely due to the difference in heat content of the calcine charged. The hotter charge has a flatter angle of repose, and an effect noticed with hot calcine is that it spreads somewhat towards the centre. This statement does not apply generally, but only with side charging, as illustrated by figure No. 3.

(5) Recent experience in reverberatory smelting seems to indicate that with the burning of larger quantities of oil in unit time the fuel economy is increased. This emphasizes the relation of heat transfer in the two zones of the furnace, as outlined above. Bearing in mind the immense heat transfer taking place by radiation, it would seem advantageous to increase the temperature of the flame to a maximum, and push the charging of the furnace. The extra heat developed in the furnace would not necessarily increase the temperature of the uptake, but would exert itself chiefly in the liquefying of the material charged.

(6) The burners should be placed well above the bath, and pointing down, say 10°, so that the bottom of the flame comes within a foot of the bath. The combustion chamber should be high enough to avoid having the flame lick the roof. Beyond the tip of the flame the roof should be depressed to force the gases down to the bath.

The author is indebted to Mr. H. W. Mossman, an associate, for his kind co-operation and assistance in making observations to obtain certain portions of the numerical data used in this paper.

Draught and Velocity Head and Force and Velocity Head*

The paper is written from the standpoint of hydraulics and hydrostatics.

Coming back to Newton's laws, we see that for a given mass a body is accelerated in direct ratio to the applied force. This holds in both a positive and negative sense. Thus, when a body is brought to rest a retarding force is applied that is proportional to its velocity. When inserting a Pitot tube in a gas stream, we bring a small portion of the gas to rest, i.e., rob it of its speed. The impact is measured by a manometer. The result, when expressed as feet of gas, is called the velocity head, although it is also spoken of as such in inches of water.

The gas has, say, a velocity head of 0.10 inches of water. If the specific weight of the gas be, say, 0.02 pounds per cubic foot, the velocity head of the gas will be $\frac{5.2 \times 0.10}{0.02} = 26$ feet. The velocity will be

$$v = \sqrt{64.32 \times 26} = 41 \text{ feet}$$

per second. A body falling 26 feet attains a velocity of 41 feet per second when acted on by gravity. It possesses a momentum of, say, $0.02 \times 41 = 0.82$ foot-pound-second units, (if we conceive of one cubic foot of gas in a weightless container), falling 26 feet. If the gas flow be stopped, this momentum is brought to zero and by a certain force, hence the force has been originally applied. It is equivalent to the loss in static pressure from position to position in the furnace less the friction. That is why velocity head and force are used synonymously in figure No. 20.

If we notice the draught to be, say, 0.10 inch of water and the velocity head, say, 0.07 inch of water and this relationship exists in a rough way with a fair degree of consistency, there can be no objection to making one the measure of the other. That is the method used in this paper in computing draughts by applying the ratios in figure No. 20.

Table No. 1.—Free Oxygen and Excess Air.

Percentage O_2 by Orsat Apparatus	No. of Cu. Ft. free O_2 per lb. of Oil Burned	No. Cu. Ft. of Excess Air per lb. Oil Burned	Excess Air in the Exit Gases per cent.
1	1.97	9.44	4.6
2	4.14	19.80	9.65
3	6.66	32.00	15.60
4	9.26	44.5	21.70
5	12.30	58.0	28.30
6	15.76	75.55	36.80
7	19.70	94.50	46.10
8	24.98	120.00	58.60
9	29.70	142.50	68.50
10	36.00	172.90	84.40

* Author's note.

Table No. 2.—Distribution of Velocities in Ports and Burner Openings.

Burner Openings		Air Port	
Position (Refer to Fig. 16)	Velocity Head Inches of water	Position (Refer to Fig. 17)	Velocity Head Inches of water
1	0.31	1	0.049
2	0.285	2	0.095
3	0.245	3	0.101
4	0.215	4	0.101
5	0.20	5	0.095
6	0.13	6	0.075
7	0.14	....	....
8	0.23	....	....
9	0.215	....	....
10	0.235	....	....
11	0.24	....	....
12	0.12	....	....
13	0.186	....	....

Table No. 3.—Distribution of Gas Velocities in Furnace.

Position (Refer by Letter to Figs. 5, 6 & 7)	Velocity Head Inches of water Pressure	Static Head Inches of water Draft	Static Head in Furnace Uptake inches of Water Draft
a	2.00	0.37	....
b	0.67	0.27	0.08
c	0.24	0.21	....
d	0.03	0.16	to
e	0.025	0.16	....
G	0.23	0.155	0.09
H	0.02	0.14	....
I	0.015	0.145	....
J	0.02	0.145	....
F	0.14	0.16	....
K	0.003†	0.105	....
L	0.31*	....	0.10
M	0.14*	....	to
N	0.245*	....	0.11

Table No. 4.—Temperature Observations in a Reverberatory Furnace 60 Feet from the Bridge Wall. Rate of Smelting 549 Tons per Day. Fuel Consumption 321 bbls. at 60° F., Furnace Hearth 25 by 120 Feet.

Date	Time	Distance in Inches below Inside of Arch at Centre	Temperature Degrees F.	Remarks
1925				
Apr. 3rd.	11.15 a.m.	at arch	2,190	Slag Surface to
.....	to	6 ins. inside	2,210	arch 52 inches.
.....	11.30 a.m.	12	2,230	Observation with
.....	....	18	2.240	Fery total radiation
.....	....	24	2,250	pyrometer on slag
.....	....	30	2,260	at point half way
.....	....	36	2,265	between side wall
.....	....	42	2,265	and centre of fur-
.....	....	2½ ins. in slag	2,160	nace 2,145°F. This
.....	2.07 p.m.	at arch	2,190	indicates a percep-
.....	....	6 ins. inside	2,190	tible cooling to-
.....	....	12	2,210	wards the side wall.
.....	....	18	2,220	
.....	....	24	2,230	
.....	....	30	2,235	
.....	....	36	2,240	
.....	....	42	2,245	
.....	....	48	2,245	
.....	....	2½ ins. in slag	2,125	1.58 p.m. reading with a Fery total radiation pyrometer sighted on the slag 2,130° F.

† Reverse flow.

* These values will be approximately equal to the static head. Towards the wall of a port where the flow is retarded, the static head is about 30 per cent greater than the velocity head.

THE

ENGINEERING JOURNAL

THE JOURNAL OF
THE ENGINEERING INSTITUTE
OF CANADA

VOLUME XI JANUARY 1928 No. 1

Ask the Member Who Has Attended

It is not sufficient to-day that a theory is sound,—everything must be put to the test before acceptance. This applies to the new piece of machinery, the new method of construction, and, in fact, to all inventions and discoveries. It also applies to affairs affecting the individual, such as his membership in various organizations and his subsequent interest in their activities.

The test so far as the Annual Meeting of The Institute is concerned has often been made,—in fact, it is made each year,—and to-day these meetings are acknowledged as among the most interesting and valuable to the individual member of any such assemblies held by technical associations.

This is the verdict of those who have attended recent Annual Meetings of The Institute,—ask the member who has attended.

The question of the value of membership in The Engineering Institute of Canada was dealt with in this column in the December issue of the Journal, and the article quite naturally included mention of certain benefits to be derived from attendance at the Annual General Professional and other Professional Meetings, stressing particularly the value of close association with other members of the profession and the resultant bonds of friendship which are established.

This is one valuable feature of our meetings, but, valuable as it is, the holding of a meeting with friendly intercourse as its primary purpose would not completely fulfil the objects of an engineering society. The Annual Professional Meetings of The Institute have as their main purpose the interchange of professional knowledge among the members, and to this end papers on important subjects of current interest, carefully prepared, printed in advance, briefly outlined by the authors at the sessions at which they are presented, and thoroughly discussed, occupy a considerable part of the time of the meeting.

The papers to be presented at the meeting in Montreal in February cover a wide range of subjects of interest to members engaged in nearly every branch of the profession. Two of these papers appear in this issue of the Journal; others will be published in the February number, while the remaining papers will be printed in advance and published in a later issue. In this way all papers to be presented and discussed at the February meeting will be available in advance, so that members will have ample time to prepare their views in the form of oral or written discussions on the various papers.

Discussion of Annual Meeting Papers Invited

The papers on the Uniflow Steam Engine, by A. E. Allcut, M.E.I.C., Associate Professor of Mechanical Engineering, University of Toronto, and the Flow of Gases in Reverberatory Furnaces, by W. K. Thompson, A.M.E.I.C., of New Brunswick, N.J., which appear in this issue of the Journal are to be presented at the Annual General Professional Meeting of The Institute, and are published in advance of the meeting for the purpose of eliciting discussion, either oral or written. Written discussions should be forwarded to the Secretary so soon as possible, so that in the absence of the authors of such discussions, arrangements can be made for their presentation.

Further Proposed Amendments to By-Laws

Certain amendments, proposed by Council and by corporate members, were published for the information of corporate members and in accordance with Sections 75 and 76 of the By-laws, on pages 532-533 of The Engineering Journal for December 1927.

In accordance with the same sections, the following further amendments proposed by Council are now communicated to corporate members, prior to their submission foi discussion at the Annual General Meeting.

Section 52.—Subsection *a* (Management of Branches).

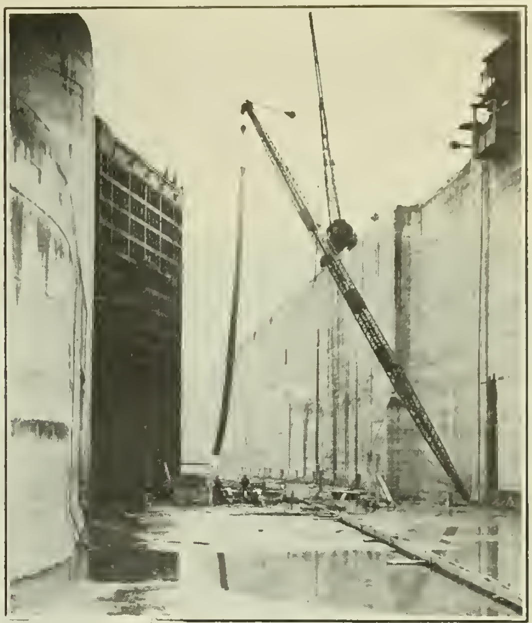
In order to authorize the present practice in a number of branches, it is proposed to add to this subsection the words:—" The Secretary and Treasurer may, as an alternative, be appointed by the Executive Committee, instead of being elected by the members of the branch."

Section 76.—Second paragraph (Amendments to By-laws).

The present wording of this paragraph apparently does not permit any modification of, or alternative to, proposed amendments during their discussion at the Annual General Meeting. Such proposed amendments must now go out to letter ballot exactly as submitted to the Annual Meeting by Council, or as draughted by corporate members.

Council now suggests that in order to permit voting on changes suggested during discussion, the following amendment be made to the second paragraph of Section 76:—

Delete all words in the first sentence after the word " meeting " in the second line and insert a semicolon, then add the words " The members there present may propose modifications or alternatives to any of the proposed amendments, and these modifications or alternatives, as well as the proposals submitted by the Council, shall be printed on a letter ballot to be submitted to the corporate membership of The Institute."



The Annual General *and* General Professional Meeting

of THE INSTITUTE *will be held in* MONTREAL *on*

TUESDAY, WEDNESDAY *and* THURSDAY FEBRUARY 14TH, 15TH *and* 16TH, 1928

With headquarters at THE WINDSOR HOTEL

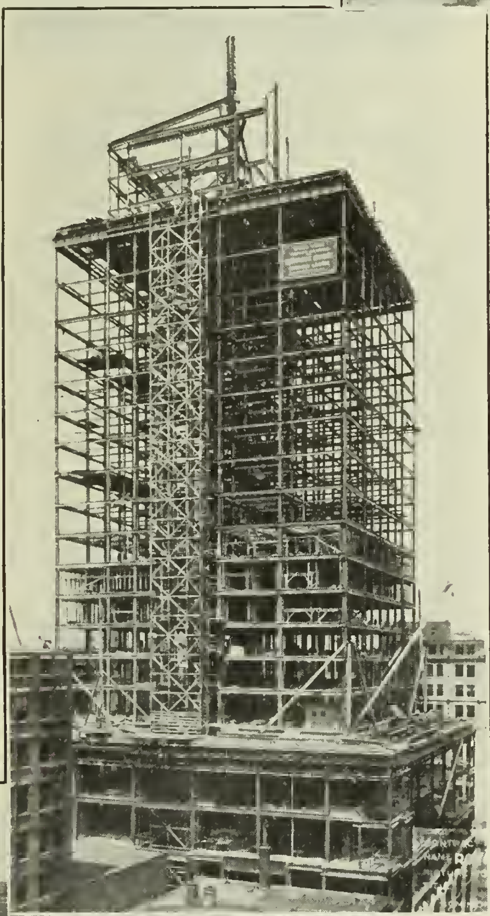
THE accompanying outline of the programme gives an idea of the general features of the meeting and of the work done by the committee of the Montreal Branch in charge of arrangements in providing features of interest to all branches of the profession. As announced in the December issue, His Excellency The Governor-General has graciously consented to attend the Annual Dinner and to address the members on that occasion.

Papers to be Presented and Discussed

"Chippawa Creek Syphon Culvert of the Welland Ship Canal"; "Lock Gates of the Welland Ship Canal"; "Movable Bridges of the Welland Ship Canal"; "Foundations of the Royal Bank Building, Montreal"; "Steelwork for the New Royal Bank Building in Montreal"; "Notes on the Removal of Carbon-Sulphur Compounds from Coal Gas by Oil Washing"; "The Flow of Gases in Reverberatory Furnaces"; "Notes on the Uniflow Steam Engine"; "The Requirements for a Durable Concrete as Observed from Structures in Service"; "The Effect of Steam Treatment of Portland Cement Mortars on their Resistance to Sulphate Action"; "The Electrical Heating of Trash Racks."

Works of Interest to be Visited

Montreal Harbour Bridge; Works of Northern Electric Company; Montreal Terminal Company's Cold Storage Plant; Coking Plant of Montreal Light, Heat and Power, Cons.; New Interceptor Sewers, City of Montreal; Plant of Associated Screen News; Plant of Victor Talking Machine Co. of Canada; New Building of the Royal Bank of Canada; Works of Dominion Engineering Works, Limited.



Outline of Programme

TUESDAY, FEBRUARY 14TH

Morning—
Registration — Annual General Meeting of The Institute, including presentation of reports of Council, Committees and the Branches; Scrutineers' report of the election of officers—Retiring President's address—Induction of newly-elected President.

Noon—Reception and Luncheon.

Afternoon—
Annual General Meeting continued.
Tea for Ladies.

Evening—
Illustrated Address by Dr. L. E. Pariseau.
Smoking Concert.

WEDNESDAY, FEBRUARY 15TH

Morning—Technical Sessions.

Noon—Luncheon.

Afternoon—
Visits to points of interest.

Evening—
Annual Dinner of The Institute.
Dinner for Ladies.

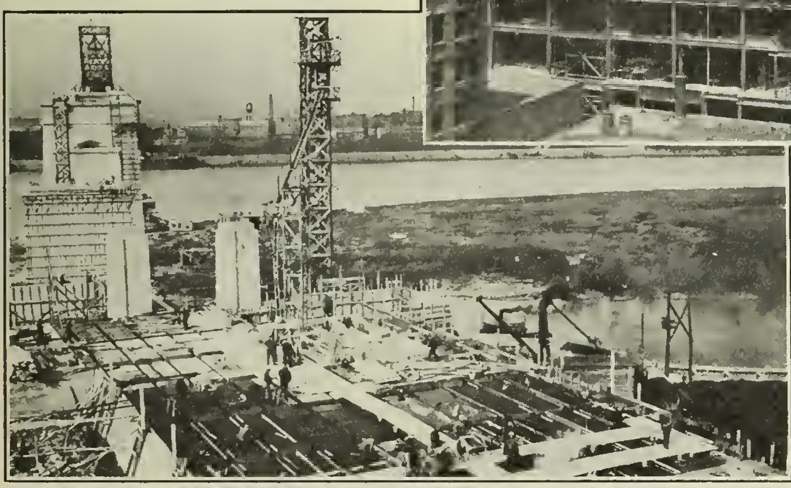
THURSDAY, FEBRUARY 16TH

Morning and Afternoon—
Technical Sessions.

Evening—
Reception and Supper-Dance.

Make a Special Note of the Dates

FEBRUARY 14TH, 15TH AND 16TH, 1928



ILLUSTRATIONS

Top—Erection of Lower Gate, Lock No. 2, Welland Ship Canal.

Centre—Steel Work of the New Royal Bank Building, Montreal.

Bottom—Construction of Montreal South Shore Bridge.

(For Details of Programme see Page 40)

Committee *of the*

IN CHARGE OF

The Annual General

J. L. Busfield, M.E.I.C.
Busfield, McLeod Ltd.
Chairman of the Main Committee

W. C. Adams, M.E.I.C.
Chief Engineer
Northern Electric Company, Limited
Chairman of the
Entertainment Committee

J. A. McCrory, M.E.I.C.
Office Engineer
Power Engineering Company
Chairman of the Hotel Committee

The

Forty-second

Annual General Professional Meeting

MONTREAL, QUE.

FEBRUARY
14th, 15th *and* 16th
1928

Headquarters at
THE WINDSOR HOTEL

H. G. Thompson, Jr.E.I.C.
Departmental Head
Affiliated Engineering Companies
Limited
Chairman of the Reception Committee

A. Duperron, A.M.E.I.C.
Chief Engineer
Montreal Tramways Commission
Chairman of the Papers Committee

Montreal Branch
ARRANGEMENTS FOR
Professional Meeting

C. K. McLeod, A.M.E.I.C.
Busfield, McLeod Ltd.
Secretary of the Main Committee

E. A. Ryan, M.E.I.C.
Consulting Engineer
Chairman of the Ladies' Committee

W. McG. Gardner, A.M.E.I.C.
Montreal Tramways Company
Chairman of the Committee on Publicity

Geo. R. MacLeod, M.E.I.C.
Engineer-in-Charge
Technical Service, Public Works Dept.
City of Montreal
Chairman of the Committee in Charge of Visits to Works of Interest

J. S. Cameron, A.M.E.I.C.
Assistant General Superintendent
Northern Electric Company, Limited
Chairman of the Sub-committee in Charge of Luncheons

Professor C. M. McKergow, M.E.I.C.
Professor of Mechanical Engineering
McGill University
Chairman of the Sub-committee in Charge of the Smoker

ELECTIONS AND TRANSFERS

At the meeting of Council held on December 28th, 1927, the following elections and transfers were effected:—

Member

DUNN, Charles Putnam, ch. engr., Portland Electric Power Co., Portland, Oregon.

Associate Members

CUMMING, Robert Egerton, engr., design & constrn. rly. trestles, bldgs., wharves, bridges, etc., Brown Corp., Quebec, Que.

DANN, Norman Leslie, acting cable engr., Northern Electric Co., Montreal.

FLEURY, J. Ernest, B.A., C.E., (Ecole Polytechnique), asst. principal at Papermaking School, Three Rivers, Que.

HALE, George Raymond, S.B., M.Sc., (Harvard Univ.), elect'l engr. in operating dept. of Shawinigan Water & Power Co., Montreal, Que.

ROBERTS, James Frank, B.S. in M.E., (Univ. of Wisconsin), hydraulic engr., Power Corp. of Canada, Mount Royal, Que.

WAKEFIELD, William Edward, timber tester to Forest Products Labs. of Canada, Ottawa, Ont.

Juniors

AHARA, Edward Victor, B.A.Sc., (Univ. of Toronto), head of steam accumulator dept., Combustion Engrg. Corp., Montreal, Que.

NAISH, Sidney Gordon, B.Sc., (Durham Univ.), engr., Mtl. div., plant dept., Bell Telephone Co., Montreal, Que.

WINSOR, Roland Blandford Marel, B.Sc., (McGill Univ.), constrn. engr. with W. I. Bishop, Ltd., Quebec, Que.

Affiliate

HERMANN, George Elliott, managing director, Vancouver Creosoting Co., Ltd., N. Vancouver, B.C.

Transferred from the class of Associate Member to that of Member

MUNTZ, Eric Percival, B.A.Sc., (Univ. of Toronto), consulting engr. to Lehigh Valley Coals Sales Co., Hamilton, Ont.

Transferred from the class of Junior to that of Associate Member

DAVIS, Sydney Herbert, B.Sc., (McGill Univ.), asst. res. engr. on constrn. highways and bridges at Chelsea & Paugan Falls with Gatineau Power Co., Ottawa, Ont.

FAHEY, James Vincent, B.Sc., (Queen's Univ.), res. engr., Spanish River Pulp & Paper Mills, Ltd., Sturgeon Falls, Ont.

HAY, Marshall Neil, B.Sc., (Queen's Univ.), asst. supt., Aluminum Co. of Can., Toronto, Ont.

MAXWELL, George Dean, B.A.Sc., (Univ. of Toronto), asst. to supt. of bldgs. & grounds, Univ. of Toronto, Toronto, Ont.

MOODY, Frederick Hayward, B.A.Sc., (Univ. of Toronto), pres. & managing director, F. H. Moody, Limited, Toronto, Ont.

RYAN, Charles Wilbert, B.Sc., (McGill Univ.), gen. supt. of constrn., Industrial Engrg. Co., New York, N.Y.

Transferred from the class of Student to that of Associate Member

BELANGER, Raphael, B.Sc., C.E., (Ecole Polytechnique), city engr., Valleyfield, Que.

HIGGINS, Joseph Alexander, B.Sc., (Queen's Univ.), investigation of pipe line system, Int. Petroleum Co., Negritos, Peru.

SNYDER, Horace H., instrumentman on hydraulic earth fill dam constrn. at Alexander power development with H.E.P.C., Hydro, Ont.

STEWART, Donald Laughlin, B.Sc., (McGill Univ.), with Bell Telephone Co. in outside plant div. of gen. engrg. dept., Montreal, Que.

Transferred from the class of Student to that of Junior

BEAM, Donald Carleton, i/c field party for Shawinigan Engrg. Co. in connection with Seven Falls-Murray Bay transmission line, Quebec-Isle Maligne transmission line and preliminary work for development of the lower Ste. Anne river, Ste. Tite des Caps, Que.

BROWNELL, George Wilson, B.Sc., (N.S. Tech. Coll.), with Electro-Motive Co. of Cleveland, Ohio.

CODE, Melville Clarke, B.Sc., (Univ. of Man.), taking C.G.E. Co.'s students' course, Toronto, Ont.

DION, J. Edgar, B.Sc., (McGill Univ.), Mtl. Engrg. Co., i/c field survey in Bolivia, S.A.

FRANKS, Selwyn Thompson, B.A.Sc., (Univ. of Toronto), research and development work on elect'l power conductors, with Northern Electric Co., Montreal.

HARDY, Albert Edwin, B.A.Sc., (Univ. of Man.), engr., Concrete Steel Co., Akron, Ohio.

MENZIES, John Ross, B.A.Sc., (Univ. of Toronto), instrumentman, with Sutcliffe Co., Ltd., New Liskeard, Ont.

SHIELDS, Stanley, B.A.Sc., (Univ. of Toronto), induction motor engr., C.G.E. Co., Peterborough, Ont.

SMART, George Wallace, B.A.Sc., (Univ. of Toronto), elect'l engrg. research asst., strength lab., Univ. of Toronto, Toronto, Ont.

STEWART, Donald, B.Sc., (McGill Univ.), dial system equipment engr., Montreal div., Bell Telephone Co., Montreal, Que.

WARKENTIN, Cornelius Paul, B.Sc., (Univ. of Man.), dfting and general office work in bridge dept., Good Roads Board, Prov. of Man., Winnipeg, Man.

Meetings of Council

Meeting of November 25th, 1927

A meeting of Council was held at eight o'clock p.m. on Friday, November 25th, 1927; President A. R. Decary in the chair, and ten other members of Council being present.

A letter was submitted from the Niagara Peninsula Branch, embodying a motion passed by that branch and recommending a general increase in the annual fees of all classes of members as being preferable to the increase of the fees of Members only recommended by Council.

It was pointed out that this matter would come up for discussion at the Annual Meeting, when the representatives of all branches would have an opportunity of presenting their points of view.

The Financial Statement to October 31st, 1927, was presented and approved.

Further discussion took place as to the possibility of making the subscription to the Journal optional to Students of The Institute, and after considering the recommendations of the Finance Committee it was felt that the advantages arising from the reduction of all Students' fees from $3.00 to $1.00 would not compensate for the disadvantages of this course.

The recommendations of the Finance Committee with regard to five special cases were approved; two reinstatements were effected, and eight resignations were accepted.

The report of the Board of Examiners on the results of the examinations held on November 1st, 1927, was presented and approved, showing that two candidates out of six had been successful in satisfying the examiners.

Discussion followed on a report from the Board of Examiners regarding the question which has arisen as to whether graduation from the courses in forestry at the four Canadian universities giving such courses can be recognized as graduation from a "school of engineering recognized by the Council." The Board of Examiners was of the opinion that while students in these forestry courses follow more or less completely the regular preliminary engineering curriculum for the first two years, and in the third and fourth years devote from one-third to one-half of the time to engineering subjects, graduation from such courses does not show that the graduate has received a satisfactory engineering training. It is, however, believed that in certain cases such graduates, if they have subsequently been engaged in responsible engineering work and have thereby obtained adequate training in the application of engineering theory, might properly be exempted from The Institute's examinations. This report was approved, and it was pointed out that Council has to deal with each application of this kind individually as regards the candidate's college training and engineering experience. It is accordingly not necessary or advisable to draw up any definite list of approved schools of engineering.

The Secretary submitted a draft of the various amendments to the By-laws which have been recommended by the Legislation and By-laws Committee, and also an amendment to Section 29 of the By-laws proposed by twenty corporate members of the Moncton Branch.

These were considered in detail and were approved in the form appearing on pages 532 and 533 of the December number of the Journal.

With regard to the committee appointed at the Plenary Meeting of Council to study the question of the co-operation of the activities of The Engineering Institute and the various Provincial Associations of Professional Engineers, the Secretary submitted the complete list of its members, as follows:—

Nova Scotia—	Professor F. R. Faulkner, M.E.I.C.
	Major H. W. L. Doane, M.E.I.C.
New Brunswick—	Professor H. W. McKiel, M.E.I.C.
	Alex. Gray, M.E.I.C.
Quebec—	President A. R. Decary, M.E.I.C.
	Geo. R. MacLeod, M.E.I.C.
Ontario—	Lieut.-Col. H. J. Lamb, M.E.I.C.
	Lieut.-Col. A. D. LePan, A.M.E.I.C.
Manitoba—	D. L. McLean, A.M.E.I.C.
	W. M. Scott, M.E.I.C.
Saskatchewan—	L. A. Thornton, M.E.I.C.
	H. R. MacKenzie, A.M.E.I.C.
Alberta—	S. G. Porter, M.E.I.C.
	R. J. Gibb, M.E.I.C.
British Columbia—	Past President Geo. A. Walkem, M.E.I.C.
	Patrick Philip, M.E.I.C.

Geo. R. MacLeod, M.E.I.C., was appointed Chairman.

The Secretary reported that His Excellency the Governor-General has graciously expressed his willingness to attend the Annual Dinner of The Institute on February 15th, 1928, and address the members. The Secretary was directed to communicate to His Excellency Council's gratification at the honour done to The Institute.

A letter was submitted signed by twenty members of the Montreal Branch and presenting the names of two additional nominees for the office of Councillor representing the Montreal Branch district.

The Secretary was directed to add these names to the List of Nominees for Officers to be placed on the ballot in accordance with Section 68 of the By-laws.

The attention of Council was called to an article, which appeared in the October 20th issue of the Engineering News-Record, regarding the recent typhoid epidemic in Montreal, and after discussion a committee was appointed to prepare a letter to be written to the editor of the Engineering News-Record regarding the situation, explaining that an investigation had already taken place, and that the matter had been given immediate attention by the Provincial Board of Health.

A resolution was unanimously passed conveying the sympathy and condolence of Council to the family of the late Mr. W. L. Scott.

The following elections and transfers were effected:—

Elections	
Associate Member	1
Students	27
Transfers	
Junior to Associate Member	4
Student to Associate Member	2
Student to Junior	8

Council rose at 12.15 o'clock a.m. and adjourned to Friday, December 2nd, 1927.

Adjourned Meeting of December 2nd, 1927

An adjourned meeting of Council was held at eight o'clock p.m. on Friday, December 2nd, 1927; President A. R. Decary, M.E.I.C., in the chair, and eleven other members of Council being present.

In accordance with the recommendations of the Legislation and By-laws Committee, the proposed amendments to the Niagara Peninsula Branch By-laws were approved.

The attention of Council was drawn to the fact that as at present worded, Section 76 of The Institute's By-laws does not provide for any modifications, during discussion at the Annual Meeting, of proposals to amend By-laws, which therefore must go out to letter ballot of the corporate members in the precise form in which they are submitted at the Annual General Meeting.

As a result of an active discussion, it was decided to request the Legislation and By-laws Committee to draft a proposal for such a change in Section 76 of the By-laws as will obviate the difficulty complained of, and, while guarding proposed amendments against any change made with little consideration or thought for their relation to other By-laws, will permit the consideration of such modifications as may be suggested at the Annual General Meeting.

A proposal from the Vancouver Branch to hold the forthcoming Western Professional Meeting on June 7th, 8th and 9th, 1928, was approved.

Thirty-three applications for admission and transfer were scrutinized and classified for the ballot returnable December 28th, 1927.

The Council rose at 10.15 o'clock p.m.

Meeting of December 20th, 1927

A meeting of Council was held at eight o'clock p.m. on Tuesday, December 20th, 1927; President A. R. Decary, M.E.I.C., in the chair, and nine other members of Council being present.

A report was submitted from the Legislation and By-laws Committee making recommendations regarding the proposed amendments to Sections 52 and 76 of the By-laws, and after considerable discussion these recommendations were approved, the Secretary being directed to send them out to all corporate members in accordance with the provisions of Section 76 of the By-laws, prior to their discussion at the Annual General Meeting.

The Financial Statement to November 30th, 1927, was submitted and approved.

One reinstatement was approved; nine resignations were accepted and nine special cases dealt with.

The list of officers of the Border Cities Branch of The Institute for the year 1927-28 was submitted and approved.

Twenty applications for admission and transfer were scrutinized and classified for the ballot returnable January 18th, 1928.

At 10.15 o'clock the Council adjourned until 2 o'clock p.m. on Wednesday, the 28th of December, for the purpose of canvassing the ballot returnable on that date.

T. McAvity & Sons, Limited, are issuing books of blue prints showing details of "World" reinforced digester brass valves and fittings for sulphite pulp mills. These blue prints, in addition to giving full details of dimensions, etc., provide an exceedingly novel and useful means for the recording, on the blue print, the service given by the equipment detailed. The McAvity Company also have issued their catalogue A-J covering "Durite" Reinforced Vanstone Joints for steel power pipe installation and of "Durite" copper piping with cupped and flared joints,—instead of threaded joints. This new type of copper water service has recently been installed in the new Pulp and Paper Research Institute at McGill University, Montreal, which is the first installation of its kind on the American continent.

Annual General and General Professional Meeting

The Annual General Meeting will be convened at Headquarters, 2050 Mansfield street, Montreal, on Thursday, January 19th, 1928, at 8.00 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, February 14th, 15th and 16th, 1928.

Programme of Meeting at Windsor Hotel, Montreal

(Subject to Revision)

Tuesday, February 14th.

9.00 a.m. Registration at Windsor Hotel.

10.00 a.m. Annual General Meeting in Windsor Hall. Reception and discussion of Reports from Council, Committees and Branches. Discussion of proposed amendments to By-laws.

1.00 p.m. Luncheon in Rose Room. (Complimentary to visiting members and visiting ladies.) Welcome to members by F. C. Laberge, M.E.I.C., Chairman of the Montreal Branch, who will preside. Brief address by the Hon. Mederic Martin, Mayor of Montreal.

2.30 p.m. Continuation of Annual General Meeting. Scrutineers' report and election of officers. Retiring President's address. Induction of new President.

4.30 p.m. Tea for ladies.

8.00 p.m. Illustrated address by Dr. L. E. Pariseau on X-ray Investigations of Egyptian Mummies. Rose Room. (Ladies will be welcome.)

9.30 p.m. Smoking concert and refreshments in Windsor Hall, (complimentary).

Wednesday, February 15th.

9.30 a.m. First Technical Session.

Presentation and discussion of papers.

Windsor Hall—

The Chippawa Creek Syphon Culvert of the Welland Ship Canal—A. J. Grant, M.E.I.C. Construction methods adopted for an important feature of the canal.

Foundations of the Royal Bank Building, Montreal, C. S. Proctor. Foundation design for a twenty-three storey office building.

9.30 a.m. *Prince of Wales Salon.*

Notes on the Uniflow Steam Engine—E. A. Allcut, M.E.I.C. Based on tests made by the Author on the economy and performance of this special type of reciprocating engine.

The Lock Gates of the Welland Ship Canal—Frank E. Sterns, M.E.I.C. Design and erection of lock gates of unusual size and importance.

1.00 p.m. Informal Luncheon.

2.30 p.m. Visits to engineering works.

These have been arranged through the kindness of the organizations named, as follows:—

Montreal Harbour Bridge—Two miles long, with 1,097 feet central span and 162 feet clear headway over navigation channel. Piers are built—steel work is being erected.

Works of Northern Electric Co.—Manufacture of cable, telephone and other electric equipment.

Cold Storage Plant of the Montreal Rail and Water Terminals, Ltd.—Recently constructed modern plant.

Coking Plant of Montreal Light, Heat and Power Cons.—Modern methods of coal carbonization.

New Interceptor Sewers, City of Montreal—Sewer construction on a large scale.

Plant of Associated Screen News—Production of motion picture films.

Plant of Victor Talking Machine Co. of Canada—Production of gramophone records.

New Building of the Royal Bank of Canada—Twenty-three storey office building, almost completed.

Works of Dominion Engineering Works, Ltd.—Construction of a number of large paper machines and hydraulic turbines.

Information regarding transportation will be furnished at the Registration Desk.

7.30 p.m. Annual Dinner of The Institute. The President in the chair. His Excellency the Governor-General has graciously signified his intention of being present.

(Seats and tables can be reserved through the Registration Committee.

7.30 p.m. Dinner for ladies.

Thursday, February 16th.

9.30 a.m. Second Technical Session.

Windsor Hall—

Bridges Over the Welland Ship Canal—M. B. Atkinson, M.E.I.C. Describes a series of movable bridges whose design involves many points of special interest.

Steelwork for the Royal Bank Building in Montreal—R. M. Robertson, A.M.E.I.C. Design and erection methods for a steel structure of considerable importance.

9.30 a.m. *Prince of Wales Salon.*

The Electrical Heating of Trash Racks—C. R. Reid. Methods of dealing with frazil ice in the St. Maurice river.

Notes on Removal of Carbon-Sulphur Compounds from Coal Gas by Oil Washing—K. L. Dawson, A.M.E.I.C. Gives the results of experimental work carried out by the author on a commercial scale.

The Flow of Gases in Reverberatory Furnaces—W. K. Thompson, A.M.E.I.C. An investigation of the conditions and performance of large copper-smelting furnaces.

2.00 p.m. Third Technical Session.

Windsor Hall—

The Requirements for a Durable Concrete as Observed from Structures in Service—R. B. Young, M.E.I.C. A discussion of various instances of deterioration in actual practice.

The Effect of Steam Treatment of Portland Cement Mortars on Their Resistance to Sulphate Action—T. Thorvaldson and V. A. Vigfusson. Deals with the results of experimental study by the expansion method, showing, in certain cases, that a marked increase in durability is produced by steam treatment.

Prince of Wales Salon—

Continuation of discussion on papers already presented, (if desired).

8.45 p.m. Reception and Supper-dance in Windsor Hall.

Reduced Railway Rates for Annual Meeting

In connection with the Annual General Meeting to be held in Montreal on February 14th, 15th and 16th, 1928, arrangements have been made with the Canadian Passenger Association, Eastern Lines, for reduced fares on the certificate plan, applying to points east of Armstrong and Fort William.

According to this arrangement, provided a sufficient attendance is certified at Montreal, members who have purchased an ordinary one-way ticket to Montreal, have obtained a C.P.A. certificate from the ticket agent *at the time of purchase,* and have had this certificate validated *at the meeting,* can purchase a ticket for the return trip at one-half the one-way ordinary first class adult fare, plus twenty-five cents, making the expense for the whole trip one and a half the ordinary fare plus twenty-five cents.

The success of this plan depends entirely on the willingness of our members to take the trouble (a) to obtain a certificate at the time of purchase of the ticket to Montreal and (b) to have this certificate validated by the proper officer at the Annual Meeting.

One hundred and fifty certificates at least must be validated for the arrangement to become effective, otherwise the rate for the return journey is less favourable.

A circular giving full information regarding this plan will be forwarded to all members with the programme for the Annual Meeting, and it is hoped that members will make a special note regarding this matter, since neglect on the part of one or two members to take advantage of it endangers the success of the whole arrangement.

Experience at previous meetings has shown a somewhat surprising difficulty in persuading members to co-operate in this scheme, and we are making a special effort to secure its advantages for members attending the Montreal meeting.

Points to Remember

when planning to attend

The Annual Meeting—

Date—February 14th-16th, 1928.

Place—Montreal, Que.

Headquarters—Windsor Hotel.

Reservations—Make these as early as possible. Cards for this purpose will be mailed to all members the second week in January. By doing this you will greatly assist the Committee in charge of arrangements.

Transportation — Special reduced rates have been arranged. (See announcement on this page.)

Be sure to secure certificate from the ticket agent when you purchase your ticket.

EMPLOYMENT BUREAU

Situation Wanted

Electrical Engineer

Electrical engineer, 27 years of age. University of Toronto graduate, six years diversified experience, two years Westinghouse engineering course, inspection of electrical equipment, industrial construction and maintenance, testing and research; at present employed in United States; wishes to return to Canada. Available on reasonable notice. Apply box No. 231-W, The Engineering Journal.

Situations Vacant

Engineer Wanted as Employment and Personnel Manager for Large Paper Mill

Employment experience not absolutely necessary, but should have had some experience in industry, preferably in Quebec, and ability to get along well with people. Must speak French fluently. Good salary to start and excellent prospects for future. Apply direct to Mr. Thos. A. McDonald, Room 1607, 50 East 42nd street, New York City, or to Employment Bureau, The Engineering Institute of Canada.

Sales Representative

A large bronze foundry in the United States, manufacturing special lines for engineering purposes, wants energetic, technically trained representative now well established in Montreal. Apply box No. 178-V, The Engineering Journal.

Mechanical Draughtsman

Mechanical draughtsman with at least four years experience in newsprint mill work. Good opening for right man in newsprint mill in province of Quebec. Apply, stating salary expected. Apply box No. 179-V, The Engineering Journal.

Designing Engineer

Designing engineer, experienced in pulp and paper machinery design, to take charge of draughting office in large newsprint mill in the province of Quebec. Applicant must be technical graduate. Apply, stating salary expected. Apply box No. 180-V, The Engineering Journal.

Designing Engineers and Draughtsmen

Designing engineers and draughtsmen for a large hydro-electric power development in the province of Quebec. Apply box No. 181, The Engineering Journal.

Sales Engineers

Two engineers required for technical sales work. One for Quebec and one for Ontario. Apply box No. 182-V, The Engineering Journal.

The Forest Service of the United States Department of Agriculture has issued a report containing some interesting information regarding the relation of forests to water supply. The report is entitled "Forests and Water in the Light of Scientific Investigation," and aims to bring together impartially the well-established scientific facts regarding this subject. The closing paragraph of the report contains the following summary of the results of the observations upon which this report is based:—"1. The total discharge of large rivers depends upon climate, precipitation and evaporation. The observed fluctuation in the total amount of water carried by rivers during a long period of years depends upon climatic cycles of wet and dry years. 2. The regularity of flow of rivers and streams throughout the year depends upon the storage capacity of the watershed, which feeds the stored water to the streams during the summer through underground seepage and by springs. In winter the rivers are fed directly by precipitation, which reaches them chiefly as surface run-off. 3. Among the factors, such as climate and character of the soil, which affect the storage capacity of a watershed, and therefore the regularity of stream flow, the forest plays an important part, especially on impermeable soils. The mean low stages as well as the moderately high stages in the rivers depend upon the extent of forest cover on the watersheds. The forest tends to equalize the flow throughout the year by making the low stages higher and the high stages lower. 4. Floods which are produced by exceptional meteorological conditions can not be prevented by forests, but without their mitigating influence the floods are more severe and destructive." The report also contains an extensive bibliography on the subject of the relation of forests to water and climate.

Recent Additions to the Library

Proceedings, Transactions, etc.

Presented by the Societies:

The American Society of Civil Engineers: Proceedings and Transactions, 1927.

The American Institute of Electrical Engineers: Transactions, 1926.

The American Society for Testing Materials: A.S.T.M. Standards, Part 1, Metals; Part 2, Non-Metallic Materials.

The Institution of Civil Engineers: Minutes of Proceedings, Part 1. 1927, Selected Engineering Papers, Nos. 43-56, The Testing of Heat-Engines.

The Engineering Association of Malaya: Transactions, 1926.

The North East Coast Institution of Engineers and Shipbuilders: Transactions, 1927.

The South Wales Institute of Engineers: Proceedings, 1927.

Reports, etc.

Department of Trade and Commerce, Canada:

Bureau of Statistics: Summary of Trade of Canada 1927, Trade of Canada with United Kingdom 1927, Trade of Canada with United States 1927, Summary of Canal Traffic 1927.

Department of Mines, Canada:

Geological Survey: Summary Report, Part A, 1926, Economic Geology Series No. 4, Arsenic-Bearing Deposits in Canada.

Department of the Interior, Canada:

Dominion Water Power and Reclamation Service: Water Resources Paper 60, Water Powers of Canada.

Department of Marine and Fisheries, Canada:

Tidal and Current Survey: Tide Tables for the Eastern Coast of Canada 1928. Tide Tables for the Pacific Coast of Canada 1928.

Department of Labour, Canada:

Report of Commission 1927.

Department of Mines, Ontario:

Annual Report, Bulletin 62. Metal Production of Ontario.

University of Alberta, Edmonton:

Scientific and Industrial Research Department: Report No. 20, Annual Report.

American Institute of Steel Construction:

Fireproofing Specification.

Department of Commerce, United States:

Annual Report of the Director of the Bureau of Mines 1927.

Bureau of Standards: Tech. Paper 351, Practical Applications of the Earth-Current Meter; Annual Report of the Director of the Bureau of Standards 1927; Tech. Paper 353, Some Vulcanization Tests of Guayule Rubber; Tech. Paper 354, A Modified Method for Determination of the Copper Number of Paper.

Department of Agriculture, United States:

Forest Service: Forests and Water in the Light of Scientific Investigation, by Raphael Zon.

Treasury Department, United States:

Public Health Service Reprint 1170, Experimental Studies of Water Purification; Public Health Bulletin 172, Studies of the Efficiency of Water Purification Processes.

Board of Health, Wisconsin:

Bureau of Sanitary Engineering: Stream Pollution in Wisconsin.

British Electrical and Allied Manufacturers' Association:

Economic and Statistical Department: The Electrical Industry and the Consumer.

Technical Books, etc.

Presented by D. Van Nostrand Company:

A Short History of Physics, by H. Buckley.

Propagation of Electric Currents, by J. A. Fleming.

Pyroxylin Enamels and Lacquers, by S. P. Wilson.

Presented by John Wiley & Sons:

Public Water-Supplies, by F. E. Turneaure and H. L. Russell.

Presented by Mrs. William McNab:

American Railway Engineering Association: Proceedings, vol. 1023, 1900-22.

Government Ownership of Railways, by S. O. Dunn.

The Dictionary of the Arts, Sciences and Manufactures, by G. Francis.

The Canadian Canals, by William Kingsford.

The Working and Management of an English Railway, by George Findlay.

Aids, Gifts, Grants and Donations to Railroads, Including Outline of Development and Successions in Titles to Railroads in Michigan.

Royal Military College of Canada. Civil Engineering, vols. 1 and 2.

Dictionary of Altitudes in the Dominion of Canada. Department of the Interior, Canada.

Standard Time in North America, by W. F. Allen.

Victoria Jubilee Bridge, Montreal.

Plans of a Railway Suspension Bridge over the River St. Lawrence, near Quebec.

Interborough Rapid Transit, New York.

BOOK REVIEWS

Motor Fuels, Their Production and Technology

By Eugene H. Leslie. The Chemical Catalogue Company, New York, 1923. Cloth, 6 x 9 in., 681 pp., figs., diagrams, tables, map, $11.00.

In this book is given a fairly complete outline of the fundamental principles of physics, thermodynamics and chemistry as employed in the operation of petroleum refining for the production of motor fuels. It also contains a review of the various sources of supply of motor fuels with a discussion as to their relative importance.

The chapters on fractional distillation, fluid flow, heat transfer and on cracking are of considerable interest to the refinery engineer and chemist. The volume is well illustrated, contains many references to other authorities on the subject, and with the comparatively large number of tabulations of useful information constitutes a handbook for those occupied in the design and operation of refinery equipment.

The book should be valuable to the student in petroleum technology, who can obtain from same considerable information in regard to the practice followed and apparatus used in the modern refinery. The review of the motor fuel situation will be of interest to the non-technical reader, but as technique and research in petroleum refining have been and are rapidly advancing no technical book on this subject can be completely up to date. The information obtained from this book should be supplemented by that obtained from recent publications which, at present unfortunately, are only fragmentary and appear mostly in technical journals.

Dr. Leslie's book represents a valuable contribution to the literature on petroleum technology.

F. C. Mechin, A.M.E.I.C.
Superintendent, Montreal Refinery, Imperial Oil Refineries, Limited.

Theory of Vibrating Systems and Sound

By Dr. I. B. Crandall, Member of Technical Staff, Bell Telephone Laboratories. D. Van Nostrand Company, New York, 1926. Buckram, 6 x 9 in., 272 pp., figs., tables, $5.00.

The Greek philosopher Heraclitus wrote "Everything flows." To-day we say "Everything waves," and find vibrations from an atom to a cepheid.

Academic subjects which were the delight of a Stokes, a Kelvin, a Rayleigh or a Lamb now find themselves in the front rank of modern engineering,—in the diaphragm of a telephone, the horn of a gramophone or loud speaker, the acoustics of a building, underwater signalling, submarine detection, depth of ocean measurement, airplane detection.

There is a remarkable and close analogy between the transmission of sound and the transmission of electricity, with its accompanying problems of phase difference and attenuation.

Indeed, many engineers approach acoustics from an electric standpoint, whereas the famous Constantinesco, (who timed the Lewis gun bullets through the aeroplane propeller), first mastered acoustics and then found alternating current mere child's play.

Generally speaking, it is easy to write down the differential equations, but it is the devil and all to solve them! So that this book is not easy to read, in some places, except by those trained in Bessel's functions, and in Ber and Bei functions beloved of Kelvin.

Most men have the mathematics they deserve, but few have the mathematics they require. Indeed, the moral of the book is more mathematics, even if the horn of the loud speaker has been evolved by practice rather than theory.

Many engineers have made their pile by grace of God, their mother wit, an engineer's pocket book and a slide rule, so that the young engineer student is apt to hope for the best, rather than to apply himself to the calculus. Perhaps the future may not be as the past, and it has been said that God must despise riches, for he bestows them so often, (not always, please !) on the undeserving.

This, however, is not a book of theology under review, but a useful compendium of those branches of vibrating systems which necessarily impinge on the attention of the Bell Telephone Laboratories.

There are references to useful war work, some of it summarized in Drysdale's "Mechanical Properties of Fluids," (Van Nostrand, 1924), and to two Canadian prophets, of more honour in other countries, Dr. L. V. King, of McGill University, and Dr. R. W. Boyle, M.E.I.C., once of McGill, now a leader at the University of Alberta, who have made notable contributions to acoustics and super-sonics.

The book is clearly written and printed, and Dr. Crandall has done useful work in bringing together and publishing material given in a course at the M.I.T. in 1926, to electrical engineers, students of physics and others who had a background of analytical mechanics, Legrange's equations, elastic deformation and electrical networks. Who runs may read !

A. S. Eve, D.Sc.
Director, Department of Physics, McGill University.

The Metallurgy of Aluminium and Aluminium Alloys

By R. J. Anderson. Henry Carey Baird & Co., Inc., New York, 1925. Cloth, 6 x 9 in., 913 pp., figs, tables, $10.00.

The constantly enlarging demand for aluminium and light alloys in many branches of industry adds greatly to the engineering interest in any book dealing with this metal. It is unfortunate, therefore, that there are so few works of any sort, and still fewer with authoritative and up-to-date information, on aluminium alloys.

This particular volume by R. J. Anderson, published first in 1925, will find wide interest among those who fabricate or use aluminium. It is probably the most complete volume published in America on this subject which undertakes to cover both the production and the properties and uses of aluminium alloys. Unfortunately, because of several factors, among them the rapid change in this industry, the book is already incomplete in many important features. It is notable in its neglect of the fundamental metallurgical studies carried out by some of the most able research men of the Aluminium Company of America, who have published freely in the technical literature during recent years. For example, one fails to find any reference in the author index to the important contributions of Jeffries, Archer, Blough, Frary and several of their associates.

Despite these limitations, some of which are inevitable with the rapidly changing industry, the book is well worth attention and probably the best available for many phases of the aluminium industry. In any event, it will serve the useful purpose of still further stimulating the proper and intelligent use of aluminium and light alloys, which have long been one of the most neglected groups of metals.

R. S. McBride.
Assistant Editor, Chemical and Metallurgical Engineering.

Essentials of Transformer Practice

By Emerson G. Reed. D. Van Nostrand Company, New York, 1927. Cloth, 6 x 9½ in., 401 pp., figs., tables, $5.00.

The second edition of this work is one of the few books published giving complete information on transformers. The first part is well presented and deals with design. The calculations of copper loss and iron loss are clearly treated, as are also the separation of the hysteresis and eddy losses, and the bearing of these losses on such points as the thickness of the laminations and the effect of the form factor of the voltage wave. A further discussion on the relation of iron loss to copper loss is very interesting and includes the consideration of the effect of change of impressed voltage, of frequency and of a number of turns in the winding. These chapters on design are concise, yet complete.

For those interested in the operation and maintenance of transformers, the book contains much useful information. The properties of insulating materials and of oils, the methods of insulation and impregnation of the windings and a general chapter on installation and maintenance are some of the major points presented. The latter half of the volume includes chapters on voltage and current transformers, voltage and phase transformation with single phase and autotransformers, stresses in operation and some data on the economics of the operation of transformers. The chapters on voltage and current transformers are especially well treated, and the discussion on phase transformation with autotransformers is very interesting.

The author has included many points having practical value which are seldom treated in a work of this kind, and the book can be recommended as an excellent reference book for engineers engaged in transformer work, provided their theoretical knowledge is sufficient to enable them to take advantage of its discussions. Notwithstanding its wide scope, the treatment throughout is satisfactory and thorough.

S. A. Craig, Jr.E.I.C.
Demonstrator, Electrical Department, McGill University.

Shale Oil

By Ralph H. McKee, Ph.D., LL.D., and Others. The Chemical Catalogue Company, New York, 1925. Buckram, 6 x 9 in., 326 pp., figs., tables, $6.00.

This volume is one of the monograph series published by the American Chemical Society. The subject matter effectively covers the origin and occurrence of shale oils, the theoretical and practical considerations in their utilization and an interesting review of general economic considerations as applied to the shale oil industry.

Not the least valuable feature of the book is the description of American experimental oil shale distillation plants and the abstracts of shale oil articles.

Anyone having occasion to study or investigate the shale oil industry will find this book valuable. Certain of the economic conclusions based on the study of conditions prior to 1925 illustrate the rapidly changing economic considerations that upset economic theories. At the time this book was published, shale oil deposits seemed to represent the only large reserve supply of fuel for internal combustion engines, and the expected shortage of gasoline about 1927 is particularly stressed. The current over-production in the oil industry has set back the possible development of a shale oil industry indefinitely, and the competition that is arising from the newer coal distillation processes promises to still further put off the day when shale oil deposits will be of great economic value.

J. R. Donald, M.E.I.C.,
Consulting Chemical Engineer, Montreal, Que.

Machine Work

By T. J. Palmateer. Stanford University Press, Cal., 1927. Cloth, 5½ x 8 in., 202 pp., figs., illus., $2.00.

This manual is intended for use in technical schools as a test and reference book to supplement oral instructions.

Part 1 consists essentially of a series of exercises or jobs forming a graded course of instruction in the more fundamental operations performed on the lathe, planer, drill-press, milling and grinding machines. The instructions are detailed and definite and clearly illustrated. Descriptions of machine tools are restricted to those commonly found in school shops.

In Part II, the operations in the manufacture of a hand-power grinder are detailed as an example of quantity production methods on a small scale and of the use of special tools, fixtures and jigs.

The book is well suited for its purpose and should be useful to shop instructors in schools as well as to students.

A. R. Roberts, A.M.E.I.C.
Associate Professor of Mechanical Engineering, McGill University.

Wood Distillation

By L. F. Hawley. Chemical Catalog Company, New York, 1923. Buckram, 6 x 9 in., 141 pp., figs., tables, $4.00.

This book belongs to a series of scientific and technologic monographs which is being edited by the American Chemical Society by arrangement with the Inter-Allied Conference of Pure and Applied Chemistry which met in London and Brussels in July 1919.

The author has divided his subject matter into two parts, first, the distillation of hardwoods, and, second, the distillation of resinous woods. Each part contains chapters on the following commercial processes;—raw materials; the decomposition of wood by heat; the products of wood distillation and their refining. New processes are outlined, together with a brief statement as to the reason for their development.

The chapter on raw material contains an excellent summary of present day knowledge of the chemistry of wood and of its proximate analysis. Numerous tables are given to illustrate the yields obtained from different species where for purposes of comparison a definite set of conditions was used in the distillation.

The effect of the presence of catalysts during the distillation is also discussed, and the monograph is generously supplied with references to the literature of the subject.

E. Parke Cameron, A.M.E.I.C.
Director, Division of Pulp and Paper, Forest Products Laboratories of Canada, Montreal, Que.

BRANCH NEWS

Border Cities Branch

Orville Rolfson, A.M.E.I.C., Secretary-Treasurer.

The annual meeting of the Border Cities Branch was held in the Prince Edward hotel on Friday evening, December 9th, 1927. After dinner at 6.30 p.m. the following reports of the year were presented:—

Report of Chairman ....L. McGill Allan, A.M.E.I.C.
Report of Secretary-Treasurer ....C. G. R. Armstrong, A.M.E.I.C.
Report of Membership Committee ....A. E. West, A.M.E.I.C.
Report of Entertainment Committee ..R. J. Desmarais, A.M.E.I.C.
Report of Publicity Committee ....J. Clark Keith, A.M.E.I.C.

After the adoption of these reports, the election of officers for the ensuing year was proceeded with, and the following slate was elected:—

Chairman	Harvey Thorne, M.E.I.C.
Vice-Chairman	A. E. West, A.M.E.I.C.
Secretary-Treasurer	Orville Rolfson, A.M.E.I.C.
Executive	R. J. Desmarais, A.M.E.I.C.
	Fred. Stevens, A.M.E.I.C.
	F. H. Kester, M.E.I.C.
Ex-officio	L. McGill Allan, A.M.E.I.C.
	J. Clark Keith, A.M.E.I.C.
	C. G. Russell Armstrong, A.M.E.I.C.

Calgary Branch

H. R. Carscallen, A.M.E.I.C., Secretary-Treasurer.
W. St. J. Miller, A.M.E.I.C., Branch News Editor.

The Manufacture of Cement

On November 16th last, W. D. Armstrong, A.M.E.I.C., superintendent of the Canada Cement Company, Limited, at Exshaw, Alberta, delivered a paper to this branch on the manufacture of cement. Mr. Armstrong handled his subject in excellent form and with a clearness and grasp that added much to the pleasure of listening. There was a good attendance and members were shown some interesting reels of cement plant activity at various centres. The trick drawings thrown on the movie screen to show the passage of ore through the mill proved a clever means of illustrating the various processes. A short discussion followed, being led by G. P. F. Boese, A.M.E.I.C., after which Chairman Beach thanked Mr. Armstrong for the excellent paper he had read.

Geology of the Foothills in Relation to Petroleum

On Tuesday night, Dr. John A. Allan, Ph.D., F.R.S.C., R.R.E., professor of geology at the University of Alberta, delivered an address before the members of the branch. The subject of his address was the geology of the foothills in relation to petroleum, which, although necessarily of a highly technical nature, proved both instructional and intensely interesting to his audience, which also included several geologists and oil operators.

Commencing with the history of the Rocky mountains and foothills formation, Dr. Allan pointed out that the former covered an area of some 40,000 square miles in Alberta, or about the size of Nova Scotia, and that the foothills formed a belt some 500 miles from the international boundary to the Peace River valley with an average width of 23 miles and an area of about 11,500 and average elevation of 4,000 feet.

Much of the lecture dealt with complex data and stratigraphy, and it was somewhat disconcerting to theorize that this continent is gradually moving in a westerly direction with a tendency for the west coast to move northward when San Francisco may some day be where Vancouver is to-day. His hearers were, however, assured that they could not expect to live to see the day. He referred to the submergence of the land surface occurring in past ages, forming a sea area extending across Alberta and possibly as far as Manitoba, which at a later period receded towards the east, giving birth to the Rocky mountain uplift.

It was his theory that the old shore line of the sea influenced the quality and strike of the coal beds rather than their varying distance from the mountains. Dr. Allan advocated the fullest co-operation between drill operators and geologists, so that the latter may be able to interpret some of the facts that cannot be observed on the surface.

As far as time went, he mentioned that the Rocky mountains are very young in comparison with the Selkirks, and were almost entirely of sedimentary origin, only two small areas of igneous rock being known. His remarks concerning mountain building were cleverly illustrated with lantern slides, as were also the folding, faulting and overthrust of the formations with a most interesting conclusion that the front range of the Rockies at Kananaskis had been thrust seven miles over the plains, and that the earth's surface had become shortened by some thirty miles in the Rocky mountain system. Dr. Allan stated that the sea floor must have been raised over three miles above its original altitude, naturally a very slow process.

Referring to oil and gas, he said that it is reasonable to believe that under suitable structural conditions production pools may be expected in the Kootenay sandstones, and that the large volumes of gas and naphtha encountered in Turner valley occur in porous dolomite limestones, probably of middle carboniferous age.

It was his contention that the anticlinal fold is only one of several suitable types of structures for the discovery of oil, one other of which was a lens between impervious beds, a very common source of supply and known to occur in Turner valley. He claimed that the largest reservoirs should occur towards the eastern side of the foothills belt and to the northwest.

He was of the opinion, with many other geologists, that the petroleum possibilities in the foothills have not yet been determined, but that there is no cause for discouragement in what the ultimate results will be when the geological conditions are more accurately understood, and that a wide knowledge of the foothills geology is required, also that reading geological books will not interpret the foothill's geology.

Dr. Allan claimed that many mistakes have been made by attempts to extend Turner valley structure almost indefinitely along the strike, which is all wrong in principle and in fact, and that while many structures in the foothills must be unproductive there are many others that may prove productive if tested by drilling.

Recognition of horizons is of the greatest importance in seeking for oil, also three great factors must be considered, mainly, time, qualifications and money.

In conclusion, Dr. Allan said that the working out of the geology of the foothills must not be regarded as a hobbyist's playground, but a real laboratory filled with the most complex problems, and that can only be interpreted and possibly solved by the most highly trained geologists who are willing to spend considerable time in the laboratory of nature.

Hamilton Branch

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

Executive Meeting, November 30th

A meeting of the executive of the Hamilton Branch was held in the office of W. L. McFaul, M.E.I.C., city engineer. L. W. Gill, M.E.I.C., chairman of the branch, presided and there were five other members of the executive present. The meeting was mainly devoted to the consideration of applications for admission and transfer and of plans for the remainder of the season.

A communication from the Niagara Peninsula Branch regarding the proposal put forth at the Plenary Meeting of Council to increase the fees of Members $5.00 per annum was considered, and it was decided to bring the communication to the attention of the members of the branch at the next meeting.

Branch Meeting, December 12th

A meeting of the Hamilton Branch was held in the cafeteria of the Hamilton Technical Institute, Monday evening, December 12th. During the temporary absence of L. W. Gill, M.E.I.C., chairman of the branch, W. L. McFaul, M.E.I.C., vice-chairman of the branch, called the meeting to order and routine business was transacted. The communication from the Niagara Peninsula Branch proposing to increase the fees of all members pro rata instead of increasing only the Members fees $5.00 per annum was brought to the attention of the meeting and much discussion ensued. The entrance of the chairman, accompanied by Major-Gen. J. H. MacBrien, C.B., C.M.G., D.S.O., the speaker of the evening, brought the discussion to a close before any decision was reached.

Civil Aviation in Canada

General MacBrien spoke upon the subject of "Civil Aviation in Canada." The talk was illustrated by charts showing the existing airway routes in the continent of Europe and the existing and proposed inter-continental airway routes. A coloured plan of a proposed design for an air port for the city of Hamilton was also shown.

General MacBrien was heartily welcomed by the meeting. Flight, he said in opening, had always been an aspiration of man. Flying had been an attribute of the ancient gods, and until recent times man's attempts to fly have been regarded as sorcery, especially by the Inquisition. It was felt that anyone who attempted to fly must be inspired by the devil.

The old philosophers saw that two things rose through the air, —smoke and birds. These ideas have developed into the lighter-than-air and heavier-than-air craft. These two schools hold distinct and contrasting views.

In 300 B.C., in the Roman forum, a man named Simon raised himself with a sort of balloon and reached so high as to fall back to his death. This is the first recorded instance of successful flight.

The balloon is the forerunner of the dirigible, which was used by the Germans during the Great War. The General gave an interesting description of one he had seen in England, which has accommodation for 100 people, with dining salons, etc., like the modern liner.

Next year, in August, one of these airships will fly to Canada, to the air mast at Montreal. It is believed that a number of these aircraft could be made to pay, charging $500 per passenger per trip. They would fly to Canada in two and a half days, and back, with the wind, in one and a half days. They could fly to Australia in eleven days.

Regarding the heavier-than-air craft, Sir John Carey, an Englishman, laid down the principles which make dynamic flight possible. These principles were used by Langley and the Wright brothers. Twenty-four years ago the first airplane flew for a few seconds. Since then there have been great developments, so that the modern airplane is now a scientific machine. What has been done this year in the heavier-than-air machine is no less than astounding, which is a great tribute to man's ability.

All progressive countries are developing aircraft. There are two reasons, first, commercial, to compete with other countries in trade; and, second, military, as an arm of defence.

To-day flying is safe, provided certain precautions are taken:—

(1) The aeroplane must be of the best type available with multiple engines.
(2) The flying must be over an organized route, that is, with proper airdromes and properly lighted along the route.
(3) There must be an efficient meteorological service and proper wireless communications, so that the plane can be advised of weather conditions at all times, thus enabling the pilot to avoid storms by flying over or around them.
(4) The flying personnel must be highly trained and efficient.

General MacBrien mentioned the "Handley-Page slot" which gives the pilot better control of his machine. When the plane stalls in midair, the Handley-Page slot, which is in the forward edge of the wings, opens and allows the pilot to maintain control and to bring the machine down under control. Previously, when a machine stalled it either went into a side spin or a nose dive, and if there was not sufficient height there would be a bad crash in which the machine would be ruined and the pilot probably killed. With the Handley-Page slot the machine settles down under control with a falling speed of 20 miles per hour. This would probably result in a smashed undercarriage, but it would save the machine and the lives of the passengers. It is reported that the United States has paid $800,000 for the right to use this feature on their military aeroplanes.

In the United States last year planes have flown five million miles over properly organized routes without an accident, but there were hundreds of accidents among aircraft flying over improperly organized routes.

There are 36,000 miles of airways now organized in Europe. People can travel to any part of Europe at slightly more than first-class railway fare and in one-tenth of the time. Germany is the leading country in this development. She could use her civil air force in wartime if necessary. The Germans believe that aviation will help them to recover their lost commercial position. Two German firms are to-day building aircraft for trans-Atlantic flying.

France has made considerable progress in air transportation. They have the finest military air force in the world and have developed scout planes which can manœuvre at a ceiling of 32,000 feet.

In England there are no internal air routes on account of the size of the country, but British planes fly into Europe, and it is proposed for them to fly to Canada and South America. In Australia there are 350,000 miles of airway actually in operation. The government has voted $2,000,000 toward the building of 800,000 miles of additional airways.

In the United States there are twenty-four manufacturing companies operating, several of them making a profit. Sixty-five million people are now served with an air mail in which the planes fly from coast to coast in thirty-six hours. In organizing an airway, the United States federal government lights the routes between cities, but the municipalities themselves establish the air ports. It is expected that this is the policy which will be carried out in Canada.

In Canada there is not a single mile of organized air route. This indicates that we are lagging behind and that those in touch with aviation believe that unless Canada wakes up, other countries, notably the United States, will develop her aviation for her. There are two flying lines in operation in Canada, but not over organized routes, one from the Sioux Lookout to the Red Lake district and the other from Haileybury to the Rouyn district.

With such an enormous hinterland not served by present means of transportation, Canada would benefit materially from proper development of aviation.

Although Canada is behind in the development of commercial aviation, there are two uses of aircraft in which she leads. These are: aerial survey work and forestry protection.

General MacBrien is organizing a Canadian Air League. The objects of this league will be to ensure the development of civil and commercial aviation in Canada, to foster scientific research and education and to secure an adequate military air force. The organization is non-political and will have a headquarters in Ottawa. Each branch must have at least fifty members, and up to the present the organization of branches has been commenced in twenty large cities.

General MacBrien outlined the means whereby the league hopes to fulfil its objects, and mentioned the arrangements which have already been made with the Hamilton Technical Institute and other educational institutions regarding the education of men for the air trades.

After General MacBrien's address, refreshments were served, accompanied by selections rendered by the Technical School orchestra.

After the refreshments there was considerable discussion, and General MacBrien was asked several questions. Mr. McFaul expressed the thanks of the meeting to General MacBrien for his interesting and instructive address.

Kingston Branch

D. G. Geiger, S.E.I.C., Secretary-Treasurer.

The Kingston Branch met in the physics lecture room, Ontario Hall, Queen's University, on December 7th to hear an address by Professor Howard T. Barnes, M.E.I.C., head of the physics department, McGill University, Montreal, on "Ice, Its Formation and Control." Professor L. T. Rutledge, M.E.I.C., chairman of the branch, occupied the chair and fittingly introduced the speaker.

Ice, Its Formation and Control

Professor Howard T. Barnes, M.E.I.C., of McGill University, the internationally recognized authority on ice and ice engineering, made the astounding statement that it will be quite possible within a few years, following the research on which he is now engaged, to keep the St. Lawrence river entirely free of ice during the winter months, thus materially raising the mean temperature in the vast section of Canada through which the river flows and solving some of the problems of engineers whose duty it is to keep power stations and other industries running.

Professor Barnes had for his subject "Ice, Its Formation and Control," and his address, illustrated as it was by lantern slides and moving pictures, proved most interesting and instructive to his large audience.

At the outset of his remarks, Dr. Barnes stated that research had proved that ice was always present in water of whatever temperature and could be frozen at the boiling point if sufficient pressure could be applied. He stressed the facts that ice would not form a solid mass except at a temperature of 32° F. or lower and that the smallest fraction of a degree change in temperature meant the difference between water usually considered free of ice and solid ice.

Concerning the St. Lawrence, Dr. Barnes' theory, summed up in a few words, is that if the waters of the St. Lawrence were all diverted during the winter months, by some mechanical means in the Kingston district, so that they flowed down the south channel the waters would move with greater rapidity, and, being considerably above the freezing temperature, would not tend to form ice until well down the river. In supporting this theory, the speaker drew attention to a curve showing that the St. Lawrence commences to freeze at its mouth. Lake Ontario forms an immense reservoir of warm water feeding the river, and this warm water gives up its heat as it flows down the river.

Dr. Barnes showed some very interesting lantern slides regarding the use of thermit, the new chemical composition containing aluminum and iron oxide which burns at a very high temperature and which he has used in his work of breaking up ice-jams. He also showed slides of his work at the Alleghany gorge and at Belleville, Ontario. At the conclusion of his address, a discussion was led by Dr. L. F. Goodwin, M.E.I.C., after which a vote of thanks was moved by Dr. A. L. Clark, M.E.I.C., and seconded by Professor W. P. Wilgar, M.E.I.C.

Annual Meeting

The annual meeting of the Kingston Branch was held in Carruthers Hall, Queen's University, on December 15th, 1927, with the chairman of the branch, Professor L. T. Rutledge, M.E.I.C., presiding.

The secretary-treasurer presented the annual report of the branch, showing it to be in a sound financial position, and that, although the number of meetings held in the past year had not been large, all had been very well attended. The total membership was shown to be approximately thirty-nine.

The officers for the ensuing year were elected as follows:—

Chairman	Professor D. S. Ellis, A.M.E.I.C.
Vice-Chairman	Professor W. L. Malcolm, M.E.I.C.
Secretary-Treasurer	D. G. Geiger, S.E.I.C.
Executive Committee	Major LeR. F. Grant, M.E.I.C.
	G. MacLachlan, JR.E.I.C.
	Dr. L. F. Goodwin, M.E.I.C.
Ex-officio	Professor L. T. Rutledge, M.E.I.C.
	G. J. Smith, A.M.E.I.C.

Programme Committee

Professor W. L. Malcolm, M.E.I.C.
Professor A. Jackson, A.M.E.I.C.
G. J. Smith, A.M.E.I.C.

After a few remarks by the retiring chairman, L. T. Rutledge, M.E.I.C., in which were expressed his appreciation of the honour of having been chairman of the Kingston Branch, and his thanks to the members of the branch for their assistance and co-operation during his tenure of office, the new officers were installed. In the absence of the newly-elected chairman, the vice-chairman, Professor W. L. Malcolm, M.E.I.C., took the chair.

After the business of the meeting had been finished the members present had the pleasure of hearing an informal address by Dr. L. J. Austin, M.D., on the history of medical science. The lecture proved most interesting and instructive, and at its close the appreciation of the listeners was presented in a vote of thanks moved by Professor W. P. Wilgar, M.E.I.C., and seconded by Professor L. T. Rutledge, M.E.I.C.

Moncton Branch

V. C. Blackett, A.M.E.I.C., Secretary-Treasurer.

An unusually large attendance of members assembled at a supper-meeting held on November 18th to hear Mr. Dexter P. Cooper describe the gigantic tidal power development at Passamaquoddy bay. Mr. Cooper is the originator of the Passamaquoddy scheme, and has for years been actively engaged in its development. His address was illustrated with maps showing proposed location of dams and gates and charts showing useful head available at all stages of the tidal cycle.

The Passamaquoddy Tidal Development

Passamaquoddy bay is an inlet of the bay of Fundy, situated at the extreme southern portion of New Brunswick, and is crossed by the international boundary separating that province from the state of Maine. Power is to be obtained through the 19-foot variation, at that location, of the bay of Fundy tides. A 17-mile chain of islands forms a great natural barrier between Passamaquoddy bay and the bay of Fundy, and one and a half mile of dam construction is all that is necessary to complete the separation of these waters. Passamaquoddy bay will itself be divided by dams into two parts, an upper or high level basin, supplying power, and a low level or emptying basin. By alternating the opening and closing of gates and connecting one or the other of the basins with the outer bay, a difference in head of between 8 and 9 feet, available for power purposes, will be maintained between these two basins.

The gates will be of the sliding lift type; the gateways being in the form of a half Venturi meter, with the smaller opening on the outside.

The plant is designed to develop 300,000 h.p. Turbines are to be of cast iron, 21 feet in diameter, and will operate at a speed of 50 r.p.m. Variations in power requirements will be taken care of by the installation of a large number of individual units. There will not be any power house. Instead, each unit is to be covered with an enormous steel helmet. A travelling crane will be provided for the purpose of lifting and afterwards replacing these helmets whenever it becomes necessary to repair any of the units.

It was stated that the project will be completed in about four years at a cost of approximately fifty million dollars.

Mr. Cooper's address was followed by a general discussion, after which a hearty vote of thanks, moved by F. O. Condon, M.E.I.C., and seconded by C. S. G. Rogers, A.M.E.I.C., was tendered the speaker by G. C. Torrens, A.M.E.I.C., the presiding chairman.

The Harmony Kings orchestra was in attendance and rendered a number of pleasing selections during the course of the supper.

The Evolution of Industrial Organization

An exceedingly able and scholarly address on the subject "The Evolution of Industrial Organization" was delivered at a supper-meeting of the branch held on December 14th by Norman M. Guy, M.A., professor of commerce and economics, Mount Allison University, Sackville. G. C. Torrens, A.M.E.I.C., chairman of the branch, presided.

The speaker's remarks were confined mainly to the field of production, and in opening he referred to the enlarged field and wider function of the engineer in these modern days. He explained what was meant by the term "industrial organization," pointing out that there had been at least five well defined stages,—"The Direct Appropriation," the "Pastoral," the "Agricultural," the "Handicraft" and the "Industrial." Briefly explaining the fundamental characteristics of each, and reviewing the various inventions that had revolutionized industry in the latter part of the 18th century, the speaker went on to deal with the later patents that were brought out and which have caused the evolution in the industrial life of the world. Modern industrial organization, the speaker said, possesses four outstanding tendencies,—large scale production, specialization, standardization and scientific management.

At the close of his address, Prof. Guy was extended a hearty vote of thanks on the motion of E. G. Evans, M.E.I.C., seconded by G. E. Smith, A.M.E.I.C.

During the evening excellent trombone solos were rendered by Mr. Walter Cosman and several enjoyable vocal selections by Mr. Charles Dodge.

Montreal Branch

C. K. McLeod, A.M.E.I.C., Secretary-Treasurer.
H. W. B. Swabey, M.E.I.C., Branch News Editor.

Target Shooting with the Short Lee Enfield Rifle

A paper indicating keen analysis and considered judgment on the part of the author was presented to the branch on November 17th by J. M. Pope, S.E.I.C., on the subject of "Target Shooting with the Short Lee Enfield Rifle."

The author, in describing the rapid development of the British service small arm since the passing of the old-fashioned flintlock musket in the middle of the last century, declared that the short magazine Lee Enfield is "to-day the most difficult of any military rifle to be put out of action either temporarily or permanently."

This feature of the Lee Enfield results mainly from its dependable bolt action, this being due to the fact that the locking lugs are placed to the rear of the bolt. Though this design unfortunately causes unsymmetrical stresses which produce lateral vibration of the bolt, affecting the accuracy of fire, it has the great merit of avoiding the recess in which the "forelocking" bolt is secured and where dirt may collect to block the bolt action. The principle employed in the Lee Enfield has the added advantage of placing the base of the cartridge right at the breech, where ready access is afforded to remove a jammed case.

After describing the interesting breech mechanism and other mechanical details of this rifle, the speaker referred to its reputed failure to achieve the accurate shooting standards of former and contemporary service arms. This is due principally to the short light barrel which whips or jumps on the discharge of a bullet, causing both vertical and lateral deflection of the muzzle from its original axis. Where this jump is constant, it may be compensated for by varying the height or lateral adjustments of the foresight, but when the whip is unevenly damped by irregular pressure of nose-cap or stock on the barrel, it is necessary to "bed" the rifle by scraping or realigning the stock to fit the barrel.

Afterwards, an interesting discussion on the relative value of open and aperture sights was led by Colonel F. F. Clarke, A.M.E.I.C., chief executive officer of the Ontario Provincial Rifle Association.

A. N. Budden, S.E.I.C., presided over the meeting, and at the conclusion of the paper a vote of thanks was tendered to the author by A. C. Oxley, A.M.E.I.C.

Capacitors

The Montreal Branch was favoured with an interesting description of the elements and uses of "Capacitors" on November 24th in a well illustrated paper by Mr. M. C. Lowe, engineer of the Canadian General Electric Company.

Although employed commercially some thirty years ago, it is but recently that improvements in the manufacture and the increasing demand for high power factor have proved the value of capacitors, or static condensers as they were once called, over other well known electrical apparatus.

The chief difference in the design of capacitors from other electrical appliances is the utilization of a very high voltage gradient in the active dielectric to keep bulk and cost within reasonable limits. As the operating stresses in standard capacitors range from 150 to 300 volts per mill, the highest grade of dielectric material is required, followed by a very careful heat and vacuum process.

The materials used in the construction of the capacitors sections consist of three or more layers of pure linen fibre paper interleaved with aluminum foil, both of approximately one-half mill thickness. The dielectric is first thoroughly dried and evacuated of gas by the application of heat and vacuum for a long period of time before it is thoroughly and slowly impregnated with a high grade treated oil. The units are then thoroughly tested.

Series capacitors secure practically direct current transmission values while retaining all the advantages of alternating current, and may be employed as automatic regulators of transmission voltages for increasing the power limit of long transmission lines or for partially compensating reactance on parallel lines of different characteristics. On the other hand, coupling capacitors, while serving as safe insulating links between carrier current circuits and high voltage transmission lines at ordinary power frequencies, provide a path for the high frequency currents to operate the relays. Capacitors have have also been used as high frequency lightning absorbers and to prevent and diminish contact sparking. Their application to radio equipment is known to all and is a field in itself.

Notwithstanding these uses, it is only in recent years that, from a former position of practically laboratory apparatus, the capacitor has developed to a standard and widely recognized device for correcting power factor on power systems. Since power factors other than unity involve additional investment in generators, transformers, lines and regulating equipment, it is advantageous in a broad sense to employ capacitors wherever it is desirable to improve the power factor.

In the discussion which followed, M. L. de Angelis directed the attention of the meeting to a new type of capacitor called the Silbermann " cable condenser " which has been developed for high voltages and large capacities. The cable condenser consists essentially of a central metal core, a hollow conductor, a metallic envelope and a lead sheet, all separated by insulation.

P. T. Davies, M.E.I.C., while taking part in the discussion, expressed the appreciation of the meeting to the speaker. The meeting was presided over by the branch chairman, Prof. C. V. Christie, M.E.I.C.

Vacuum Process of Paper Manufacturing

The paper submitted to the branch on December 1st by Mr. Ogden Minton on the vacuum process of paper manufacturing, presents an interesting development invented by the author in the art of paper manufacturing. The paper was completely illustrated by lantern slides illustrating the development of the dryer. A special feature of the meeting was the distribution by the author of copies of his paper and illustrations in book form to all those present. The paper is published in full in the current number of the journal.

The interest in the subject was manifested by the number present at the meeting, among whom were many visitors, and considerable discussion followed the presentation of the paper.

The author mentioned that the vacuum dryer is not a completed piece of machinery, but is so far developed that its ultimate success is assured. Its success is due in a great measure to the foresight of Price Bros., who had a trial machine installed at their plant and have carried out a great deal of experimental work with it.

Considerable discussion took place on the subject of dryer felts and their composition, shrinkage, lasting qualities, etc., in which Messrs. G. N. Stevenson, W. G. Mitchell, M.E.I.C., and Van de Carr participated. The latter referred to his experiences with dryer felts on his own dryer machine at the Ste. Anne's mill, where the shortest life was stated to be about 120 days.

The high level of achievement which the inventor had attained in initiating his ingenious improvements in paper manufacturing was remarked on by Julian C. Smith, M.E.I.C., also his efforts to get higher production at cheaper cost. In referring to the possibilities of higher vacuums, which had recently attracted attention when Professor Claude had demonstrated his device for developing power from small temperature variations in sea water, he stated that had the present inventor been able to increase his vacuum slightly he might have dispensed with the use of steam entirely. Not only had the author's efforts benefited the paper industry through the vacuum dryer, but they had also spurred others on to improve the mechanical means for drying paper.

The author stated in his reply that the maximum vacuum he had attained in drying paper was 28.86 inches. He referred to the difficulties in determining the shrinkage of the paper and where this takes place, and also mentioned that 35 to 36 per cent of the moisture can be removed in the pressure process, leaving about 65 per cent to be removed by the dryer.

In reply to a question in regard to steam economy, he stated that in tests made at Price Bros'. mill at Kenogami a saving of steam of 43.8 per cent was shown by the use of the vacuum dryer.

W. G. Mitchell, M.E.I.C., mentioned that there were still opportunities for increased economy in the dryer part of the paper-making equipment, although dryer presses had done a lot in this direction.

It was further stated that in 30 or 40 years no radical changes had been made in paper-making and drying, and that great credit was due to Mr. Minton for his invention.

In reply to remarks by R. A. Ross, D.Sc., M.E.I.C., in which he inquired about the type of pump used for producing the vacuum, Mr. Minton stated that two pumps of 40 h.p. combined were used, manufactured by the Ingersoll-Rand Company, running at 144 r.p.m., which would produce the full vacuum of 28 inches in three minutes.

In expressing the thanks of the meeting, Professor Keay, M.E.I.C., pointed out the great obstacles that arose in the interval between laboratory discovery and field practice, and described the great achievement of the author as a lesson to all in courage and persistence. Mr. G. N. Stevenson added a few remarks in seconding the vote of thanks.

The chairman of the meeting was E. P. Cameron, A.M.E.I.C.

Montreal South Shore Bridge

The following is a synopsis of the address delivered before the Montreal Branch by P. L. Pratley, M.E.I.C., on December 8th, on the progress of this bridge. There was a record attendance at this meeting, which was under the chairmanship of G. H. Duggan, M.E.I.C.

The speaker began by pointing out that he would keep well within the bounds set by the title as printed, and discuss only the actual progress made with the work up to date. In the previous lecture, given in March 1926, the review covered the 1925 season and the commencement of the excavation for pier 25 on the city side of the river, which was started in the winter of 1925-26.

A description of the pneumatic method of sinking caissons as used on this and other piers was entered into and slides were shown of the construction of the caissons used on the bridge. In all, eight pneumatic caissons were employed, two for pier 25 and two for the temporary falsework piers of the Dominion Bridge Company, just north of pier 25, one very large one for the river main pier No. 24 and three others of more moderate dimensions for piers Nos. 13, 14 and 21. These caissons were of different types only as to their upper walls, some being steel throughout, others concrete and others wood. On the south side of St. Helen's island the two built by Messrs. Quinlan, Robertson and Janin were operated by steam, but all the others by electric power. Views were then shown of the large caisson for pier No. 24 being launched at Vickers and being towed up the river to the site. This caisson was a vessel drawing about 12 feet and weighing about 1,030 tons afloat. It was entirely of steel construction and is about the fourth or fifth as to size in the world to date.

The progress of the stone laying and concrete pouring on all the various piers on both contracts and general views showing the gradual completion of the substructure were interspersed with slides of individual piers. Charts indicating the work done during each construction season were presented, and the progress was shown by comparative figures. In 1925, for instance, some 8¼ per cent was done; by the end of 1926 about 68¾ per cent had been completed, and by the close of the 1927 season 95½ per cent. The remainder consists of work in the city on the pedestals and concrete viaduct of the approach, the figures applying to the substructure only.

Allusion was then made to steelwork progress, and a number of views were shown dealing with this interesting feature. It was remarked that, although this to the layman is the real sign of visible progress, to the engineer the completion of the foundations meant a great deal as it is principally in the latter connection that he is dealing with the unknown. Erection of the short spans at the south shore, in September 1926, constituted the first item of the steel placing that means much to the public, but actually anchorage girders had been embedded in the city anchor pier previously. In 1926 the steel was taken out to pier No. 7, and in 1927 it has reached the island and is to be left at pier No. 20 until next season. On the city side, very gratifying progress has been made with the north anchor arm of the main span, and many slides were shown to illustrate the setting of main shoes, falsework bents and trusses, erection travellers, chords, web members and the huge main post sections.

A short study of the economics of the south side steel and masonry layout was given by the lecturer, where the respective costs of substructure and superstructure were compared at various spans.

Mr. Pratley stated that he was not touching on the erection methods and equipment to any greater extent than the presenting of slides, as no doubt the Dominion Bridge Company engineers would be making that the subject of a much more technical paper at a later date. He stated that although there had been delays here and there in certain parts of the work, excellent progress had been achieved on the whole, and nothing had yet occurred to lead the commissioners to fear that the work would not be completed by the date set. The lecture was illustrated by one hundred and twenty lantern slides prepared from progress photographs.

At the close of the address, the chairman proposed a vote of thanks to Mr. Pratley, which was heartily accorded.

Annual Meeting

The annual meeting of the Montreal Branch was held on December 15th, C. V. Christie, M.E.I.C., the chairman of the branch, presiding.

On the motion of H. W. Swabey, M.E.I.C., the minutes of the preceding meeting were taken as read. Thereupon, the chairman presented the annual report of the branch for the year 1927. During the year the executive had held nine meetings, the average attendance being ten. Although the branch membership had shown a slight decrease from 1,023 in 1926 to 1,021 in 1927, this had not been reflected in the financial statement, as the decrease had occurred in the student section, all other sections showing an increase. With regret, the branch reported the loss by death of B. J. Forrest, M.E.I.C., W. L. Scott, M.E.I.C., H. C. Read, A.M.E.I.C., and R. C. Forbes, S.E.I.C. The report described in detail the activities of the branch committees relating to papers, reception, publicity, membership, smoke abatement, annual visit, professional meeting and nominating under the respective chairmanship of A. Duperron, A.M.E.I.C., H. G. Thompson, Jr.E.I.C., H. W. Swabey, M.E.I.C., D. C. Tennant, M.E.I.C., C. M. McKergow, M.E.I.C., J. A. McCrory, M.E.I.C., J. L. Busfield, M.E.I.C., and F. A. Combe, M.E.I.C.

The attendance at the branch meetings during the year proved to be entirely out of keeping with the large resident membership. The average of 98 established in 1926 had fallen to 92 in 1927. It was a cause for regret that in two years 475 members had not attended even one meeting, while 415 others had attended less than six. As a consequence, only 10 per cent of the membership could be considered active.

In presenting the financial statement, the chairman announced that for the first time in the history of the branch it would be possible to hold the professional meeting without calling upon the members for donations. The surplus of 1926 had been increased from $1,533.24 to $2,150.02 at the present time.

On the motions of J. B. Challies, M.E.I.C., and Geo. R. MacLeod, M.E.I.C., respectively, the financial statement and the branch report were adopted unanimously.

On behalf of the scrutineers, F. A. Combe, M.E.I.C., reported the result of the ballot for the election of officers of the branch for the year 1928.

Chairman	F. C. Laberge, M.E.I.C.
Vice-Chairman	J. A. McCrory, M.E.I.C.
Executive Officers	H. Massue, A.M.E.I.C.
	R. DeL. French, M.E.I.C.
	E. A. Ryan, A.M.E.I.C.

On rising to express his personal appreciation, the chairman-elect referred to the honour conferred at the same time upon his French-Canadian confreres. In commenting upon recent engineering developments, Mr. Laberge voiced the opinion that 1928 would prove to be a banner year for the profession in all its branches.

Mr. McCrory, in a few words, expressed his thanks to the members for the honour conferred upon him.

In outlining the progress of the arrangements for the Annual Professional Meeting of The Institute in February, J. L. Busfield, M.E.I.C., chairman of the Annual Meeting Committee of the branch, asked for volunteers to serve on the various committees and announced another interesting paper by Dr. Pariseau, dealing with the Scientific Investigation and History of Egyptian Mummies, to be read at the Annual General Professional Meeting.

Considerable discussion followed, led by Messrs. D. C. Tennant, Geo. R. MacLeod and P. L. Pratley, on the suitability of the grades of membership in The Institute. The secretary, Mr. Durley, reported that Institute committees are working on this subject and announced that His Excellency the Governor-General, Lord Willingdon, had graciously consented to attend and speak at the Annual Dinner.

On a motion of Mr. Tennant, it was resolved that the branch authorize the branch executive to appoint a committee to co-operate with these Institute committees.

O. O. Lefebvre, M.E.I.C., moved a vote of thanks to the outgoing chairman and executive, while Mr. J. A. McCrory expressed the appreciation of the officers to the various branch committees and to the press.

Following an interesting screening of the pictures presenting prominent members of The Institute on the Gatineau trip, obtained through the kindness of the Associated Screen News, the meeting adjourned for refreshment provided by the Reception Committee.

Ottawa Branch

F. C. C. Lynch, A.M.E.I.C., Secretary-Treasurer.

General F. A. Sutton, M.C., late military adviser to Marshal Chang-Tso-Lin, present head of the Pekin government, was the guest of the Ottawa Branch at a luncheon held in the Chateau Laurier on November 24th. The gathering was so large as to overflow the banquet room. The chairman, Noulan Cauchon, A.M.E.I.C., introduced the noted general, who has had a colourful and varied career in the Argentine, Mexico and Siberia and lost an arm at Gallipoli in the great war. During the past seven years General Sutton has been with Chang-Tso-Lin in China, and, with a large improvised map of the Chinese Republic in the background, the general rose to address the members on his "Experiences as a military adviser to the Chinese government."

General Sutton on China

General Sutton sketched a picture of conditions in China as they are to-day; conditions which he said were not properly presented in the press because the news services come entirely from southern China. Northern China or Manchuria, the general said, is the scene of the most rapid settlement in the world to-day. This he attributed to Chang-Tso-Lin, whose stern measures were responsible for keeping a semblance of law and order in the land, and this in spite of Russian influence. Manchuria, he said, is a wonderful agricultural country and had great possibilities. The Russians, however, are taking a big hand in business in Manchuria and Mongolia, and Russian interests now operate and make a large profit from the Chinese Eastern Railroad.

In southern China, or China proper, beyond the domain of Chang-Tso-Lin, conditions are very much worse. According to General Sutton, nineteen per cent of the people are hopelessly poverty-stricken, or, as he expressed it, "one jump ahead of the wolf." The morning salutation in China was not "How are you ?" but "Have you had any breakfast ?" The Chinese he divided into three classes, the coolie, who lived from hand to mouth and formed the bulk of the population, the Chinese merchants, who formed the backbone of the country, and, thirdly, the three or four million half-baked students. The upper classes treated the lower classes very badly and graft was almost universal and worked as a family system. There were never two parties in China, but always a third and each with his two henchmen and their supporters, so that there were usually eight or nine parties in every contentious issue. In this grouping in threes, when the main contenders got through scrapping there was always someone to jump on the vanquished and finish him up.

In the opinion of General Sutton, the Chinese students, mostly fourteen or fifteen years old, could not have any great influence for the advancement of China; there were more students than jobs, and the youngsters were an easy prey for Russian agitators. Into this maëlstrom, said the general, Russian money to the extent of seventy or eighty millions annually is being poured, and the Bolshevist agitators are under instructions to stop at nothing, even murder, to stir up anti-British hatred. The whole campaign is being directed against the British, and there are, he said, eighteen thousand Soviet propagandists at work seeking to undermine British prestige.

General Sutton thought the principal source of trouble in China as it affected Great Britain was lack of a strong-arm policy. One of the main characteristics of the Chinese was in keeping their face. Once a nation or an individual showed even a suggestion of backing down they lost caste. Britain's policy of conciliation in handing back concessions and rights worth many millions of dollars only resulted in ridicule and contempt. British merchants, he said, should have more backing from the home government. When the concessions were given back, these merchants in many cases were absolutely ruined.

Very interesting was General Sutton's sketch of the meteoric rise of Marshal Chang-Tso-Lin. From being an obscure bandit, he had risen to his present commanding position. "He has real courage," said the general, "and although he received little credit for it, he is the best friend foreign interests have." As for the yellow peril, there need be no fear on that score. No Chinese, he said, could organize an army capable of standing up for ten minutes against that of a foreign power.

A number of prominent military men of Ottawa were among those who were seated at the head table. These included Major-General H. C. Thacker, C.B., Major-General H. H. Panet, C.B., C.M.G., D.S.O., Lt.-Col. Lindsay Gordon and Major T. W. MacDowell, V.C., D.S.O.

National Parks Idealism

At a luncheon at the Chateau Laurier on December 1st, the members of the Ottawa Branch had the pleasure of hearing J. B. Harkin, commissioner of Canadian National Parks, in an inspirational address on Canada's National Parks.

Mr. Harkin chose as the theme of his address "National Parks Idealism," and stressed the necessity for the joys of natural beauty in an age when so many people were huddled into cities and living on their nerves. Concentration of vast population in large cities had not been good for man physically or mentally; now, Mr. Harkin said, mass production had given factory work a character of monotony and drudgery disastrous to the nervous system. In fact, man's whole habits had been changed. Less than a hundred years ago he lived largely on his muscles. Now he lived on his nerves and he had not been doing so long enough to have adapted himself to his new environment. So far man had found no effective antidote for these ills of civilization except beauty and the great out-of-doors.

Forty years ago, said Mr. Harkin, Banff, the first Canadian National Park, was created, in the words of Sir John A. Macdonald, "to recoup the treasury and recuperate the people." In Canada's National Parks to-day are incorporated portions of the Dominion which represent the very soul and spirit of beauty, areas of grandeur and sublimity beyond imagination, which arouse in one feelings of almost religious awe and veneration.

Mr. Harkin briefly touched on the enormous traffic to the National Parks. Last year, he said, they were visited by over 250,000 people and they were bringing millions into the treasury. Monetary considerations, however, Mr. Harkin put second to the great fundamental fact that national parks were intended for the preservation of beauty in its natural state; beauty he looked on not as a national but an international property to be enjoyed by all, and he instanced the art galleries and museums of the world which were open for the enjoyment of people of all nationalities.

Speaking of the engineering staff, Mr. Harkin said that on macadam, gravel and dirt roads the parks engineers produced better roads at less cost than any other engineers in America.

Noulan Cauchon, A.M.E.I.C., chairman of the branch, presided and, in expressing thanks to the speaker, he referred to the hope felt by the majority of the people of Ottawa that the government would acquire as a national park an area of the Gatineau hill country, north of Ottawa.

Pscho-analysis and Mental Health

An unusual pleasure was afforded members of the Ottawa Branch at an evening meeting in the Chateau Laurier on December 8th in listening to an address which might be said to be entirely extraneous to engineering. Professor J. W. Bridges, M.A., Ph.D., associate professor of abnormal psychology at McGill University, came from Montreal especially to address the engineers and their friends on "Psycho-analysis and Mental Health."

Professor Bridges, in introducing his subject, reviewed the original concepts of the personality by James, Hartmann, Freud and Jung. According to James, the average person consisted of several selves, as, for instance, his home self, business self and club self. Freud divided the personality into consciousness, foreconsciousness and unconsciousness. Man's actions were motivated by drives, notably sex instinct, ego instinct or the desire for power or security, while other motivating influences were fear, hunger, pugnacity.

Mental conflict, explained Professor Bridges, arose from the individual not being a perfect unit, and he dealt with the various conflicts which arose in different individuals and their alleviation or cure through an understanding of the principles of psychology. Once understood, man's weaknesses might be resolved by sublimation, and he spoke of the sublimation of various conflicts which really consisted in finding an outlet rather than repressing the tendency. For instance, he said, if a man was of a pugnacious disposition he would find alleviation for this distressful state of mind in taking up boxing or perhaps better still in entering politics, which would furnish the necessary outlet for his combative proclivities through the medium of speech.

"Know yourself, accept yourself and be yourself" were Professor Bridges' fundamental rules for mental health, which afterwards provoked considerable interesting discussion by the audience, particularly as to the possibilities of persons psycho-analyzing themselves to discover their mental conflicts and thus be able to apply the correct antidote or find the outlet. Professor Bridges explained that it is quite possible for a person to make considerable progress in self-analysis by following certain set methods for the application of psycho-analysis to oneself.

The meeting was presided over by Chairman Noulan Cauchon, who thanked Dr. Bridges for his most fascinating outline.

Peterborough Branch

W. E. Ross, A.M.E.I.C., Secretary-Treasurer.

Annual Banquet

Mirth and wisdom were both present at the annual banquet of the Peterborough Branch held November 22nd, 1927, at the Empress hotel. The speeches were short and interspersed with many stories, but in their serious portions conveyed many fine ideas.

A. E. Caddy, M.E.I.C., chairman of the local branch, occupied the chair. Music was provided by "The Musical Engineers," and the dinner served by the Empress staff left nothing to be desired.

Amongst the guests of the branch were His Worship Mayor Holloway, R. J. Durley, M.E.I.C., L. W. Gill, M.E.I.C., of the Hamilton Technical School, C. E. Sisson, chairman of the Toronto Branch, A.I.E.E., D. A. McKenzie, of the Hydro-Electric Power Commission of Ontario, J. Showalter, of the Westinghouse Company, J. A. Johnson, of the English Electric Company, Professor H. E. T. Haultain, M.E.I.C., University of Toronto, and representative of the sister professions.

The chairman proposed the toast to the King, which was duly honoured. He then welcomed all those present from the sister professions and sister associations before calling on His Worship Mayor Holloway to speak.

His Worship referred to the remarks made by the engineers and others at the Great Lakes Harbour Association regarding the work of Canadian engineers, and appreciation of Canada's Welland canal project. In conclusion, the Mayor remarked that the people of Peterborough were proud of the local engineers.

A. L. Killaly, A.M.E.I.C., in proposing the toast to "The Engineering Institute of Canada," referred to the establishment of The Institute as the Canadian Society of Civil Engineers forty years ago and gave a brief history of The Institute up to its present position with twenty-five branches and about five thousand members.

R. J. Durley, M.E.I.C., general secretary of The Institute, expressed pleasure at being present at the annual banquet of the Peterborough Branch. He announced that The Institute had this year for the first time been able to get the members of the Council together for a three-day session of great value. The most important question that came up was, he said, the matter of relations between The Institute and the several associations of professional engineers in Canada. It pleased him to say that steps had been taken toward getting admission into all the associations put on an equal basis.

Other subjects considered by this plenary meeting of Council were, Mr. Durley said, qualifications for admission into the various grades of membership, engineering education, etc.

Mr. Durley announced the next annual general meeting for February 14th, 15th and 16th in Montreal, at which the Governor-General is expected to be present.

L. W. Gill, M.E.I.C., of the Hamilton Technical School, congratulated the Peterborough Branch on the large number present and conveyed the greetings of the Hamilton Branch.

He first touched on the matter of engineering education, which had been discussed at the Council meeting. In fifteen years of teaching he had discovered that the engineer is a pretty hard case to educate, learning only what he thought good for him.

He had been asked to speak on technical education, and hoped he would clear up some of the misconceptions. He declined to be considered an expert, who is a man who knows "more and more about less and less."

Technical education is intended to cover something not included in any other scheme. Before the war, 40 per cent of the children never completed the public school. About 25 per cent entered high school, 10 per cent completed the high school course and 1 per cent entered university. The technical school in Ontario was conceived as an aid to industry. People concerned said that the state was providing training for 30 per cent of the children free, while the others were allowed to go out into the world untrained. To provide free training for every person for four years after leaving public school is the aim of technical education. It gives every boy and girl some opportunity to develop latent talent.

Mr. Gill summarized the work of the technical schools in terms of the qualities required for success, namely, character, judgment, efficiency, executive ability, general knowledge and specialized knowledge or skill.

Tribute to the memory of the late R. B. Rogers, M.E.I.C., who passed away since the last annual banquet, was paid by Mr. Caddy. Forty years ago, said the chairman, Mr. Rogers joined The Institute as one of the first members of the Canadian Society of Civil Engineers and fifty years ago he graduated from McGill. Mr. Caddy announced that the branch had decided to place a memorial on or near the Peterborough lift lock, which was designed by this faithful member of the local branch.

Recollections of the old engineering sextette were sung by a new edition containing only one member of the original six. They responded to an encore with "Engineering All the Time."

The toast to "Sister Associations" was proposed by M. V. Sauer, M.E.I.C., which was honoured by the singing of "For They Are Jolly Good Fellows."

C. E. Sisson, of the Toronto Branch of the American Institute of Electrical Engineers, said that he always felt that he was coming home when he was coming to the annual banquet of the Peterborough Branch. He brought greetings from his branch and extended his best wishes for success of the branch. He had good support, he remarked, having with him D. A. McKenzie of the Hydro; J.

Showalter of the Westinghouse Company; and J. A. Johnson of the English Electric Company. Each of these gentlemen also briefly responded to the toast.

Professor Haultain spoke of the Technical Service Council, recently formed by a committee of men from the Association of Professional Engineers and the Canadian Manufacturers' Association. He gave a list of prominent men who form the advisory board. This council is primarily a selling organization to sell the engineer to the public.

W. E. Ross, A.M.E.I.C., introduced the next item, a moving picture entitled "There's Always Room at the Top," and explained it as a man's dream of success in the engineering profession. This was written by Mr. Ross, photographed by Ross L. Dobbin, M.E.I.C., and the actors were members of the Peterborough Branch, with A. B. Gates, A.M.E.I.C., as the hero and W. M. Cruthers, A.M.E.I.C., as the villain.

E. R. Shirley, M.E.I.C., then proposed the toast to "The Sister Professions," which was responded to by representatives of the Teachers' Association, the Ministerial Association and the Legal Profession.

Mr. F. H. Dobbin was, as usual, one of the speakers, and he suggested that the name of the late Walter J. Francis should also be included in the memorial to the late R. B. Rogers.

The singing of "Auld Lang Syne" brought the banquet to an end.

Regular Meeting

The regular meeting of the Peterborough Branch on December 8th, 1927, was held in conjunction with the Peterborough Radio Club. The branch chairman, A. E. Caddy, M.E.I.C., installed G. H. Burchill, Jr.E.I.C., as chairman for the evening, who introduced the speaker, J. M. Thomson, S.E.I.C., radio engineer of Ferranti Electric, Limited.

Mr. Thomson's subject was "The Modernizing of Old Radio Sets and Correction of Troubles Encountered with B Eliminators." The first part of his address, however, reviewed the changes and advances in the construction of radio receiving sets during the past eighteen months. To meet the demand for simplified control, the use of coupled condensers has been adopted, thus reducing the number of controls to one or two, namely, tuning control and volume control with filament switch. This change has involved several problems which have been solved by the radio engineers.

Other developments have been a.c. batteryless sets, the use of shielding and the increase of the amplification of tubes by reducing plate capacity.

Turning to the subject of troubles in radio sets, the speaker listed a number of these with their remedies. He advised the changing of tubes at the beginning of each season and the frequent checking of the condition of batteries. He pointed out the slight difference in characteristic of tubes of the same type and how this might cause trouble when changing tubes. In connection with lightning arresters, he strongly advised the use of a simple grounding switch. At the conclusion of his address, Mr. Thomson gave an interesting demonstration of a method which has been developed to cure a trouble known as "motor boating." This demonstration showed how by a combination of change in transformer connections and the use of by-pass condensers the "motor boating" could be greatly reduced or entirely eliminated.

At the conclusion of the address, Mr. Thomson answered a number of questions on radio matters.

H. O. Fisk, M.E.I.C., proposed a hearty vote of thanks to the speaker which was endorsed by all those present.

Saint John Branch

W. J. Johnston, A.M.E.I.C., Secretary-Treasurer.

A meeting of the Saint John Branch was held on December 9th, 1927, with twenty-one persons present. S. R. Weston, M.E.I.C., chairman of the branch, presided.

A resolution of regret was passed at the death, on December 6th, of D. L. Hutchinson, an Affiliate of the Saint John Branch. Mr. Hutchinson had been interested in branch affairs for a number of years as a Branch Affiliate. He had been in the service of the Meteorological Department for forty-one years, and for a number of years had been in charge of this service in the Maritime provinces.

A proposal to increase the fees of members $5.00 per member started a lively discussion. Geoffrey Stead, M.E.I.C., councillor in attendance at Plenary Meeting of Council, explained the necessity for increased revenue. The executive were asked to submit a report at next branch meeting.

Filtration

An address on filtration was given by J. L. Feeney, A.M.E.I.C. The address dealt largely with the principles of rapid sand filtration and was given in general terms for the benefit of a mixed audience of engineers which had not made this subject a specialty.

In order to discuss the various factors entering into the design, a mechanical filtration plant required for a theoretical city with 10,000 assumed population, located on the upper Saint John river in New Brunswick, was described. It was assumed that the city already had a water system installed with mains in good condition and below frost line, and practically all services metered; the problem was only the purification of the water before it entered the mains. The method of determining the capacity of the proposed plant was described, with due allowance for unusual demands such as occur in the case of a conflagration. It was decided to design a plant to be equipped to filter 2,000,000 U.S. gallons, or twice the normal demand, and capable of housing in future sufficient equipment to filter an additional 1,000,000 gallons. To meet abnormal fire demands, the necessary reservoir capacity was to be provided.

The design of various sizes of pipes, pumps, valves, etc., in accordance with hydraulic laws and practical experience was explained in detail. The economy of designing the pumps for present capacity and the mains to provide for future installations was pointed out.

The speaker compared different methods of water purification and referred to various details of the mechanical filtration process.

The address was illustrated by several wall diagrams and was further explained during a discussion after the reading of the paper. A vote of thanks was tendered to Mr. Feeney on motion of H. F. Morrisey, A.M.E.I.C., and E. A. Thomas, A.M.E.I.C.

Demonstration of a Public Address System

A demonstration of a public address system was given by A. A. Turnbull, A.M.E.I.C. The transmitting horn was installed in the room where the meeting was being held and the amplifier on a lower floor. The principles underlying the system were briefly explained and an inspection made of the several pieces of apparatus.

Toronto Branch

W. B. Dunbar, A.M.E.I.C., Secretary-Treasurer.
(Reported by J. W. Falkner, A.M.E.I.C.)

Joint Luncheon Meeting to Professor Peter Gillespie, M.E.I.C.

Following up the generally expressed opinion, and an informal meeting between the chairmen of the various local engineering socities, looking towards all practical measures of co-operation and fraternization, a special committee was appointed during the summer of 1927 from the Toronto Branch, E.I.C., Toronto Section, A.I.E.E., and the Ontario Section, A.S.M.E., to arrange for one joint meeting during the winter season of 1927-28, and this committee decided that a joint luncheon-meeting should be held on December 1st, 1927, at the King Edward hotel, in honour of one who has for many years rendered single-eyed service to the community, and to the engineering profession,—Peter Gillespie, M.E.I.C., professor of civil engineering at the University of Toronto and one of the vice-presidents of The Engineering Institute of Canada.

The luncheon was held on the above date and was exceptionally well attended, over one hundred and fifty engineers sitting down to the luncheon. It was a thoroughly representative gathering from all the numerous Toronto engineering offices and organizations, and the executives of the three engineering societies sponsoring the luncheon were fully represented at the head table.

Professor A. E. Allcut, M.E.I.C., chairman of the Ontario Section, A.S.M.E., acted as chairman, and after referring to the goodly custom in the professions of law and medicine of according recognition to those who had well and truly served their profession and the community, and, after speaking of Professor Gillespie's sterling worth, genial personality and his qualities as a "prophet whom we delight to honour," called upon Professor A. T. De Leury to introduce the guest speaker.

Professor De Leury, in a witty and appreciative speech, then took his hearers back to the years when "Peter" was a raw undergraduate and afterwards a colleague and friend, comparing him with many other famous "Peters" whom he had known, not omitting such notable characters as Peter the Hermit and Saint Peter. The faculty of arts, he said, unlike the school of engineering, played with ideas long before their practical use, solely for their beauty, interest and diversion, and he believed that "Peter" would have been as much at home in "Varsity" as he was at S.P.S., where, like the famous Saint, he had been a contributory "rock" when strong and sure foundations for that institution were being laid.

Professor Gillespie was then called upon to speak, being warmly greeted with vocal honours and the School of Science "yell." After a humorous story and a few opening remarks thanking those present for his reception, Professor Gillespie launched into the subject matter of his speech, which was based on a newly published book he had recently read,—"The Babbit Warren," by C. M. Joad. This book, Professor Gillespie said, had apparently been published in England by an Englishman who had never been in the United States, and, in his opinion, offered a very unflattering view of that country; in fact, he ventured to think it a caricature or burlesque, and evidenced that fact by some dozen or more paragraphs read at random from the book, which were greeted with loud laughter by the meeting.

The favourite United States "indoor pastime" of "twisting the lion's tail," said the speaker, had its counter-part in the British Empire of frequently "plucking feathers from the eagle's tail." Dickens had indulged that propensity eighty years ago, and the book from which he had read extracts was but another example of a very common attitude of mind, but it was an attitude with which he had little sympathy either on this side of the boundary line or the other. Two reasons why he was not in sympathy were, (1) that such an attitude of mind burlesques manners, things and people in the other country which could be found, were we honest, amongst ourselves, and, (2) that the things so burlesqued had in many cases a very worthy foundation. We should remember that the United States was born in a struggle for liberty in which they were supported by the elder Pitt, Chas. James Fox, Burke, and many other such great Englishmen, and that even to-day, after a century of immigration, fifty-five per cent of the United States stock was said to be of British extraction, and two million of that number were said to have been Canadian born.

The Professor then gave the other side of the story to that contained in "The Babbit Warren," showing how in its one hundred and fifty years history that country had given birth to, and was giving birth to, outstanding spiritual, literary and material values that were an asset to the whole world.

Each of these fields were investigated in detail, through the great New England poets and writers; the fearless struggle against slavery, with its modern counterpart promising some solution to the negro problem in the south; the material values given to the world in labour-saving devices, improved building construction methods, and the system of mass production; the Rockefeller, Sage, Carnegie and such like foundations, devoted to the alleviation of suffering, and the investigation of diseases in Korea, China, Japan, Africa, Jugo-Slavia, Netherlands, Great Britain, Canada, and, in fact, all parts of the civilized and uncivilized world, as well as in the United States, evidenced so far as the British Empire is concerned by the munificent foundation and building recently presented to University College Hospital, London, England, filling a sorely felt need at the centre of the Empire, and also by the magnificently equipped and endowed School of Hygiene and Preventive Medicine opened last year at Toronto University. In connection with mass production, the average output of one workman in the United States was said to be thirty times that of one Chinaman and two and one-half times that of one German, and Kettering has said with reference to the automobile industry that the output of one American was ten times that of one European.

In a spirited address, the Professor pleaded for greater appreciation and understanding in the things which we held in common. He felt that engineers on both sides of the line, with their frequent contacts one with another, were in a peculiarly favoured position to exert a most wholesome influence in this matter. He quoted John Bright to show that the influence of each single man was far greater than he realized, with an ever extended radius.

The relations between the United States and the British Empire were never better than they were to-day, as evidenced by the frequent causes for friction during the 19th century, most of them now happily settled, the present good feeling, and the appointment of a Canadian Ambassador at Washington and a United States representative at Ottawa.

In conclusion, the speaker quoted with approbation the United States Secretary of War Davis' words at Washington on November 12th, 1927, in connection with the unveiling of a memorial to those Americans who enlisted in the Canadian forces during the Great War before the United States had joined the Allies:—

> "Canadians and Americans speak the same language, read the same books and think the same thoughts. Jointly, they occupy the largest area of the earth's surface where a single language is spoken. No unfriendly rivalry mars the even tenor of their intercourse. The calamity of one is the calamity of the other and an attack upon one is an attack upon the other. They are jointly engaged in the greatest work of settlement and civilization known to mankind. The young men who crossed the border and enlisted in the Canadian forces are the latest and most precious offering upon the altar of our mutual friendship."

The Grand Falls Power Development

(Reported by H. Neville Mason, A.M.E.I.C.)

A very interesting paper was read before the Toronto Branch at the regular meeting held on Thursday, November 17th, in the Mining building of the University of Toronto. The speaker of the evening was A. C. D. Blanchard, M.E.I.C., resident engineer on the Grand Falls power development in New Brunswick. Mr. Blanchard represents the consulting engineers for the construction of the power plant, Messrs. H. G. Acres and Company, Limited.

The various stages of construction to date were described, and slides shown giving very good illustrations of the various works covered by the address.

One of the most noteworthy achievements lay in the concluding of all the necessary negotiations with the various governments concerned, and the signing of the contract, in a remarkably short space of time after the formation of the Saint John River Power Company of Grand Falls; construction work being started only four months after the company was formed. The work was awarded to the Dominion Construction Company of Toronto, and it is considered to be one of the rare occasions upon which work of such a character has been let on a unit price contract.

The engineers having been so closely associated in the past with the construction of the Queenston-Chippawa power development for the Ontario Hydro-Electric Power Commission, needless to say, brought their vast experience so gained to the advantage of this construction; so that, when completed, it may be said to be the last word in hydro-electric power construction.

The preliminary foundation and sub-aqueous construction had to be arranged to conform to the peculiar behaviour of the Saint John river, having especial regard to the danger of destruction of the coffer dams by the spring freshets, which are very heavy.

The main dam consists of a series of armoured concrete piers and steel screw lift sluice gates extending entirely across the river, by means of which a head-pond is formed, thirty miles in length, impounding over one billion cubic feet of water with the surface at an elevation fifteen feet above ordinary summer water level.

The Johnson-Wahlman intake is located a short distance above the control works. Two gathering tubes of reinforced concrete built in ledge rock converge on a "*Y*" connection to the tunnel. The tunnel is approximately 28 by 28 feet, horseshoe in shape, and was constructed from a heading 9 by 10 feet.

Very great care was taken to ensure that the minimum of rock excavation was done, to the extent that inspectors checked all drillings before blasting, and, the spacing of holes and depths being all predetermined and regularly arranged, the work was carried through very systematically with very little loss of time.

Only two units will be completely installed for the present; provision is being made for two future units in the superstructure and a fifth penstock from the present distributor. There is room for unlimited expansion at the downstream end of the power house.

Work was officially commenced on August 10th, 1926, and the substructure was completed early in the spring of 1927. Drilling of the lower portal of the tunnel was commenced in September 1926, and the heading was completed in March 1927. The lining of the tunnel is scheduled to be completed by November 30th, 1927. The construction force has averaged 350 men, and considerable credit is given to them, as also to the engineering staff, for the very satisfactory progress that has been made.

Many new mechanical features have been introduced by the engineers, tending to greater efficiency of operation.

It is expected that the work will be completed by July 1st, 1928. It is being carried out under the general direction of Mr. A. H. White, M.E.I.C., vice-president and chief engineer of the International Paper Company. The engineering and supervision of the project are in the hands of Messrs. H. G. Acres and Company, Limited, of Niagara Falls, Ontario.

Discussion was entered into and several pertinent questions asked by O. Holden, A.M.E.I.C., P. Gillespie, M.E.I.C., (vote of thanks), A. T. C. McMaster, M.E.I.C., R. O. Wynne-Roberts, M.E.I.C., F. W. Clark, A.M.E.I.C., G. O. Vogan, Jr.E.I.C., J. A. Knight, A.M.E.I.C., J. R. Montague, A.M.E.I.C.

At the conclusion, a vote of thanks was proposed by Professor Peter Gillespie, M.E.I.C., which was unanimously endorsed by those present and presented to Mr. Blanchard by the chairman, R. B. Young, M.E.I.C.

Vancouver Branch

F. P. V. Cowley, A.M.E.I.C., Secretary-Treasurer.

On Wednesday, November 30th, at the regular meeting of the branch, an excellent paper, illustrated by lantern slides, was given by A. K. Robertson, M.E.I.C., as follows:—

The Reconstruction of Ocean Falls Dam for the Pacific Mills, Ltd., at Ocean Falls, B.C., 1922-1923

The paper-making plant of the Pacific Mills, Ltd., is situated at Ocean Falls, B.C., about 340 miles north of Vancouver, B.C. The first company to operate there was the Ocean Falls Company, Ltd., which built in 1910 a small dam with a spillway at elevation of 225, (datum is 100 at mean tide level), and a small plant, but the company was not successful and the property was taken over by the Crown Williamette Company and the Pacific Mills, Ltd., was formed to operate the plant. In 1915 a gravity section dam with a spillway level of 245 was designed by M. B. C. Condit and built in 1917. Early in 1922 it was decided to add 15 feet to this spillway level. Plans were prepared by Mr. Condit, a contract for the work was let to the writer's firm and work started in July 1922. The raising of the level of the spillway, with consequent alterations in bulkhead sections and necessary increase in thickness, required 17,000 cubic yards of mass concrete 1:3:5 mix, with displacers, and following are the principal figures of the reconstructed dam:—

Type, gravity, mass concrete, 1:3:5 and displacers
Height, (maximum) .... 74.5 feet
Curve, 8 per cent on 716.8-foot radius upstream

Length	691.5 feet on curve
Length of spillway	365 feet
Elevation of spillway	260 feet
Elevation of bulkheads	270 feet
Developed head	171 feet
Average head	140 feet
Storage area, (Link lake)	9 square miles
Length of Link lake	16 miles
Drainage area	140 square miles
Storage	211,000 acre feet at 260-foot elevation

The principal problems in construction arose from climatic conditions, and also from the difficulty in securing a sufficient and satisfactory supply of sand for concrete.

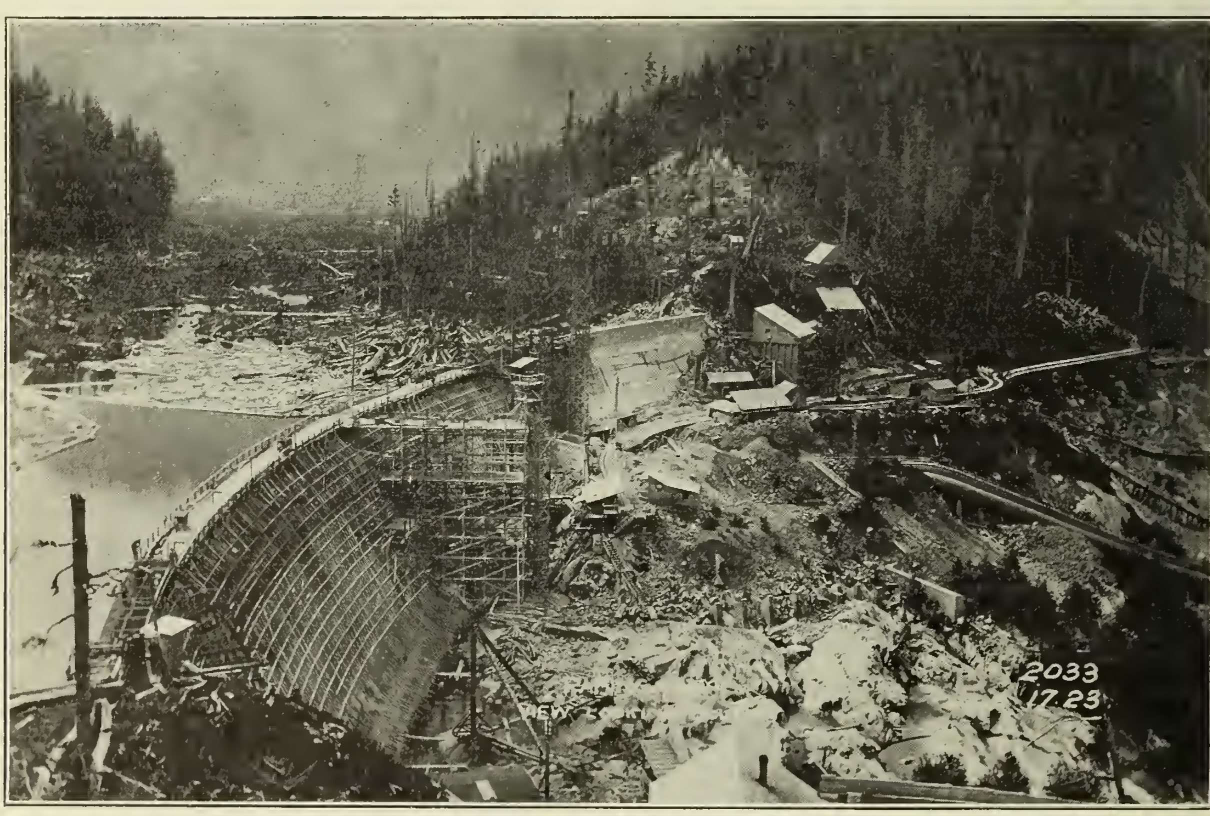
The average annual rainfall at Ocean Falls is about 160 inches and the average snowfall 76 inches, and work is a practical impossibility during the winter months. Construction work could start about March 1st and continue without fear of floods over the spillway until July, when the rise in level of water in Link lake, due to melting snow, reaches its peak. If the water does not go over the spillway then it is a safe assumption that, after July, the water level will fall until the late fall rains bring it up again, usually flowing over the spillway intermittently during the rest of the year. Contractors could therefore count on a safe period from March to July, and if the water did not come over the spillway in July conditions were reasonably safe until about the end of October. This contract was started in July 1922, and during that season all that could be done was the installation of the necessary plant and the building of the south bulkhead. No work was done on the spillway section that season, as with such a late start in the year the risk of doing work on the spillway was too great, and the work was closed down for the season in November. In 1923 work was resumed at the end of February and continued without a stop until completion in August.

Regarding the supply of sand, any of the available sources were very expensive and the contractors decided to supplement the small available supply by using crushing rolls and making sand from the finest product of the rock crushers. In 1922 a set of 24-inch rolls was used, but they were not heavy enough to produce either sufficient or fine enough sand, and in 1923 a set of 36-inch rolls was installed. These were satisfactory, and about 50 per cent of the sand used was provided from the rolls, the balance coming from a local deposit of bank sand. The contractor's view is that, if a project had to depend *entirely* on sand from crushed rock a more elaborate system of rolls would be needed. The rock was granite which shot up well in the quarry and crushed well. The writer has done a considerable amount of concrete work where the supply of sand came altogether from crushed rock.

In addition to the raising of the level of the spillway, the dam was thickened by an average of 10 feet by adding concrete to the downstream face, and great precautions were taken to ensure a good bond and to avoid hydrostatic pressure between the old dam and the new concrete. These precautions were:—a channel about 10 by 10 inches was cut in the old dam along the crest of the spillway. Tile drains were placed in channels cut along the old down stream face and covered with porous concrete to drain any seepage through the old work. The whole of the surface of the old dam on which new concrete was placed was chipped off, (using pneumatic chisels), to a depth of about one inch. Tie rods of twisted steel were set into the old work at intervals of about 4 feet, and these tie rods projected into the new concrete.

The use of displacers was permitted, but except in the south bulkhead where they could be placed without difficulty, their use was discontinued, as the tying wires of the forms and the batter of the form work prevented them being placed easily, and, in addition to that, the organization and plant necessary to move heavy displacers along work in progress interfered very seriously with progress.

In placing concrete it was found that shoots of any length, say, over 30 feet, were not satisfactory as the crushed rock aggregate rolled down the shoots first and the matrix flowed after. Another serious objection was that sometimes a stone would stick in a shoot and, especially at night, this caused serious delay. The system adopted was to have straight short shoots leading from the hoppers at top of towers direct to subsidiary hoppers at different elevations, (which also acted as reservoirs in event of a short delay), and



Reconstruction of Ocean Falls Dam at Ocean Falls, B.C.

take the concrete away from these hoppers in concrete buggies which held about 4 cubic feet. The last lift of 15 feet on the dam was done with small concrete cars which held one batch, (¾ yard), and these fed from hoppers and ran along a steel trestle, 15 feet high, built along the crest of the old dam. This trestle was built of the lightest possible section of steel uprights and braced with lumber. As the concrete rose, the braces were removed and the steel trestle was left embedded in the new work.

The largest month's work was done in June 1923, when 7,000 cubic yards of concrete were placed. At present the daily output of the Ocean Falls plant of the Pacific Mills Limited, is about 270 tons of paper and 20 tons of Kraft pulp.

ANNUAL MEETING

The annual general meeting of the branch was held on Wednesday, December 14th, the ballot for the election of the new officers of the branch for 1928 resulting as follows:—

Chairman	W. Brand Young, A.M.E.I.C.	
Vice-Chairman	W. B. Greig, A.M.E.I.C.	
Secretary-Treasurer	F. P. V. Cowley, A.M.E.I.C.	
Executive Committee	A. S. Wootton, M.E.I.C.	(2 years)
	E. A. Wheatley, A.M.E.I.C.	(2 ")
	H. B. Muckleston, M.E.I.C.	(2 ")
	P. H. Buchan, A.M.E.I.C.	(1 year)
	H. W. Frith, M.E.I.C.	(1 ")
	A. C. R. Yuill, M.E.I.C.	(1 ")
	E. A. Cleveland, M.E.I.C.	(*Ex-officio*)

A full report of the Annual Meeting will appear in a later issue of the Journal.

Victoria Branch

K. M. Chadwick, M.E.I.C., Secretary-Treasurer.

TOWN PLANNING

On Wednesday, October 26th, an interesting lecture was given by Mr. J. H. Doughty-Davies, city zoning engineer of Victoria, B.C., on the subject of "Town Planning." Mr. Doughty-Davies said that town planning had been defined by the Town Planning Institute of Canada 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 in urban and rural communities. He then outlined the five main branches into which town planning is divided, and spoke at length of the situation in Victoria, with particular reference to the district which will be affected by increased port activities in that city.

VISIT TO ROOFING AND PAPER PLANT

On November 11th, on the invitation of Mr. R. Mayhew, manager of the Sidney Roofing and Paper Company, members of the Victoria Branch visited the company's plant and viewed the manufacturing processes used in the production of the company's products.

WATER POWERS OF THE DOMINION

On Wednesday, November 23rd, E. Davis, M.E.I.C., chief engineer of the Water Rights Branch of the British Columbia government, addressed the members of the Victoria Branch on "Water Powers of the Dominion." Mr. Davis' address was illustrated by about fifty lantern slides. He briefly outlined the hydro-electric development which is going on throughout the Dominion. Quoting from a pamphlet recently issued by the federal department of the interior, Mr. Davis gave some outstanding facts of the power situation in this country. One-fifth of the water power utilized in the manufacturing industry is in the manufacture of pulp and paper. His figures also showed that Canada is well ahead of the United States in the use of hydro-electric energy in proportion to the population.

Winnipeg Branch

James Quail, A.M.E.I.C., Secretary-Treasurer.

RESEARCH PROBLEMS IN CANADA

A meeting which aroused considerable interest was held on October 26th, when Theo. Kipp, M.E.I.C., addressed the members on the subject of "Research Problems in Canada." In his opening remarks, Mr. Kipp explained that he had prepared his paper with a view to having it used as a basis for the discussion on research in Canada. He read from journals and newspaper items and editorials to illustrate the interest that has been taken in research and the results which had been obtained, reviewing these results at some length. The speaker then described the various organizations established for the purpose of undertaking research work.

The discussion was opened by Professor J. N. Finlayson, M.E.I.C., who emphasized the importance of the subject and expressed his appreciation of Mr. Kipp's recognition of this. He reviewed the conditions leading to the proposal to establish the National Research Bureau.

It was suggested by Mr. Kipp that the National Research Council might be criticized for not giving sufficient publicity to its activities.

Professor Dorsey drew attention to the fact that the most effective fashion in which impetus was given to research was the demonstration of the money-making aspect of invention. In this connection he defined invention as "The art of the application of scientific principles to practical use." Professor Dorsey supported the idea that effort in research in a country should not be confined to one point or locality, but should be carried on at a number of centres. Conditions peculiar to particular localities and problems of specific interest to them should tend toward the more active and effective research being carried on where the advantage of the conditions utilized and the interest recognized.

E. V. Caton, M.E.I.C., urged that the purely scientific research should be placed well forward in the thought of those formulating a policy toward constructive research; also, that the broader the scope of endeavour, and the wider the field from which is drawn those engaged in research, the more certain is the result.

J. G. Sullivan, M.E.I.C., gave it as his opinion that the more purely scientific research might well be carried on largely at one centre, but that the more practical research could much better be engaged in at a number of centres.

J. W. Sanger, A.M.E.I.C., instanced the difficulty of marketing carbonate of copper produced by the electrolitic process locally as illustrating the necessity of some co-ordinating medium.

G. R. Pratt, A.M.E.I.C., spoke in support of Mr. Sullivan's attitude.

Mr. Kipp suggested that the National Research Council might use The Institute as one of its avenues through which to get publicity. Messrs. Caton and Finlayson spoke with reference to the advantage of publicity.

It was moved by W. P. Brereton, M.E.I.C., seconded by Prof. Dorsey, and carried, that,—The Research Committee of the branch, with power to add to its numbers, approach the University of Manitoba relative to the possibility of co-operating with it in the matter of research; having particularly in mind the activities of the National Research Council or such further activity in research as may or might develop as the result of legislation that may be brought down before the next session of the federal parliament; further, that the Research Committee of the branch report back to the branch at its next regular meeting.

Moved by J. G. Sullivan, M.E.I.C., and seconded by Professor Dorsey, and carried, that the branch address a communication to the governmental authorities advising them that the Winnipeg Branch of The Engineering Institute of Canada was definitely in favour of the enactment of legislation that would stimulate and facilitate research in Canada.

ELECTRIC WIRING REGULATIONS

At the regular meeting of the branch held on November 3rd, Mr. F. A. Cambridge addressed the members on the subject of "Electric Wiring Regulations." He explained the first attempt to formulate rules for governing wiring in 1892, when the New York Board of Fire Underwriters issued rules for safety wiring. In 1897, the first edition of the National Electric Code was issued and adopted by all Fire Insurance Boards.

Following the discussion of the subject of electric wiring of buildings by the Fire, Water and Light Committee of the city of Winnipeg in 1897, a municipal act incorporating the results of the discussion was passed in the following year, 1898. Public feeling on the subject of proper wiring of public buildings was stirred by the Iroquois theatre fire and resulted in the adoption in 1907 of special regulations regarding the wiring of theatres.

In 1913 a by-law was passed calling for metal encased wiring in congested business districts. In 1921 the prohibiting of duplicate services to buildings was covered by a by-law, and the compulsory use of rigid conduit for service wires and grounding, and the use of externally operated service boxes were also covered by the by-law. In 1926 the present by-law was passed which incorporated the 1928 National Electrical Code.

The next portion of the paper dealt with the defects met with as affecting (a) the power company; (b) the safety of the installation; (c) sufficiency of installation; (d) trades other than electrical wiring.

The speaker then mentioned the necessity of revising the electrical codes periodically in order to keep abreast of development, and stated that codes must strike a balance between adequacy and excessive cost. The question of demand factor would need further and careful consideration.

Institute Committees for 1927

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C. M. McKergow (two years)
J. M. Oxley (one year)

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Preliminary Notice

of Applications for Admission and for Transfer

December 16th, 1927.

The By-laws now 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 election 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 1928.

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 or 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.

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.

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

ALLCHURCH—HARRY, of Lachine, Que., Born at Bradford, Eng., Apr. 17th, 1886; Educ., course in textile mach., Bradford Tech. Coll., 1906-07, course in applied science, Mtl. Tech. School, 1913-14, mathematics, I.C.S.; 1910-11, shop experience, Allis-Chalmers-Bullock; 1911, Can. Crocker Wheeler, St. Catharines, Ont.; 1911-12, Railway Signal Co. of Can.; 1913-14, dfting, Dom. Bridge Co., Lachine; 1919-20, with Dom. Engrg. Works, Lachine, on design for Fourdrinier paper machines, Warren grinders, suction rolls, peels and miscellaneous paper making machinery; 1921-22, with Can. Northwest Steel Co., Vancouver, on design of steel structures for Britannia Mines and Powell River Paper Mills, B.C., highway bridge at Stave Falls, B.C., sluice gates, coal conveyors, etc.; 1922 to date, Dom. Bridge Co., Ltd., Lachine, designing steel coal scows and gate lifting scows, grain car unloaders, electric overhead travelling cranes, and, at present, checking details, Montreal-South Shore bridge.

References: F. P. Shearwood, F. Newell, A. Peden, F. J. McHugh, P. L. Pratley.

BANKS—OSBORNE HENRY, of London, Ont., Born at Toronto, Ont., Mar. 31st, 1900; Educ., 1st class prof. Ont. teacher's certif., hon. matric., 2 yrs. science at Queen's Univ.; at present, teacher, London Pub. Schools, i/c constrn. work of 1st Signal Batt.

References: F. C. Ball, W. M. Veitch, R. W. Garrett, J. R. Rostron, W. P. Near, E. V. Buchanan.

BLOOMFIELD—JAMES MUNRO, of Kamsack, Sask., Born at Turma Factory, Behar State, India, Dec. 22nd, 1887; Educ., 1897-99, private and public school educ., Edinburgh, 1899-04, George Watson's College, 1906, diploma, Heriot Watt College, Edinburgh; 1902-03-04 (summers), apptceship with Cran & Co., Ltd., Leith, Scotland, marine engrs.; 1905-10, apptce., Mavor & Coulson, elect'l engrs., Glasgow; 1910-12, Brit. Thomson Houston Co., Ltd., Rugby, Eng.; 1912-14, Lancashire Dynamo & Motor Co., Manchester, Eng., i/c ordering material for switchboards and switch gear and instruments for a.c. and d.c. motors and generators; 1914, Cunningham Electric Co., Calgary, i/c constrn. passenger and freight elevator motors and switchgear; 1914-16, Bowness Improvement Co., Ltd., Calgary, ch. operator of power plant; 1916-19, officer overseas with Can. Engrs., 8th Field Co., and Can. Tunnelling Co.; 1919-22, partner in firm of General Engrs., Ltd., Calgary, i/c shop work, rewinding motors and generators, outside erection work, etc.; 1922 to date, supt., light, heat & power plant, Kamsack, Sask.

References: H. P. Fuller, C. F. Corbett, R. MacKay, R. S. Trowsdale.

CHVILIVITZKY—JAKOV, of Toronto, Ont., Born at Orsha, Russia, Nov. 28th, 1895; Educ., high school, infantry officer school, 3 yrs. Politechnic Institute in Petrograd, at present, 4th yr. Dept. of C.E., University of Toronto; 1915-20, in Russian army; Jan. to Nov. 1920, dept. of armouries and barracks, Pskov, as asst. to ch. engr.; Apr. to Dec. 1922, dept. of sewers and pavements, Petrograd, supt. of work in one of city districts; Aug. 1925 to Apl. 1926, Petrograd branch of State Industrial Trust in dept. of depreciated machines and materials; May to Sept. 1927, field and office work with J. J. Newman and C. R. Armstrong, Windsor, Ont.

References: C. G. R. Armstrong, P. Gillespie, C. R. Young, W. B. Dunbar, P. V. Jermyn.

DEWEY—PHILIP ANDREW, of Niagara Falls, Ont., Born at Montpelier, Vt., May 29th, 1888; Educ., B.S.C.E., Univ. of Vt., 1909; 1909 to date, in engineering dept. of Can. Ramapo Iron Work, Limited, designing ry. road track equipment; 1923 to date, also with Ramapo Ajax Corp. of Niagara Falls, N.Y.

References: H. M. King, T. S. Scott, J. R. Bond, G. Mountford, W. Jackson.

DOUGHTY-DAVIES—JOHN HERBERT, of Victoria, B.C., Born at Llangollen, North Wales, June 28th, 1893; Educ., articled pupil, Urban D. C. engr's. office, Llangollen, 1910-13; 1913-16, asst. engr., P.W.D., Sask. Prov. Govt.; 1920-22, res. roads engr. under War Office, Salisbury Plains, Eng.; 1923-25, res. engr., Humber canal, Nfld.; 1925-26, various temporary works; 1926 to date, zoning engr., city of Victoria.

References: H. L. Swan, E. G. Marriott, K. M. Chadwick, F. M. Preston, A. O'Meara.

GREEN—LESLIE THOMPSON, of Toronto, Ont., Born at Brantford, Ont., Oct. 17th, 1893; Educ., high school, I.C.S., architecture and maths.; 1907-10, apptce. in architecture; 1911-13, apptce. in engrg.; 1914-18, engrg. dftsman, Trussed Concrete Steel Co.; 1919, ch. dftsman, F. W. Warren, archt.; 1920-22, ch. engr., R. E. W. Haggerty, consulting engr., Toronto; 1923-24, in business for self; 1924, engr., A. Kohn, archt., Detroit; 1925-27, asst. ch. engr., S. S. Kresge Co., Detroit; 1927 to date, designing and supervising engr., T. Pringle & Son, Ltd.

References: J. S. Costigan, G. M. Wynn, M. Helbronner, A. C. Dogherty, E. C. Miller.

HURST—WILLIAM, of Winnipeg, Man., Born at Ottawa, Ont., Jan. 1st, 1877; Educ., public schools, Man.; 1900-10, grading streets, preparing for pavements and building macadam pavements, i/c brick and concrete sewers, supt. of sewers and water works, i/c artesian wells for one year, i/c foundation of high pressure plant and intake from river to plant, for city of Winnipeg; 1910, completed deep well and screen house intake for water and discharge of steam from Red river to standby plant, Winnipeg Electric Ry.; 1911, formed Hurst Engrg. & Constrn. Co., engaged on sewerage, pavements, excavation and intake for pump well for C.N.R., constrn. of reinforced concrete bridge, water supply systems, culverts for ry. road work, repairs on bridges and abutments; 1922-25, mtce. work for C.P.R. and C.N.R.; 1926-27, i/c rock crushing plant, Bonheur, Ont., and i/c rock ballasting of C.P.R.; at present, pres., Hurst Engrg. & Constrn. Co., Ltd.

References: W. Aldridge, E. W. James, A. W. McGillivery, H. Dixon, T. Lees.

LAURIAULT—WILFRED ELDIGE, of Montreal, Que., Born at Montreal, Nov. 24th, 1899; Educ., chem. engr., Univ. of Mtl., 1922; 1922, asst. engr., Dept. of Lands & Forests; 1923, asst. engr., Belgo Paper Co., Shawinigan Falls; 1924-26, professor, School of Papermaking, Three Rivers; 1926-27, supt. and tech. engr., Que. Pulp & Paper Co., Chicoutimi; at present, engr., tech. service, city of Montreal.

References: G. R. MacLeod, E. Lavoie, B. Pelletier, L. Delisle.

LAZENBY—THOMAS WILLIAM, of London. Ont., Born at York, Eng., Feb. 13th, 1900; Educ., high school. 4 yr. course of study in mech. engrg. at York Tech. Evening School, certif. of merit awarded, first class certif. for maths. awarded by Nat. Union of Teachers, Eng.; 1915-23, with Leltham Flour Mills, York, 2 yrs. dfting and 4 yrs. fitter and machinist; 1918-19, dfting, with T. H. Scar, shipbuilder, Howden, Yorks; 1923 to date, ch. dftsman, with E. Leonard & Sons. Ltd., London, Ont.

References: I. Leonard, A. H. Morgan, E. V. Buchanan, D. M. Bright, J. K. Ashworth.

MATHIESON—T. STANLEY, of Hawkesbury, Ont., Born at Beachburg, Ont., Sept. 29th, 1903; Educ., B.Sc., Queen's Univ., 1926; May 1926 to Mar. 1927, asst. to combustion engr. and Mar. 1927 to date, dftsman, Can. Int. Paper Co., Temiskaming and Hawkesbury.

References: L. S. Dixon, J. G. MacLaurin, L. M. Arkley, L. T. Rutledge, C. B. Shaw, J. Tomkins.

MIDGLEY—GEORGE HENRY, of Montreal, Que., Born at Glasgow, Scotland, Oct. 13th, 1901; Educ., B.Sc., mech. engrg., N.S. Tech. Coll., 1924; 1922-23 and 24 (summers), mechanic in machine shop, Brit. Empire Steel Corp., Sydney; 1925 (4 mos.), testing and inspecting engr., Marconi Co. of Canada, Ltd., Montreal; 1925-26, constrn. engr., layout, field work, etc., Riordan Pulp Corp., Temiskaming, Que.; 1926 to date, sales engr. i/c of this branch as related to pulp & paper mill work in Canada, Dodge Mfg. Co. of Canada, Ltd., Montreal, Que.

References: A. P. Theuerkauf, L. S. Dixon, D. W. Munn, H. W. McKiel.

PRUD'HOMME—MICHAEL ALEXANDER, of Outremont, Que., Born at Ottawa, May 8th, 1891; Educ., 3 yrs. private tuition, passed final exam. of Corp. of Prof. Engrs. of Quebec, 1925; 1919 to date, with Hart-Otis Car Co.; 1919-22, dftsman; 1922 to date, ch. dftsman, design and constrn. of ry. freight cars of spec. constrn.

References: F. B. Brown, W. Walker, R. E. Jamieson, J. A. McCrory, W. H. Yost.

RAINSFORD—CHARLES ALEXANDER, of Cadboro Bay, B.C., Born at London, Eng., Feb. 28th, 1881; Educ., 3 yr. elect'l engrg. course at Northampton Polytechnic, completed 1902; 1903, i/c testing dept., Langdon Davies Motor Co.; 1904-07. Lots Road power house of Underground Rlys. Co. of London; 1907, in elect'l assembly dept. of Allis-Chalmers-Bullock Co., Montreal, in drawing office of Point-du-Bois power scheme; 1908-17, general elect'l constrn. and repairs; 1919-21, elect'l supt. at Port Alice plant of Whalen Pulp & Paper Co.; 1921-25, general repair and constrn. work in B.C.; 1925, installed switchboard and electrical apparatus at the Esquimalt drydock for Hodgson, King & Marble; 1926 to date, 2nd operating engr. at the new Esquimalt drydock.

References: R. F. Davy, S. Hodgson, J. P. Forde, W. M. Everall, J. B. Lambert.

FOR TRANSFER FROM ASSOCIATE MEMBER TO A HIGHER GRADE

KENNEDY—HOWARD, of Ottawa, Ont., Born at Dunrobin, Ont., May 31st, 1892; Educ., B.Sc., McGill Univ., 1914; 1912 and 13 (summers), student asst. on topographic and magnetometric surveys for Mines Branch; 1914, i/c survey party for Mines Branch; 1915-19, overseas service in England and France with Can. Engrs., 1916, and B.E.F., M.C., 1917, wounded, Aug. 1918, in hospital till Nov. 1919, rank captain; 1919, dftsman and designer for Lockwood Greene & Co.; 1920-21, res. engr. on constrn. for same firm; 1921, contracting and bldg. roads and bridges for Co. of Carleton; 1922 to date, with E. B. Eddy Co., Ltd.; 1922-23, asst. to ch. engr. on steel design and erection and concrete work; 1924-25, i/c surveys and constrn. of roads, dams, bridges, etc., on company's limits; 1926 to date, manager, woodlands dept., i/c all woods operations and purchase of pulpwood and match lumber.

References: F. M. Pratt, A. H. A. Robinson, C. S. L. Hertzberg, A. MacPhail, J. A. Duchastel.

McVEAN—HAROLD GORDON, of Toronto, Ont., Born at Dresden, Ont., Dec. 18th, 1880; Educ., B.A.Sc., Univ. of Toronto, 1902; 1902-05, on faculty of applied science and engrg., Univ. of Toronto; 1905-07, investigation of Mexican Light & Power Company's development near Mexico City for a report to Senator Cox; associated with W. Chipman as res. engr. on design and constrn. of sewers, sewerage works, water supply and distrib. systems, power & pumping stations; 1908-15, engaged on engrg. and contracting under own name; 1912-14, actively interested in inception, org. and training of 3rd Field Troop, Can. Engrs.; 1915-19, with C.E.F. in Canada, England and France, with rank of lieut.-col. from 1917; 1919-22, engaged in engrg. and contracting business under name of H. G. McVean Co., Ltd., extending field of work to inc. concrete structures and railroad work for C.P.R. and C.N.R.; at present, consultant re business and personal estate org., estate taxation, life ins., business and personal trusts, etc.

References: P. Gillespie, C. R. Young, W. Chipman, C. B. Hamilton, A. E. K. Bunnell, N. R. Gibson, L. A. Thornton, H. R. MacKenzie, R. N. Blackburn.

FOR TRANSFER FROM JUNIOR TO A HIGHER GRADE

HOPPER—GARNET HENRY, of Toronto, Born at Deseronto, Ont., Dec. 31st, 1893; Educ., B.A.Sc., Univ. of Toronto, 1919; field dftsman with Bernard H. Prack; heating engr., Taylor Forbes Co., Ltd.

References: R. W. Angus, W. Cross, J. Gibson, F. Goedike, T. R. Loudon, W. Orr, C. R. Young, P. Gillespie.

FOR TRANSFER FROM STUDENT TO A HIGHER GRADE

BONNEVILLE—SYDNEY, of Montreal, Que., Born at Ottawa, Sept. 28th, 1896; Educ., B.Sc., McGill Univ., 1922; 1919 (summer), militia survey; 1920 (summer), C.G.E. Co.; 1921 (summer), Geodetic Survey; at present, protection engr., reporting to transmission engr., Bell Telephone Co. of Can.

References: J. L. Clarke, G. A. Wallace, C. V. Christie, E. Brown, F. C. C. Lynch.

CHALMERS—ANDREW EDWARD, of Ridgeway, Ont., Born at Cobourg, Ont., Dec. 18th, 1899; Educ., B.Sc., Queen's Univ., 1923; 1920 (summer), inspector for Toronto-York Roads Comm.; 1922 and 1923 (summers), asphalt plant inspector, Dept. Public Highways, Ont.; 1923-24, jr. office engr., Kerry & Chace, Toronto; 1924, res. engr. for E. H. Darling on Smiths Falls dam, filter plant and elevated tank, dance pavilion and improvements to Crystal Beach Park, sewer constrn. and filter plant pumping station intake and 7 miles of watermains, Crystal Beach; Jan. 1925 to Apl. 1927, supt. of waterworks dept. and engr. for Crystal Beach on design, constrn. and supervision of sewers; Apl. 1927 to date, engr. and road supt. for twp. of Bertie in Welland county.

References: E. H. Darling, A. T. C. McMaster, R. M. Smith, L. Malcolm, W. P. Wilgar, A. MacPhail.

ELKINGTON—GERALD ERLAM, of Toronto, Ont., Born at Duncan, B.C., Jan. 7th, 1899; Educ., B.Sc., McGill Univ., 1923; 1922 (summer), with Shawinigan Engrg. Co.; 1923-24, in test dept. of Gen. Electric Co.; 1924 to date, erecting engr., with Can. Gen. Electric Co., Ltd.

References: C. V. Christie, J. T. Watson, G. N. Thomas, G. R. Wright, N. D. Seaton.

FLEMING—CANMORE DRAKE, of Toronto, Ont., Born at Windsor, Ont., Jan. 2nd, 1899; Educ., B.Sc., McGill Univ., 1924; town surveying and planning dept., Morris Knowles & Co., Pittsburgh, Pa.; dfting and checking, Can. Bridge Co., Walkerville, Ont.; dfting and checking, Whitehead & Kales, Detroit, Mich.; shipping and dispatching, United Fuel and Supply Co., Detroit, Mich.; Anglin Norcross, Ltd., Royal York Hotel, Toronto.

References: C. M. McKergow, E. Brown, C. G. R. Armstrong, W. H. Baltzell, A. J. M. Bowman.

FLEMING—JOHN MURRAY, of Port Arthur, Ont., Born at Winnipeg, Man., July 16th, 1899; Educ., B.A.Sc., Univ. of Man. 1921; 1917 (summer), rodman on constrn. of Hudson Bay Ry.; 1920 (summer), field dftsman on revision of sectional sheets for Topographical Surveys Branch; 1921-22, demonstrator at Univ. of Man., taking course in reinforced concrete design towards M.Sc. degree; 1922-23, dftsman, Manitoba Power Co., on design of power house superstructure and masonry dam; Feb. to Sept. 1923, asst. to contractor's ch. engr. with Walbridge Aldinger Co. of Detroit, for Spavinaw water project, i/c laying out and supervising constrn. of a temporary ry.; Oct. & Nov. 1923, on foundation of a Coppers coke plant for Wpg. Electric Ry.; 1924 to date, designing engr., with C. D. Howe & Co., on design and supervising erection of terminal grain elevators.

References: C. D. Howe, W. H. Souba, R. B. Chandler, J. N. Finlayson, J. M. Morton, A. W. Fosness.

HARLOW—GEORGE HAMMOND, of Toronto, Ont., Born at London, Eng., May 16th, 1900; Educ., B.A.Sc., Univ. of Toronto, 1922; 1923, inspection for Can. Inspection Co. at Algoma Steel Corp., Sault Ste. Marie; 1923-25, development dept., Dunlop Tire & Rubber Corp., Buffalo; 1925-27, development dept., Goodyear Tire & Rubber Co., New Toronto; at present, instructor in thermodynamics at Univ. of Toronto.

References: E. A. Allcut, R. W. Angus, P. Gillespie, T. R. Loudon, C. H. Mitchell, C. R. Young, J. R. Cockburn, W. B. Dunbar.

LONG—CLARENCE ROBERT, of Orillia, Ont., Born at Orillia, Dec. 12th, 1898; Educ., B.Sc., Queen's Univ., 1923; 1919-23 (summers), in machine shop of E. Long, Ltd., Orillia; 1923 to date, engrg. and cost accounting in connection with sawmill, mining and elevating and conveying equipment with E. Long, Ltd.

References: L. T. Rutledge, L. M. Arkley, G. L. Guy.

MESSENGER—WILLIAM AUBREY, of Windsor, Ont., Born at Valleyfield, Que., July 30th, 1900; Educ., B.Sc., McGill Univ., 1922; one summer, bridge inspection with G.T.R. evaluation; 2 summers, on constrn. work at Cedar Rapids power plant of M.L.H. & P. Co.; eighteen months with Can. Bridge Co. on detailing and checking drawings on structural steel bldgs., bridges, etc.; four years with J. V. Gray Constrn. Co. of Toronto, as engineer and cost clerk and superintendent; at present, vice-president and engr., with G. H. Emery Constr. Co. of Windsor, Ont.

References: H. M. MacKay, A. J. M. Bowman, R. A. Spencer, E. G. Ryley, F. S. Milligan, G. Porter, H. Thorne, J. C. Keith.

RIDDELL—WILLIAM FOREST, of Winnipeg, Man., Born at Smiths Falls, Ont., Apl. 25th, 1897; Educ., B.Sc., Univ. of Man., 1924; 1923-24, instrumentman, C.P.R.; 1925-27, lecturer, civ. engrg. dept., Univ. of Man.; 1925, asst. engr., Backus Brooks Pulp & Paper Co., Kenora, Ont.; 1927, of designing and estimating, Dom. Bridge Co.

References: J. N. Finlayson, E. P. Fetherstonhaugh, N. M. Hall, H. M. White, J. R. Paget.

TRUEMAN—MARK CECIL, of Winnipeg, Man., Born at Chatham, Eng., July 1st, 1899; Educ., B.Sc., Univ. of Man., 1923; 1923-25, grad. apptce., Can. Westinghouse Co., Hamilton; Jan. 1926 to May 1927, jr. elect'l engr., Rio de Janiero Tramway, Light & Power Co., Brazil; 1927 to date, power engr., attached to sales dept., Wpg. Hydro-Electric System.

References: E. P. Fetherstonhaugh, T. W. Sanger, D. G. Sutherland, N. M. Hall, T. C. Main.

WESTREN—J. HARVEY, of Toronto, Born at Toronto, June 8th, 1900; Educ., B.A.Sc., Univ. of Toronto, 1922; 1923-24, asst. to ch. inspector, pneumatic tire div., Dunlop Tire & Rubber Corp., Buffalo; 1924-25, asst. to experimental engr.; 1925-27, asst. to supt., mech. goods div., same Co., in Toronto.

References: E. A. Allcut, J. R. Cockburn, T. R. Loudon, R. W. Angus, P. Gillespie, W. B. Dunbar.

WHITE—JOSEPH JAMES, of Saskatoon, Sask., Born at Oldham, Eng., Mch. 3rd, 1896; Educ., B.E., Univ. of Sask., 1925; 1912-15, gen. bldg. constrn., with Frid Lewis Co.; 1915-19, with Can. Forces and R.A.F.; 1920 (summer), dfting, Murphy & Underwood, Saskatoon, also fabricating & placing reinforcing steel on Lanigan school; 1920-23, dfting, designing and general constrn., Miners & Ball, Ltd., Saskatoon; 1923 to date, supt. of general constrn. work and design, with same firm.

References: A. R. Greig, C. J. MacKenzie, G. M. Williams, E. H. Phillips, H. McI. Weir, J. E. Underwood, W. G. Worcester.

WIGHTMAN—JOHN, of Sydney, N.S., Born at Digby, N.S., Feb. Ist, 1900; Educ., B.Sc., McGill Univ., 1922; 1921 (summer), underground experience, Champion Copper Mine, Mich.; 1922-23, surveyor's helper, ry. & concentrator constrn., Kimberley, B.C.; 1923-24, surveyor's asst., underground and surface surveying, Sullivan Mine, Kimberley, B.C.; 1924-25, surveyor, Sullivan Mine; 1925-26, standardizing mine and surface maps, Coast Copper Co., Quatsino Sound, Vancouver Island, B.C.; 1926 to date, mine exploration in N.S., N.B. and Nfld. for Cons. Mining and Smelting Co. of Canada, Ltd., Trail, B.C.

References: H. W. McKiel, C. M. McKergow, F. C. Wightman.

FOR TRANSFER FROM AFFILIATE TO A HIGHER GRADE

NELSON—MAXWELL STUART, of Montreal, Que., Born at Montreal, Aug. 14th, 1893; Educ., B.Sc., McGill Univ., 1915; 1911-14, mtce. of way dept. and instrumentman, res. engrs. dept., C.P.R.; 1914, asst. demonstrator, survey field school, McGill Univ.; May to Aug. 1915, roads, streams and lake survey, Geological Survey; Aug. to Dec. 1915, mine survey, engrg. dept., Int. Nickel Co., Copper Cliff, Ont.; 1916-17, chemist, physical test dept., in ind. lab., Can. Inspect. & Testing Labs., Ltd.; June to Nov. 1917, works engr., A. F. Byers & Co., Ltd.; 1917-18, plant chemist, Can. Electro Metals, Shawinigan Falls, Que.; 1919-23, purchasing dept., A. F. Byers & Co., Ltd., i/c small constrn. jobs; 1923 to date, i/c design, detail, manufacture and installation of architectural and bldg. constn., ironwork and light structural steel, A. Faustin, Ltd., Montreal.

References: J. H. Forbes, C. S. Kane, A. F. Byers, W. McG. Gardner, H. W. B. Swabey, P. Simpson, A. T. Bone.

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Chippawa Creek Syphon Culvert of the Welland Ship Canal

Deep Open Pit Excavation in Soft, Water Bearing Material

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Paper to be presented at the Annual General Professional Meeting of The Engineering Institute of Canada, at Montreal, Que., February 15th, 1928

General Description of Canal

The Welland ship canal, now in course of construction by the Dominion Government across the Niagara peninsula, is one of the most important engineering works in hand at the present time in the British Empire and North America. When completed, about 1930, it will be the fourth canal built by Canada during the past one hundred years across the peninsula for the purpose of connecting lakes Erie and Ontario. The canal will also be the largest link in the projected ship canal project connecting the Great Lakes with the Atlantic ocean via the St. Lawrence river. Its general location and profile are shown in figure No. 1.

The total length of the canal will be 25 miles, and for all practical purposes it will be a straight line throughout; it will be 1¾ miles shorter than the present 14-foot navigation canal, and will have only eight locks in place of twenty-six on the latter. It will be 25 to 27½ feet deep, 200 feet wide on the bottom and 310 feet at the water line. All of its structures will be built for a depth of 30 feet, so that the canal, at some future date, can be enlarged by simply dredging out the canal prism and harbour entrances. There will be twenty-one bridges on the canal; two swing, seven rolling lift and twelve of the vertical lift type.

The fall of 325½ feet between the lakes will be overcome by seven locks of 46½ feet lift each. The direct line of the canal down the face of the escarpment, and the configuration of the plain below it, permitted the adoption of these high lifts, which constitute a peculiar feature in the design of the canal, and have no precedent in actual construction of locks of their size. The usable dimensions of the locks will be 820 feet long, 80 feet wide and 30 feet of water on the sills. The guard lock at Humberstone will have a usable length of 1,355 feet and will have the same width of chamber and depth of water as the other locks of the canal.

These dimensions at once place the present work in the front rank, and, in fact, in some respects it stands absolutely unequalled. The Panama canal, for instance, has a total rise of 85 feet, and the highest lift of any of its locks is 34.29 feet, compared with 46.5 feet by each of the Welland ship canal locks. Furthermore, the Thorold flight of three locks on the Welland ship canal has a rise of practically 140 feet and is comparable in respect to its quantity of mass concrete with the Gatun flight of three locks at Panama.

The summit level of the canal, Thorold to Humberstone, is sixteen miles long and at the city of Welland crosses the Chippawa creek. The present canal is carried over the creek by a cut stone aqueduct which will be dug out as soon as the syphon culvert that is now being built to pass the creek under the ship canal has been completed and placed in commission. As the syphon culvert is one of the important structures of the canal, this paper has been prepared for the express purpose of describing its design and construction.

Chippawa Creek

The Chippawa creek rises in the hills southwest of the city of Hamilton and flows easterly to its confluence with the Niagara river at the village of Chippawa, about 1¾

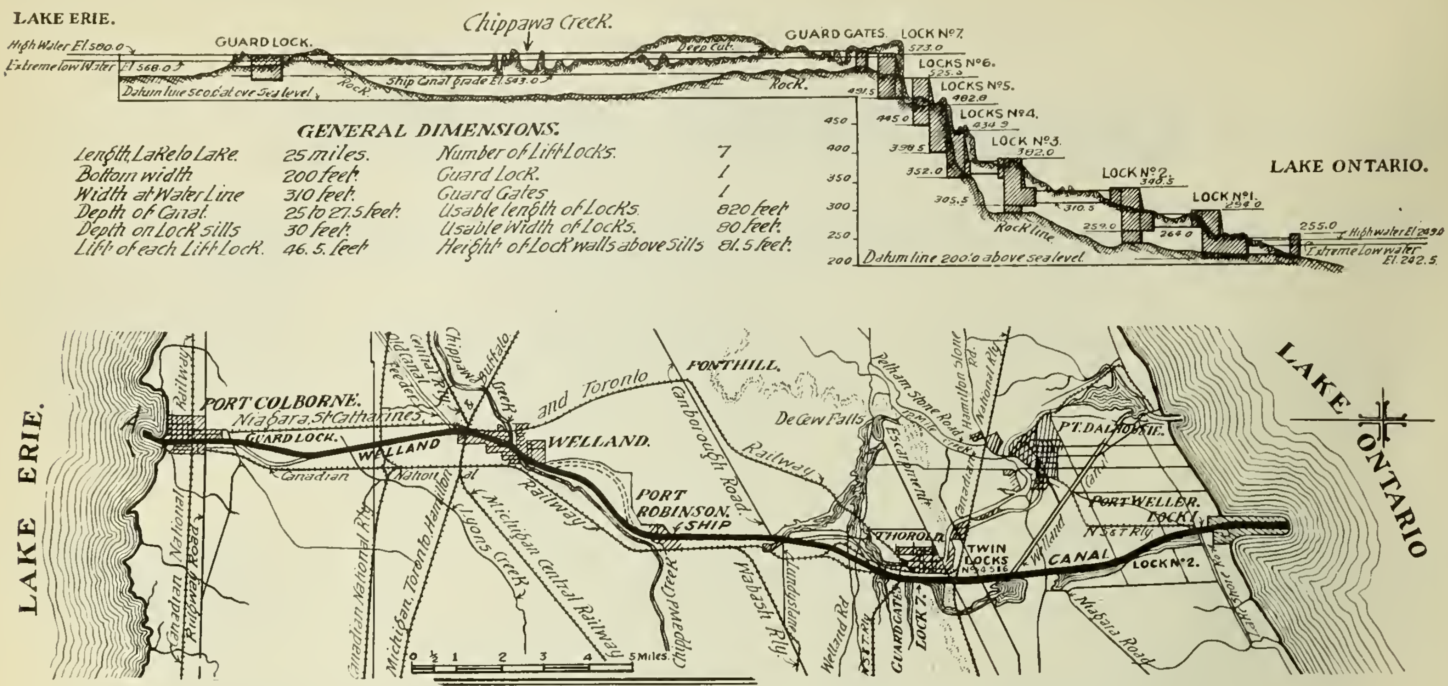

Figure No. 1.—Map showing Location and Profile of Welland Canal.

miles above Niagara Falls. The drainage basin of the creek comprises about 350 square miles and has a summer flow of about 200 c.f.s. The spring freshet flow of the creek varies greatly, as meterings of the stream that have been made by the Welland ship canal office show discharges at Welland varying between 2,600 and 6,400 c.f.s., and from these investigations it has been determined that the March 1908 discharge was probably about 8,700 c.f.s. The conditions that govern extreme flood flow on the creek are maximum winter storage of precipitation due to continued cold weather throughout the season, and heavy rains concurrent with the spring thaw. If these conditions occurred together, an extreme flood flow of 10,000 c.f.s. might be expected.

The water surface of the creek between the Niagara river and Port Davidson, about 27 miles west of Chippawa, is practically level at periods of low flow, and as the heads observed on the canal aqueducts during flood periods of the creek have been less than one foot, a culvert with a large area is essential to pass the extreme flood flow under combined adverse conditions of ice, floating débris, silt, etc., in order to avoid all danger of flooding the city of Welland and the low-lying lands west of the canal. Ordinary summer level of the creek is elevation 562.0 and ordinary flood level west of the canal varies between elevation 567.0 and 569.

Geology

The palæozoic or bed rock formations of the Niagara peninsula pass under the waters of lake Erie with a monoclinal dip of about 30 feet to the mile. As a result of the monoclinal structure of the bed rock formations of the peninsula, successively older beds appear at the surface in following the line of the canal from south to north. Owing to the varying degrees of hardness of the shales and limestones comprising the rock formations, differential erosion has developed, on their surface cropping margins in tertiary times, two north facing scarps trending east and west, each with a lowland plain to the north of it. One of these, the Niagara escarpment, was too prominent a physiographic feature to be buried by the glacial and lake deposits of pleistocene times. The lesser scarp, which has been called the Onondaga escarpment, formed by the Onondaga limestone and Bertie water-lime, is well exposed for a few miles west of Fort Erie, but in the vicinity of the canal zone this north facing scarp has been almost entirely obliterated by the boulder clay of the glacial period and the lake deposits which accumulated in the interval between two advances of the continental ice sheet. The city of Welland lies within the limits of the old Huron plain. This old tertiary lowland was buried in the vicinity of Welland to a depth of 100 feet by the glacial till and associated interglacial lake deposits. The course of the Chippawa creek has its direction determined chiefly by the position of the Onondaga escarpment on the south and the south slope of the Niagara escarpment to the north. The Niagara Falls moraine on the north of the Chippawa creek valley also helps to outline it near the Niagara river. The Welland canal cuts through the latter about a mile north of Port Robinson.

Owing to the southerly dip of the bed rocks in the Niagara peninsula, the water level of lake Erie has no effect on the level to which water may rise at the site of the syphon culvert at Welland from the base of the pleistocene beds or lower. The culvert is located not very far from the junction of the Guelph dolomite and the Camillus shale, (Salina), parting or contact with the overlying pleistocene beds. The level to which water will rise from this source is determined by the highest level attained by water bearing horizons, north, east and west of the culvert. In the case of the Salina-Lockport horizon, this is in the neighbourhood of 600 feet above sea level near Chippawa and Navy island in the Niagara river, northeast of Welland. It might, therefore, be expected that water from the above source would rise to about elevation 600.0 wherever it might be tapped in the Niagara peninsula. The water found in the test borings at the culvert site has risen in pipes to elevation 584.0, and as it is sulphurous it is probably impregnated with hydro-sulphuric acid, (H_2S), formed by the decomposition of pyrites in the saccharoidal more or less porous dolomite, and water impregnated with this gas would be likely to move freely for a considerable distance along the contact of the Guelph dolomite and the overlying Camillus shale, (Salina formation).

Test Borings

For the purpose of determining the class of rock and the material overlying it at the site of the syphon culvert, two holes, one 400 feet left of station 965+70 and one 40 feet right of station 968+00, were put down in 1920. These holes were sunk to rock by a cyclone drill and lined with six-inch pipe. The material was removed by augers from the pipes as they were driven down, and was found to be a soft sticky red clay, containing a few striated stones down to about elevation 490. Between the latter elevation and the surface of the rock the clay was more or less mixed with sand and gravel. The holes also indicated that a thin bed of sand and gravel overlaid the rock found at elevation 489.4 in the hole opposite station 965+70 and at elevation 479.8 in the hole opposite station 968+00. Holes were drilled in the rock in both the holes by a three-inch calyx core drill to elevation 424.0. The cores show the rock to be gypsum, with bands of shaly grey and brown dolomite. Very little water was found in the holes until the rock was uncovered or slightly penetrated, when the water instantly rose in the pipes to elevation 578.0. In the hole at station 968+00 the water rose in the pipe to elevation 584.0 when the bottom of the hole had reached elevation 448.0. The pipe in the hole at station 965+70 has discharged continuously about 15 gallons of sulphurous water per minute since it was put down in 1920.

Previous to the preparation of the plans and specifications for the letting of the contract for section No. 6, two more holes, similar to the above, were drilled in October 1924. One at 353 feet east of station 966+74 and one at 250 feet west of station 969+66. The material found above the rock was the same as in the two previous holes. The rock surface in the first hole is at elevation 484.2, and in the second one at elevation 483.1. The rock was drilled by a diamond drill to elevations 410.1 and 400.6 and was found to be the same as that in the holes drilled in 1920. No water was found in these holes above the rock, but as soon as it was penetrated 18 to 36 inches the water rose in the pipes to elevation 578.0, and rose to elevation 583.0 when the hole

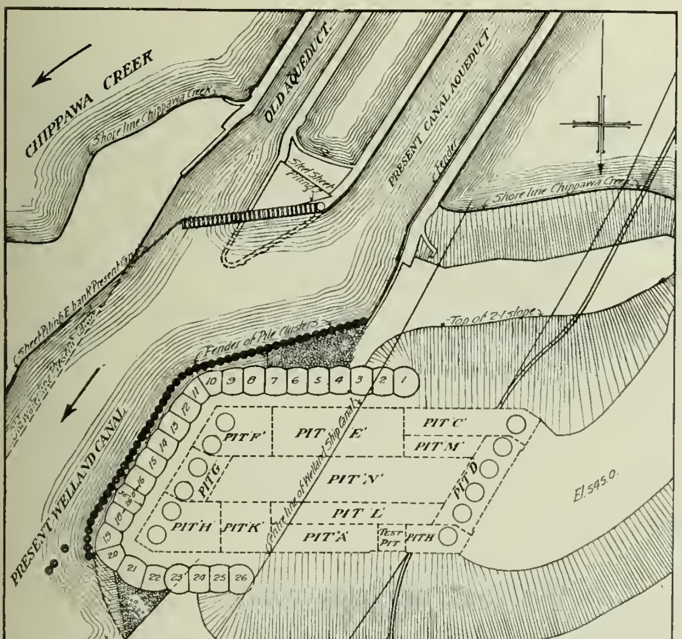

Figure No. 2.—Plan showing Present Canal, Chippawa Creek and Excavation Pits for New Syphon.

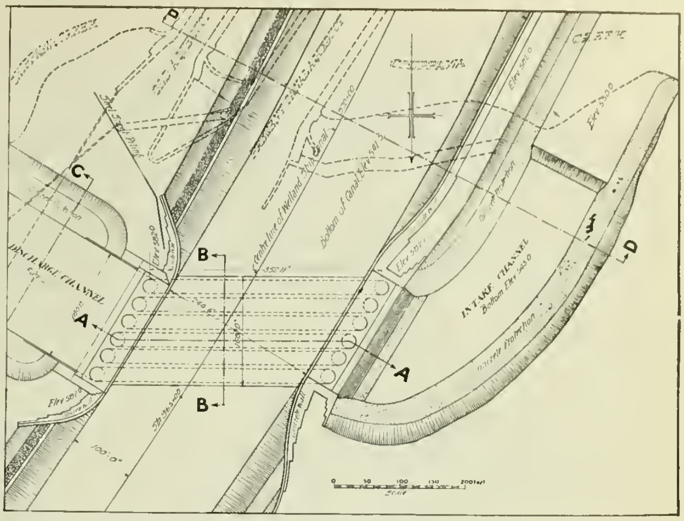

Figure No. 3.—Plan showing Location of Syphon with Relation to New Canal.

250 feet right of station 969+66 had been drilled to elevation 402.0. When the hole 353 feet left of station 966+74 was drilled to elevation 410.1 it produced sulphurous water at the rate of 12 gallons per minute, and stood at elevation 580.3 in the pipe.

After the deflection of the cellular cofferdam in 1926, (described later in this paper), the contractors drove three small test pipes into the material within the culvert area. The results obtained were similar to the above. The material found in the hole driven down in cell No. 14 of the cellular cofferdam showed it to be very soft between elevations 516.0 and 510.0, and when elevation 496.0 was reached wet sand rose in the pipe to elevation 540.0. A few days after the pipe had been driven to refusal water came up in it to elevation 579.4.

The results obtained by the contractors were such that the department deemed it advisable to drive four 10-inch heavy wrought iron pipes to rock, one at each end and side of the culvert site. A derrick was used to handle the pipes and augers and a pile hammer to drive the pipes. The same class of material was found, varying from soft to very soft clay, clay mixed with stones and a mixture of clay, sand and gravel. The clay was generally found to be very soft between elevations 535.0 and 500.0 or lower, and would flow into and rise as much as 10 feet in the pipes. Small striated stones were found in the clay, generally below elevation 535.0, and one of 5 inches in diameter was taken out of one of the pipes. Below elevation 490.0 sand and gravel seams, sometimes mixed with hard clay, were found overlying the rock at elevation 483.0. When the shale rock was penetrated water rose in the pipes to elevation 578.0. Only one large boulder about 4 feet in diameter has been found in the foundation. It was in the "test pit" at elevation 505.0 and was left there.

Aqueduct of Second Canal

The second Welland canal was carried over the Chippawa creek by a cut stone aqueduct whose canal waterway is 44 feet wide at its floor level, elevation 562.5. The creek is passed under the aqueduct by four segmental arch culverts, each 40 feet wide at the springing line of the arches. The floors of these culverts are at elevation 545.0. The height from the floors to the springing lines of the arches is 6 feet and to the soffits of the arches 13 feet. The aggregate area of the culverts for the passage of the creek is 1,699 square feet. The aqueduct is built on a timber pile foundation, was completed in 1846 and is still in existence, but is not now used for the passage of vessels. This aqueduct will be buried by the east embankment of the ship canal.

Aqueduct of the Third or Present Canal

The present canal is carried over the creek by a cut stone aqueduct whose canal waterway is 85 feet wide at its floor level, elevation 555.4. The creek is passed under the aqueduct by means of six segmental arch culverts, each 40 feet wide. The floor of each culvert has an invert of 2 feet. The bottom of the inverts is at elevation 540.7. The height from the bottom of the inverts to the springing lines of the arches is 5 feet and to the soffits of the arches 12 feet. The aggregate area of the arch culverts for the passage of the creek is 2,161 square feet. This aqueduct was completed in 1888 and is situated 82 feet west of the aqueduct of the second canal. The 82 feet space between them is an open pool of the creek. This aqueduct will be dug out when the syphon culvert has been completed and placed in commission. The location of both aqueducts is shown in figures Nos. 2 and 3.

Original Design for Section No. 6

The original design of the ship canal contemplated taking the Chippawa creek into the canal at Welland and discharging its flood waters back into the creek through a weir at Port Robinson. The basic reason for this scheme was the fact that ordinary high water in the Chippawa creek and the lowest stage of lake Erie coincide at elevation 568.0. The design of taking the creek into the canal therefore involved always maintaining the summit level of the ship canal at elevation 568.0. The complications that would have arisen between the department and all parties concerned by the adoption of the scheme, and the large and unknown damages that would have been presented by the municipalities and private parties along the canal and creek as a result of its construction, finally led to its abandonment and to the decision to maintain the " status quo " for the ship canal when preparing the plans and specifications for the letting of section No. 6 on which the syphon culvert is located.

Proposed Syphon in Rock

The first plan prepared for the syphon culvert was one showing two parallel tubes 397 feet long with an aggregate area of 2,400 square feet. The tubes would have been excavated in rock and lined with concrete. The bottom of the tubes were to be at elevation 412.0, or 170 feet below the surface of the ground. Owing to the unknown quantity of water that would have had to be handled at such a depth during the construction of the tubes, and the great depth of the syphon, the design was abandoned in favour of the one now being carried out.

General Description of Syphon Culvert

The syphon culvert now being built to pass the Chippawa creek under the ship canal is shown in plan in figure No. 3 and in section in figures Nos. 5 and 6. It consists of six parallel tubes, each 22 feet in diameter and 353 feet long between centres of the vertical wells at each end of the tubes. The interior bottom of the tubes at the upper end is at elevation 508.0 and the lower end at elevation 507.5. The top of the reinforced concrete block forming the battery of tubes under the canal is at elevation 535.0, or 3 feet lower than the bottom of the canal when ultimately deepened to 30 feet. The aggregate area of the six tubes is 2,281 square feet. This is slightly larger than the aggregate area of the water passages under the aqueduct of the present canal.

The canal prism is formed across the culvert by means of massive walls built across the ends of the tubes. Their adjacent vertical faces are 244.5 feet apart and are parallel to the centre line of the canal. The top of the vertical wells of the tubes is at elevation 550.0. Above this elevation the

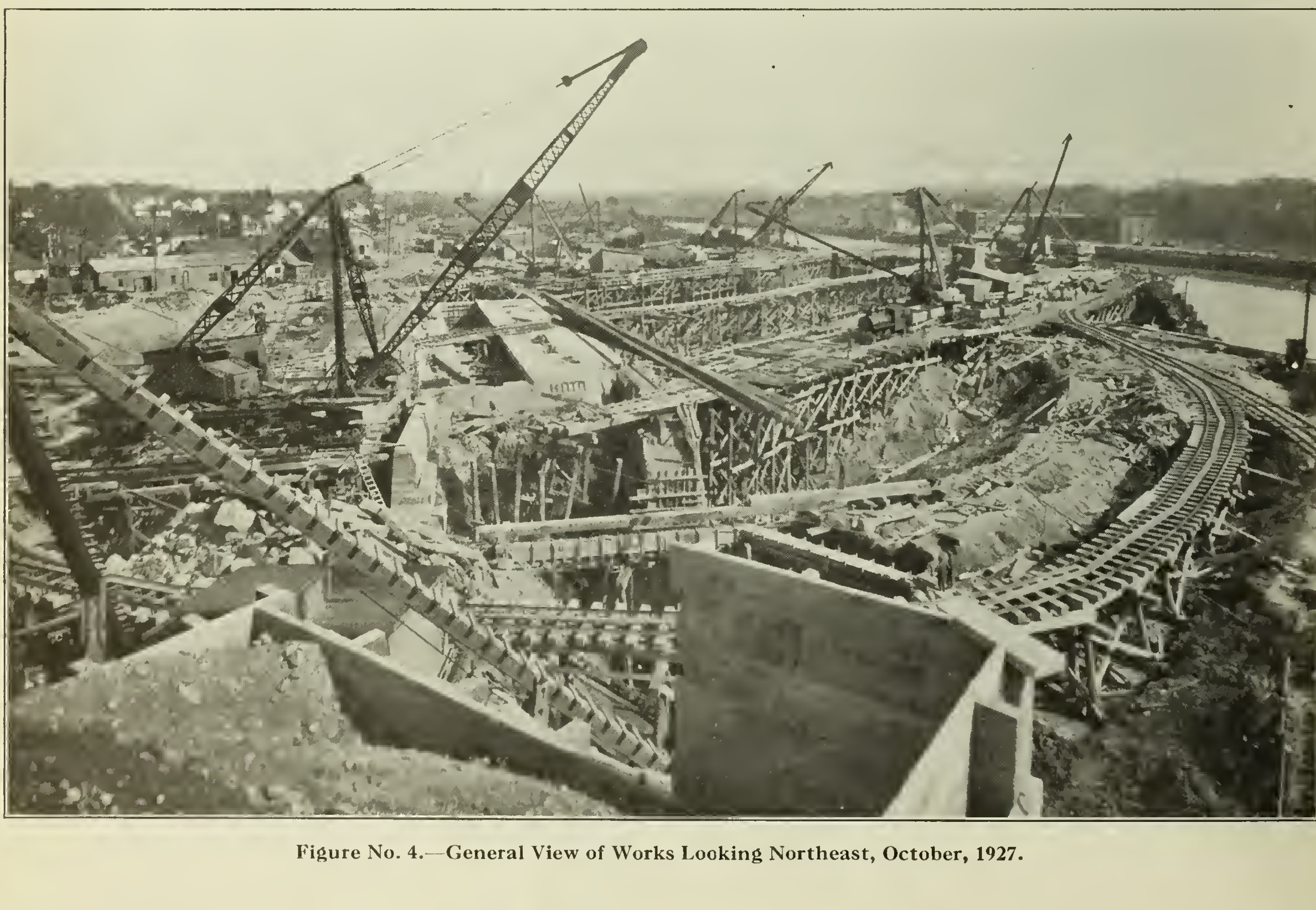

Figure No. 4.—General View of Works Looking Northeast, October, 1927.

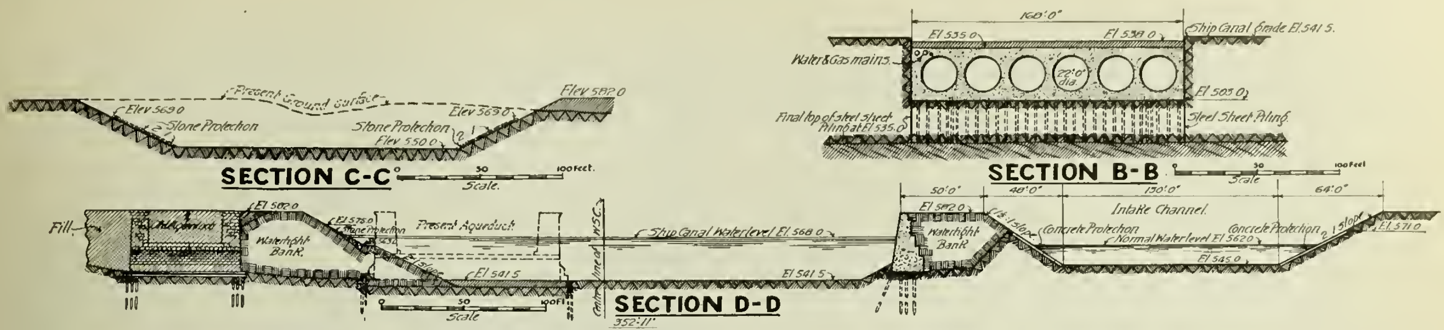

Figure No. 5.—Cross Sections, Showing Syphon, Intake Channel and Canal Prism.

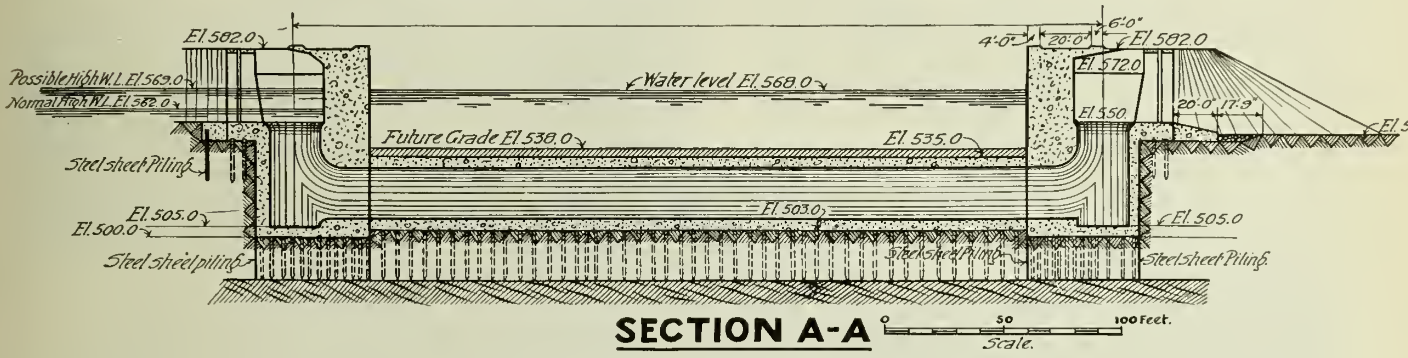

Figure No. 6.—Longitudinal Section of Syphon.

wells are divided into pairs by division walls which also act as buttresses to the canal walls. The forebay in front of each pair of wells is divided into three openings by two small piers. The sides of the piers and division walls are provided with checks for stoplogs for unwatering a pair of tubes at any time for inspection and cleaning purposes. The main walls carry a roadway 20 feet wide and a side walk 5 feet wide across each end of the structure. The outer ends of the division walls and the small piers support a concrete stoplog platform 12 feet wide. The ends of the structure are connected to the embankments forming the canal prism on each side of the culvert by means of long concrete wing walls. The whole of the structure is carried on timber piles driven to rock found at about elevation 483.0.

As the creek passes through the centre of the city of Welland it could not be diverted to a large extent in the vicinity of the canal crossing except at great cost. The culvert was therefore located as close to the north end of the aqueduct of the present canal as navigation and economic construction conditions permitted. The latter necessitated placing the centre line of the culvert at an angle of 59 degrees to the centre line of the canal. The foregoing conditions, together with the necessity of having to maintain uninterrupted traffic in the present canal and the deep foundation in soft material required for the culvert, have made its construction a very interesting problem.

Culvert Pit

The plans for the construction of the culvert, whose eastern end projects about 125 feet into the prism of the Welland canal, indicate that the excavation of the pit, 80 feet deep, was to be taken out in two layers, the upper one in an open cut down to elevation 541.5 and the lower one in steel sheet pile timber braced trenches to elevation 500.0 and 503.0. The extent of the excavation is shown by figures Nos. 2 and 4. The westerly half of the pit is bounded on its southern, western and northern sides by earth slopes, while the easterly half is protected on its three sides by a cellular steel sheet pile cofferdam. Much of the excavation in the upper layer was taken out by dredging while the cellular cofferdam was being built.

Steel Sheet Pile Cellular Cofferdam

The steel sheet pile cellular cofferdam constructed around the eastern end of the pit is about 685 feet long and is built up of twenty-six cells, as shown in figure No. 2. The majority of the cells have parallel partition walls and segmental shaped ends. The major axis of the cells is 36 feet and the minor axis is 26 feet. All the cells are connected together at their corners by *Y* piles fabricated to the required angles. The piling used was Lackawanna 15 by 3/8 inch and 12¾ by 3/8 inch straight web section weighing 42.6 and 37.2 pounds per lineal foot. The piling in the outer walls is 70 feet long and in the inner and partition walls it is 55 feet long. The top of the piles forming the cofferdam were all driven to elevation 580.2, which is one foot higher than the highest water in the canal. The bottoms of the 70-foot piles are therefore at elevation 510.2 and the bottoms of the 55-foot piles at elevation 525.2. Driving the piling was begun about February 1st, 1926, and was completed on July 31st, 1926.

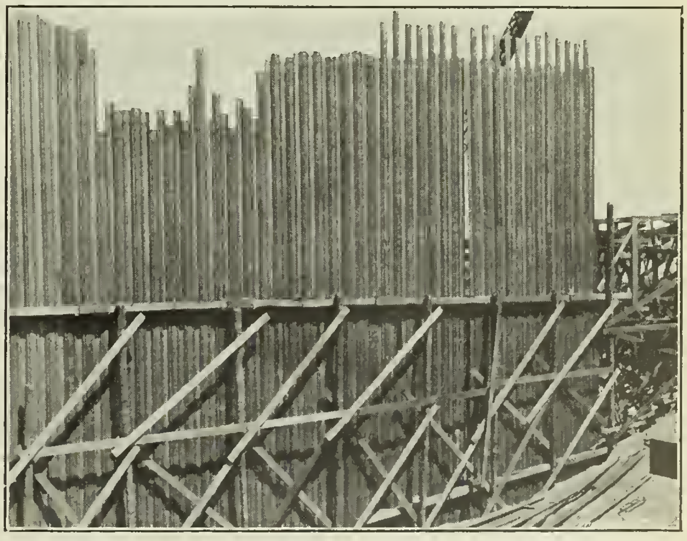
Figure No. 7.—Preassembly of Enclosure Piling.

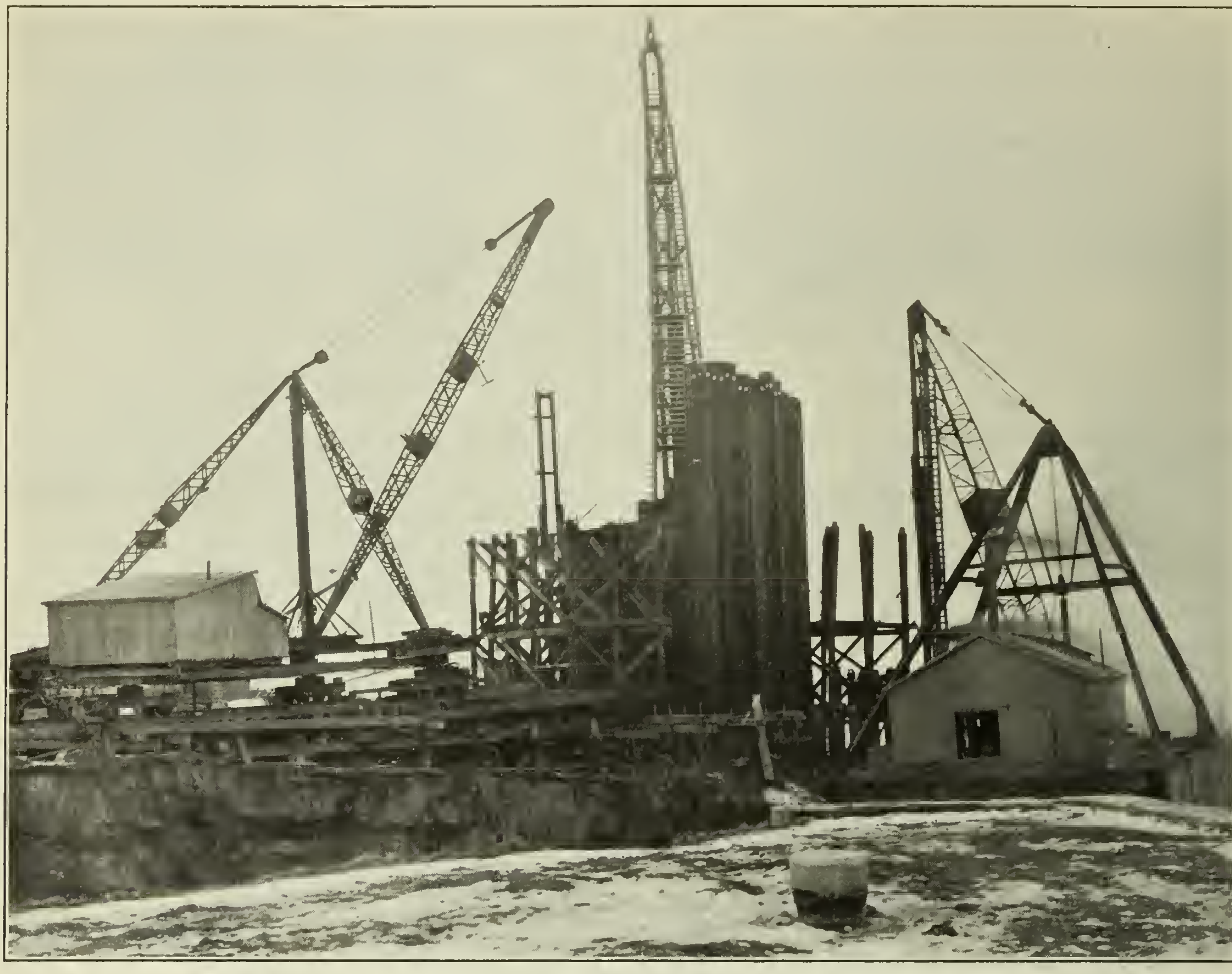

Figure No. 8.—Driving Cell Piling after Preassembly, February, 1926.

The piling of both cells and pits was driven by the preassembly method, (as shown in figure No. 7), which involved first driving, within the area of the sheet pile cell or pit, a timber pile trestle with the timber piles left standing about 30 feet above the ground surface. Around the outside of the timber piles at the ground surface and at their tops were attached square timbers to form templates corresponding to the alignment of the perimeter of the cell or pit to be driven. The steel sheet piling was then assembled around this timber trestle and all the units forming a cell were definitely threaded into each other, including the special *Y* units at the corners of the cells, before very much or any driving was done. When the pile units were assembled and locked together driving was begun. The piles were driven down 10 feet or less at a time all the way around the perimeter of the pit or cell until they were driven to the required elevation. The piles forming the wall of the next cell to be assembled were only driven to the top of the timber preassembly trestle, and were temporarily left at this elevation to act as a starting point for the next cell. The preassembly timber trestle was then removed. The steel piles for the cells of the cofferdam were assembled by a derrick on top of the preassembly trestle and driven by 4,000- and 6,760-pound McKiernan-Terry steam hammers operating in short leads suspended over the piles by a derrick standing on the ground. The cell piling is further shown in figures Nos. 8 and 9.

This type of cofferdam, owing to the friction of the interlock between the piles, can resist considerable lateral pressure without the aid of bracing when its cells are filled with suitable material. It is self-supporting and is watertight, and when in use can be used to support working platforms and superimposed loads, and when it has served its purpose it can readily be removed.

When designing the cellular cofferdam each cell was considered as an independent unit and its weight was assumed as being equal to that of the steel sheet piles and enclosed material. The loading diagram for the exterior cellular cofferdam is shown in figure No. 10. The cofferdam was designed to withstand an unbalanced hydrostatic head of 37.5 feet when the water in the Welland canal was at elevation 579.0 and the excavation and water in the culvert pit at elevation 541.5. Under the above assumptions the resultant pressure falls well within the middle third, and the cells of the cofferdam were therefore considered as being stable. The cells were filld with hard brown clay taken from the excavation of the pit. As the cells were more or less filled with water up to the level of the water in the canal, the clay was in all cases deposited in the water from cars.

On August 7th, 1926, the unwatering of the pit was begun with two 8-inch and one 5-inch centrifugal pumps. The water in the Welland canal was then at elevation 570.1. Pumping was continued day and night until about noon on August 12th, 1926, when two of the piles in the inner wall of cell No. 10 unlocked.

It is pertinent to remark here that the Bethlehem Steel Company recommended a safe working strength of interlock of 3,000 pounds per lineal inch for 15 by ⅜ inch straight web section Lackawanna steel sheet piling. In August, 1926, the Bethlehem Steel Company made for the contractor four breaking load tests of the interlock of 15 by

Figure No. 9.—Cofferdam Under Construction Looking South, June, 1926.

⅜ inch Lackawanna steel sheet piling with the following results:—

Sample	Length of Interlock	Breaking Load in Pounds	Ultimate Interlock Strength per lin. inch. in Pounds
1. A piece of new pile not driven.	1.93	18,000	9,326
2. A piece of driven pile from cell No 7.	2.55	17,400	6,824
3. A piece of driven pile from cell No. 11.	2.82	21,600	7,660
4. A piece of driven pile from cell No. 10.	2.25	19,200	8,533

As the piles of cell No. 10 tore apart, the inner ends of cells Nos. 8 and 9 moved westward and the inner ends of cells Nos. 11, 12 and 13 northward. When the accident happened the water in the pit had been lowered to elevation 549.8. Pumping was immediately stopped and the pit refilled to elevation 570.1. The parted piles in cell No. 10 were then drawn out and examined, when it was found that the interlock of the lower 15 feet of the piles had not given way. They were immediately replaced by driving new ones. A survey of the cofferdam then showed that horizontal and vertical movements had occurred in all the cells, due to the steel piling adjusting itself to the pressure of the clay filling, developing tension in the interlocks, and from the hydrostatic head of 20.3 feet on the cofferdam at the time of its failure. The maximum horizontal deflection was about 4.5 feet at the top of cell No. 13 and the maximum vertical settlement of the inner walls of cells Nos. 13 and 14 was about 2.0 feet. The outer walls of these cells showed no vertical settlement. The cofferdam was then reinforced on the inside by depositing behind it 13,300 cubic yards of gravel. On October 6th pumping out the pit was begun for the second time at the rate of lowering the water 3 feet per twenty-four hours. During the six days that were occupied in pumping out the pit, practically no movement took place in the cofferdam. Since then the cofferdam has shown no further movement except at cells Nos. 1 to 8, at cell No. 6 and at cells Nos. 23 to 26. When pit *C* was being excavated in March and April, 1927, the top of cells Nos. 1 to 8 developed a maximum northward deflection of 2 feet at cell No. 1. A further northward deflection of the top of cells Nos. 1 to 8 has developed since the excavation of pit *E* was begun early in October 1927. When the excavation in pit *F* had reached elevation 516.0 a web plate riveted connection at the centre of the *Y* pile in the southeast corner of cell No. 6 tore apart along the line of rivets with a cannon-like report on August 27th, 1927. The cell was repaired immediately by driving new piles around the outside of the *Y* pile so as to re-establish the connection between the outer walls of cells Nos. 6 and 7. When pit *A* was being excavated in January and March, 1927, the top of cells Nos. 23 to 26 developed a maximum southward deflection of one

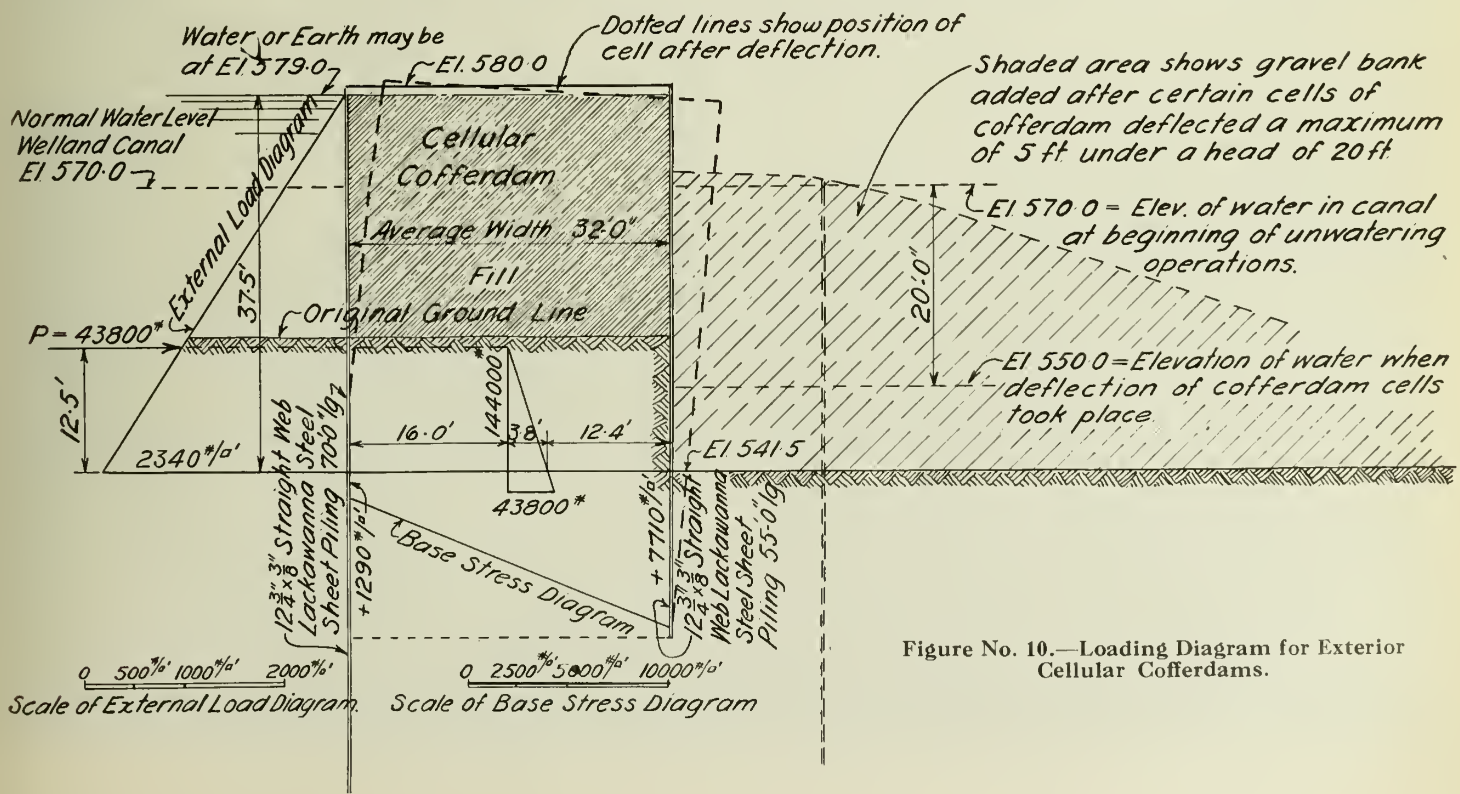

Figure No. 10.—Loading Diagram for Exterior Cellular Cofferdams.

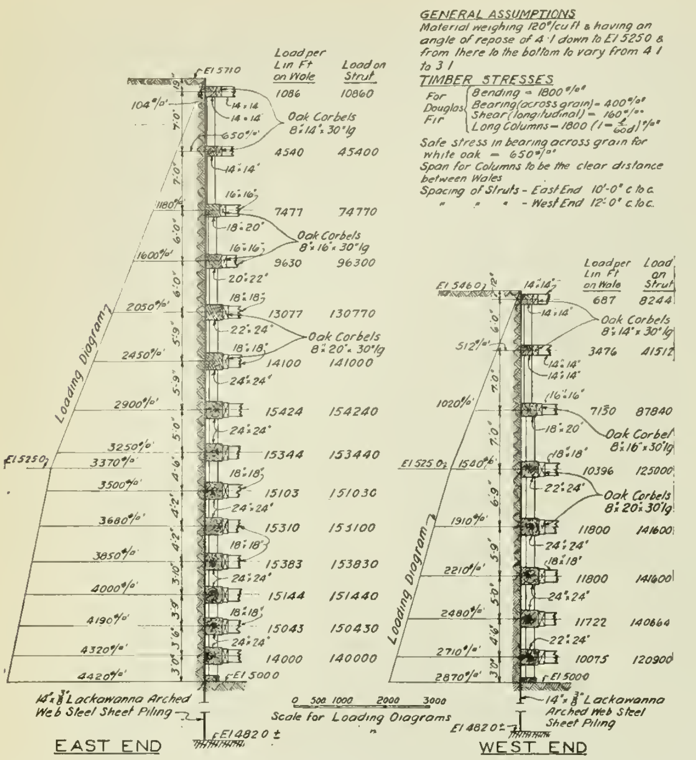

Figure No. 11.—Loading Diagrams and Timber Bracing for Interior Cofferdams.

foot at cell No. 26. The cofferdam has from the date of the first unwatering of the pit been absolutely watertight.

The deflection of the cofferdam was attributed to the piles in the partition and inner walls being too short and to the low shearing value of the clay filling in the cells. Had all the piles been 70 feet long and the cells filled for a height of 30 feet with crushed stone or gravel the cofferdam would in all probability have been stable without any gravel back-filling and could have been made watertight by filling the interlocks of the piles after driving with fine sand or wheat.

The deflection of the cofferdam, and the very soft material in which the pits below elevation 541.5 had to be sunk for the construction of the culvert tubes, made the contractors so dubious as to the possibility of building the culvert according to the contract plans that they would not proceed with the work. The engineer, however, felt that with proper precautions and care the culvert could be built as designed, and ordered the contractors to put down a test pit and to build within it a section of the culvert tube. As this operation was successfully carried out, the balance of the work was at once proceeded with, and the culvert, at the end of October 1927, was about 60 per cent built.

Steel Sheet Pile Braced Pits

The construction of the culvert in the steel sheet-pile timber-braced pits has been of an unusually interesting character, due to the great depth and size of the pits, the very long lengths of steel piling used, and the very large timber bracing required to resist the heavy pressures produced by the very soft plastic clay in which the pits have been sunk. There will be thirteen pits required to build the culvert, as designated by letters on the plan. At the end of October 1927 eight pits, *A, B, C, D, F, H, K* and the test pit, (figure No. 2), had been excavated and sections of the culvert built in them. The work of building this part of the culvert and the troubles that developed in doing so are best told by a brief description of each pit, as follows:—

The contract drawings show the top of the steel sheet pile timber-braced pits for excavating the lower layer of material for the culvert pit at elevation 541.5, and that 14 by 3/8 inch arch web Lackawanna steel sheet piling was to be used in their construction. This piling has great flexural strength. The plans show also that the steel pile wall enclosing the perimeter of the entire structure was to be made with piles 59 feet long, driven to rock, and that all the interior pile walls were to be made with piles 45 to 55 feet long. It was also assumed, when the contract drawings were prepared, that the wells of the tubes could be built in trenches 45 feet wide, and the side tubes of the culvert in trenches 32 feet wide. It was further assumed that when the side tubes and all the wells at each end of the culvert were built, the central portion of the pit thus enclosed could be excavated as an open unbraced pit, except for two zones each 32 feet wide and 60 feet from each end of the pit, which were to be excavated across the pit in trenches, and in which sections of the tubes were to be built to act as buttresses to the completed side tubes before the excavation in the central open portion of the pit was proceeded with.

The above layout of the steel sheet pile timber braced trenches was gradually abandoned as the construction of the culvert progressed, as, owing to the contracted area enclosed by the cellular cofferdam, the gravel bank placed behind the cofferdam over-ran the site of the culvert foundation and necessitated raising the top of the steel sheet pile trenches to elevation 546.0 at the west end, and to elevation 565.0 and 571.0 at the east end, and led to an entirely different layout of the pits.

For the purpose of building the culvert a large and wide heavy timber trestle of round bearing piles and square timber was built around the site of the culvert, (see figure No. 4). The trestle is about 70 feet wide and 35 feet high, with its top at elevation 582.0. The trestle supports the derricks and railway tracks required for the execution of the work. All excavation and concrete trains, etc., are handled over these tracks.

Test Pit

The location chosen for the test pit was near the west end of the north tube, and the size of the pit was limited to 36 feet wide by 43 feet long. The timber work was designed to resist a material weighing 120 pounds per cubic foot and having an angle of repose of 4 to 1. The bracing of the pit resisted external pressures with very few signs of overloading down to elevation 501.0. From the behaviour of the timber bracing in the test pit it was decided to use the following assumptions for designing the bracing of the remaining pits:—120 pounds per cubic foot of material, an angle of repose of 4 to 1 down to elevation 525.0 and from this level to elevation 500.0 an angle of repose of 3 to 1. These assumptions have given good results, although serious difficulties have been encountered in several of the pits due to causes other than the assumed loading. It was also decided to drive all the steel sheet piling to rock. The loading diagrams and timber bracing for the interior cofferdams are shown in figure No. 11.

The preassembly trestle for the test pit was erected between October 4th and 13th, 1926, and the 14 by 3/8 inch arch web Lackawanna steel sheet piling 69 feet long was all assembled and driven to rock by October 24th. Excavation of the pit was begun on October 24th and finished to elevation 501.0 on November 24th, 1926. When the pit had been excavated to elevation 516.0, water came up close to the steel sheet piling on the north side at the rate of about 170 gallons per minute. When elevation 507.6 was reached it was found that two piles had unlocked and it was at this point that the water was entering the pit. The opening between the piles was 1.2 foot wide at elevation 501.0, and at this elevation it was also observed that the width of the pit was reduced from 36 feet to 34 feet 7 inches and that the alignment of the piling was very irregular. The material varied little with the depth and was very difficult to handle owing to its gummy quality. The sizes of the wales were 16 by 16 inches, 18 by 20 inches, 22 by 22 inches and 24 by 24 inches, and the struts were 12 by 12 inches and 14 and 16 inches. Hardwood corbels and steel plates were used between the wales and struts. Many of the one-inch thick steel plates in the lower courses were dished and pressed into the hardwood corbels, which in turn were forced into the Douglas fir wales. Bearing piles 22 feet long spaced 4 feet by 3 feet 7 inches were driven to rock, elevation 481.0. The penetration of these piles was very rapid for the first 10 to 15 feet, after which it decreased slightly until a bed of hardpan was encountered, when the piles reached refusal very quickly. The piles were driven with square ends, consequently they may not have completely penetrated the hardpan to rock. The 756 cubic yards of concrete in the test pit was poured between December 6th, 1926, and January 12th, 1927. The bottom tier of struts was left in place and buried in the concrete when the first course was poured to elevation 507.75. All timber wales and struts above the lowest tier were removed, except some of the wales along the north wall of the steel piling against which the concrete was poured. A lot of time was consumed taking out the wales and struts, setting up concrete forms in such a confined place, waiting for the concrete to harden, and placing struts within the completed portions of the tube before removing more struts above it, etc. A tendency for the whole timber system to sag at the centre was observed and it is believed that the placing of all the wales and struts would have been greatly facilitated had the top course of wales been set level around the four walls of the pit and securely bolted to the top of the piling.

The successful excavation of the test pit and the construction of a section of the culvert tube within it proved beyond all question that the culvert could be built as shown on the contract drawings. A new layout of the steel sheet pile timber braced trenches was then made, the bracing for pits *A*, *B*, *C* and *D* designed, and the contractor ordered to proceed with their construction.

Owing to the tendency shown by the walls of the test pit to squeeze inwards and the impossibility of driving such long steel piles absolutely vertical it was decided to make all the pits for one tube 2 feet wider than the test pit.

Pit A

A view of pit *A* is shown in figure No. 12. This pit was 38 feet wide and 127 feet long, and enclosed a section of the north tube adjacent to and east of the test pit. The assembling and driving of the steel piling was begun on December 23rd and completed an January 6th, 1927. It was all driven to rock, and in order to prevent the piles creeping, wedges were inserted at the bottom of all pile joints as the piles were assembled. Excavation of the pit was begun on January 7th and completed on March 7th. It was found that two piles in the east end wall near the south-east corner had unlocked at elevation 508.0. A similar occurrence at two other points took place in this pit at the same elevation. It was assumed that the unlocking of the piles was due to their hitting boulders in the clay. A small quantity of water entered the pit at one of the open joints in the steel piling. The water entering the pit increased considerably while the bearing piles were being driven. As soon as the piles penetrated the gravel seam overlying the rock, water in some instances forced its way up along the piles. It was estimated that about 70 gallons of water per minute were coming into the pit when the excavation was completed and while the bearing piles were being driven.

The pit was braced longitudinally from end to end by one line of struts. At each intersection of the longitudinal and transverse struts a 12- by 12-inch square timber pile 48 feet long was driven down and the struts bolted to it. These piles prevented the tendency of the bracing to sag at the centre, as observed in the test pit. Owing to there being

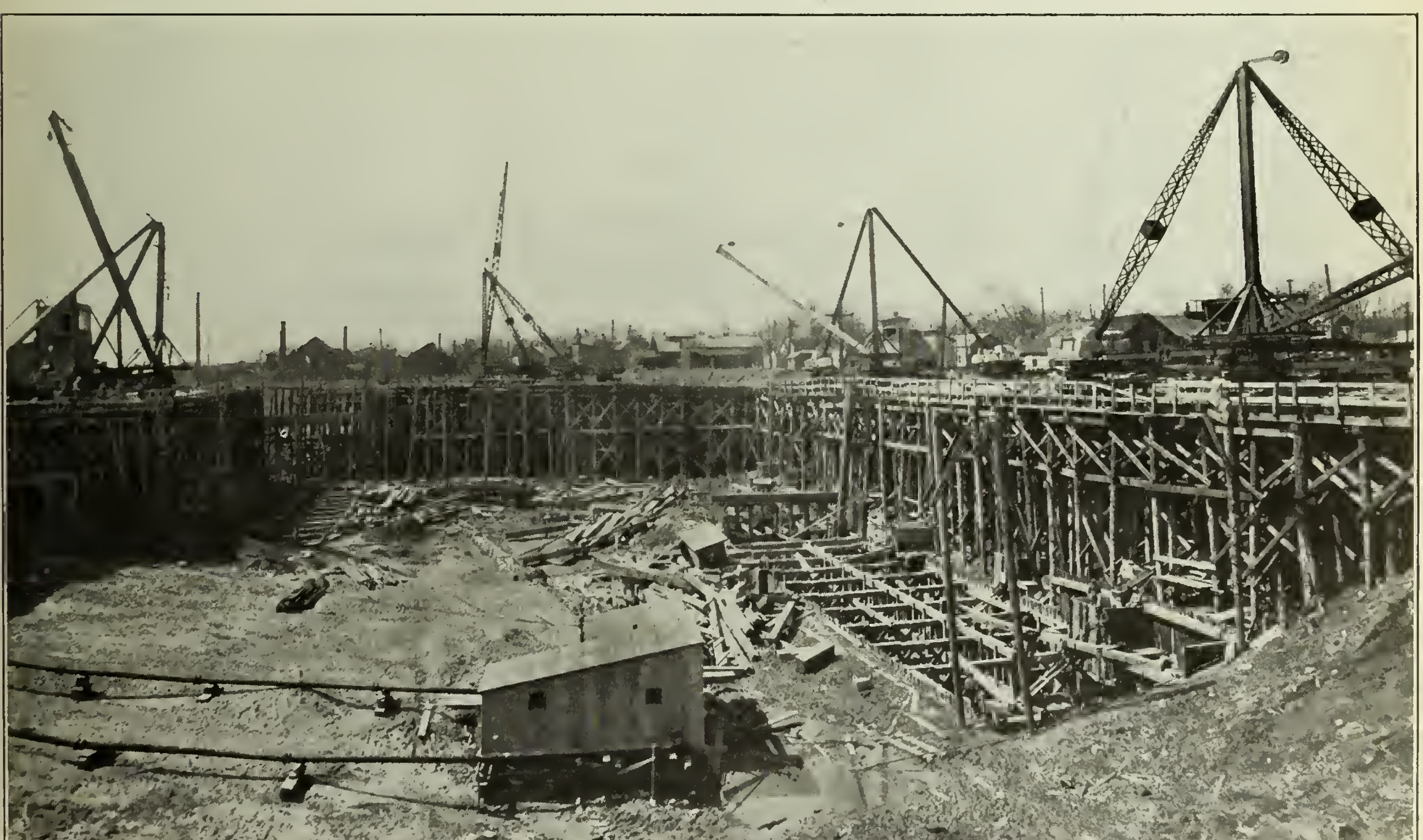

Figure No. 12.—View of Pit A Looking Northwest, April, 1927.

very few boulders in the clay it was possible to drive the 12- by 12-inch square timber piles accurately in a vertical plane. When the excavation had reached elevation 507.0 one of the 12- by 12-inch transverse struts failed in row *D*. This was followed by the failure of two 12- by 14-inch struts in row *E*, and as most of the other struts in *D* and *E* were showing signs of distress additional timbers were placed alongside the struts already in place, which prevented further failures. Before the extra struts were placed one 24- by 24-inch wale in row *E* failed by splitting longitudinally. The pressure had forced many of the steel plates into the hardwood corbels, some of which were badly crushed and split. The movement at the top of the steel piling averaged about 7 inches southward and at wales *D* and *E* the bulging decreased the width of the pit 2 feet. The timber bearing piles were driven between March 8th and 19th, and placing concrete was completed on April 14th, 1927.

PIT B

Pit *B* is adjacent to the west side of the test pit, and in it was built the west end and well of the north tube of the culvert. The pit was 38 feet wide and about 75 feet long. The steel piling was assembled and driven by January 31st. Excavation was begun late in January and completed on March 29th. No water entered the pit until shortly before the excavation was completed, when seven separate streams broke through the floor near the southwest corner of the pit. Water also entered the pit from the test pit. Three small pumps, however, kept the water under control.

The west end of the pit was irregular in shape and detailed timber bracing of special design and the use of long hardwood corbels. From the experience gained in the construction of pit *A* additional 12- by 12-inch struts were placed in rows *C* and *D* of pit *B*. Only one strut failed in this pit, but there was a tendency of the whole pit to move southward. At the top of the pit the greatest movement was 1.8 foot southward. At wale *H* the north wall had a maximum bulge of 2.4 feet, and the south wall was pressed southward one foot.

Driving the bearing piles was done during the last two days of March by a McKiernan-Terry No. 9-B-2 hammer, weighing 6,760 pounds. The weight of the hammer forced the piles down 12 to 14 feet without a blow. Two blows would then drive the piles about 4 feet further, when the piles would begin to drive hard and ultimately bring up on rock. The driving of the bearing piles caused the material to heave up 2 feet all over the bottom. Concreting was commenced on April 1st and completed on the 28th to elevation 535.0.

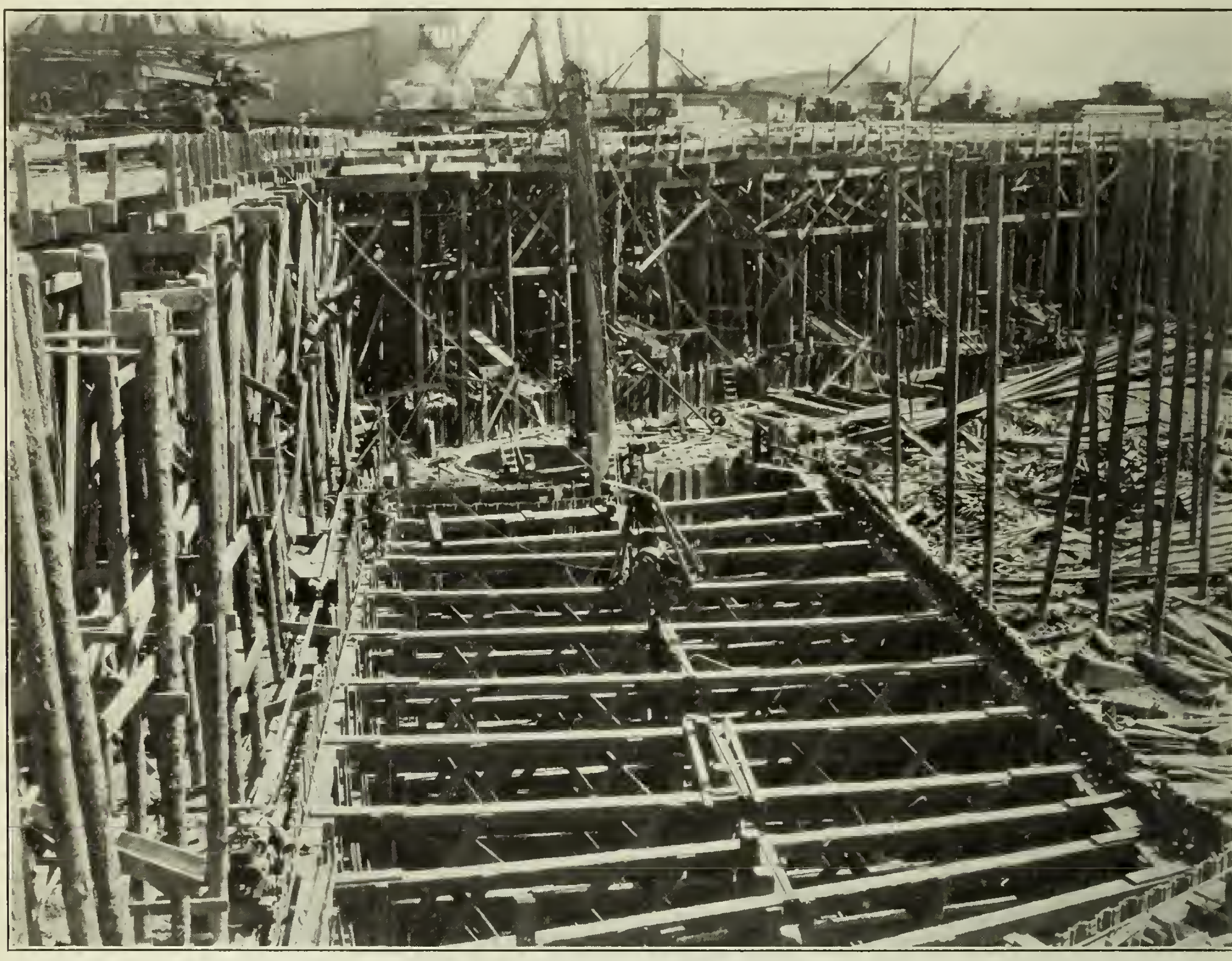

Figure No. 13.—View of Pit D Looking North, June, 1927.

PIT C

Pit *C* enclosed the western half and west end well of the south tube of the culvert. It was 38 feet wide and 170 feet long. On December 30th the work of assembling and driving the steel piling was begun, but was not completed until February 12th, 1927. Excavation was started on January 15th and completed on April 18th. No water other than surface drainage entered the pit until nearly all the bearing piles had been driven, when it started coming up the side of one of the piles.

Like pit *B*, the west end of pit *C* was irregular in shape and entailed timber bracing of special design and the use of long hardwood corbels, and, like pit *A*, it had one line of longitudinal struts from end to end of the pit. Considerable trouble was experienced from the timber bracing in this pit failing. When the excavation was only down to elevation 538.5 a 12- by 12-inch wale failed in the north wall near the east end. When the excavation was down to elevation 523.5 two struts failed in row *C* near the east end. It was then decided that the 12- by 12-inch struts in rows *B* and *C* were too light and all the struts in these rows were doubled. About this time a check survey was made of the cellular cofferdam. It revealed a northward movement of about 2 feet at the top of cell No. 1. The movement extended easterly as far as cell No. 8, being a maximum at cell No. 1 and zero at cell No. 8. The dimensions of all the transverse struts in all the rows below row *C* were then increased to 18- by 18-inch and no further trouble was experienced from breaking struts. When the excavation was down to elevation 512.0, the interlock between the first and second piles at the north-east corner of cell No. 3 of the cellular cofferdam failed, and the wall of the cell was forced out until the opening was about 6 feet wide. This break was repaired by burning off a few of the piles as low down as possible and driving a new wall outside the break. Each end pile of the new wall was driven down on top of a burned-off pile in the old wall and interlocked with the adjoining full length pile of the original wall. Nine new piles, 54 feet long, were required to repair the break. During the excavation of the pit it was observed that the timber construction trestle alongside the pit was gradually settling, and had eventually to be blocked up 3 feet to permit the derricks to travel upon it. It was also observed that the material out in the centre of the culvert site was heaving up opposite the east end of pit *C*. When the excavation was completed a survey of the steel pile walls showed a maximum movement of 4.5 feet northward at the top of the south wall. The top of the north wall moved about one foot in the same direction. This movement extended throughout 100 feet from the east end of the pit. The steel piling was badly bulged in places, but none of its interlocks failed. Driving the bearing piles was begun on the 12th and completed on the 21st of April, with the same characteristics as were experienced in pit *B*. By May 16th, 1927, the tube was completed to elevation 535.0.

Pit D

Pit *D*, (shown in figure No. 13), enclosed the west end of the four central tubes and their vertical wells, and was 54 feet 7 inches wide by 116 feet 6 inches long. The steel piling was assembled and driven between February 15th and 28th. Excavation was begun on April 29th and completed on June 20th. As the end walls of pit *D* did not require to be supported a through longitudinal strut was not required. This was a great advantage in designing the bracing as it enabled the long transverse struts to be placed in position in one length in all the tiers. In this system of bracing the transverse struts were tied together in pairs at the centre with tie rods and short longitudinal struts and supported midway of their length by vertical 12- by 12-inch piles. This left every alternate space between the transverse struts open from side to side. In these spaces the struts were lowered full length and set in place. This system of bracing also had the great advantage of reducing the amount of manual labour required to excavate the pit, and permitted of greater freedom for the operation of the clamshell buckets used for excavating the material. The excavation of the pit was not begun until the concrete in pits *B* and *C* had been built up to about elevation 545.0, since it was deemed advisable to support the concrete tubes in pits *B* and *C* against the side wales of pit *D*, as the tubes were not considered stable against sliding from external pressure. This proved to be the case when the steel piling, separating pit *D* from pits *B* and *C*, was pulled.

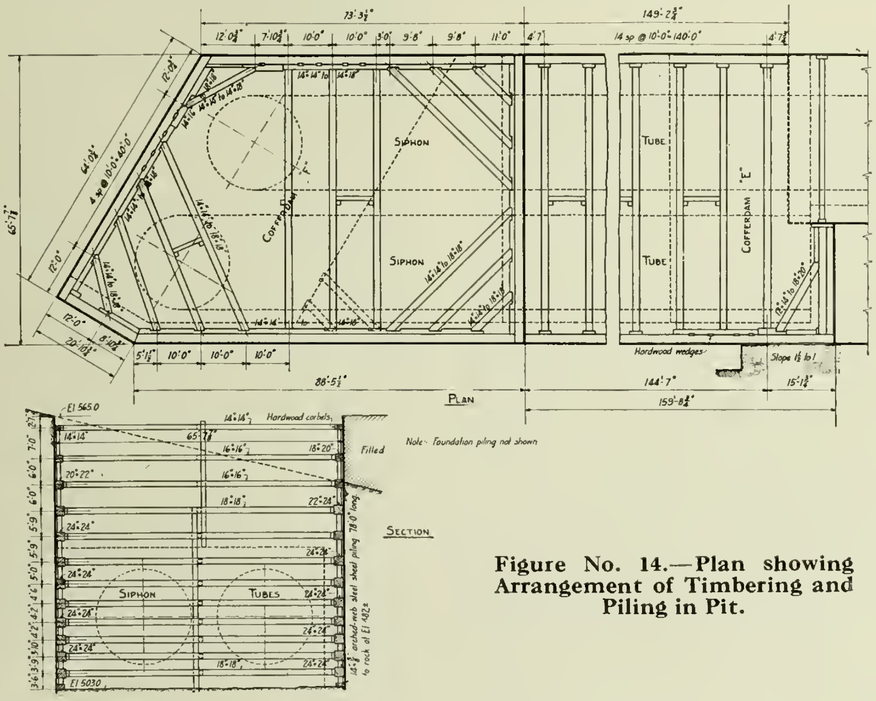

Figure No. 14.—Plan showing Arrangement of Timbering and Piling in Pit.

When the steel piling between pits *B* and *D* was pulled, and the excavation completed to elevation 499.0, a flow of water estimated at 200 gallons per minute, came in from pit *B* and the "test pit." A similar flow occurred at the south end of the pit when the steel piling between pits *C* and *D* was pulled. During this operation the west end of the north tube in pit *B* moved south about 2 inches, opening up slightly the expansion joint between the sections of the north tube in pit *B* and the test pit. This movement was amply taken care of by the metal cut-off in the joint.

Driving the bearing piles was finished on June 23rd.

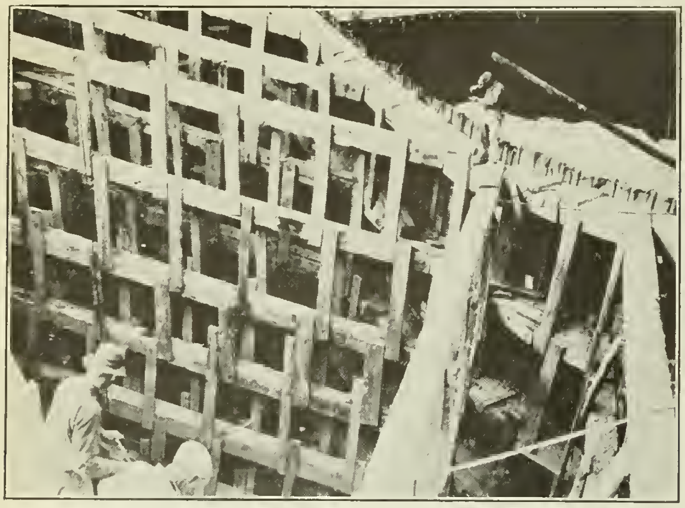

Figure No. 15.—View showing Settlement of Sheet Piling in West Wall of Pit H, August, 1927.

and the placing of concrete was completed up to elevation 546.0 on July 20th, 1927.

As the western end of the culvert was built without any serious troubles developing, it was decided to proceed at once with the construction of the east end of the structure. A study of the conditions surrounding this end of the culvert showed that owing to the gravel bank in rear of the cellular cofferdam the steel sheet pile braced pits would have to be carried up to about elevation 571.0, which meant pits 68 to 71 feet deep, or about 30 feet deeper than originally contemplated, and that, owing to the necessity of having to buttress the cellular cofferdam continually while the culvert pit was unwatered, it would be very difficult and expensive to carry this out if the pits were made only wide enough for one tube, and that if they were made wide enough for two tubes no difficulties would be encountered in continually supporting the cellular cofferdam.

Pits in which two tubes could be built at the same time would have to be 65 feet 8 inches wide. After very serious consideration it was decided to take the risk of using wide pits, and pits *F* and *H* were laid out to enclose respectively the ends of two tubes at the southeast and northeast corners of the culvert.

Pit H

Pit *H* is located at the northeast corner of the culvert area and is similar in shape to pit *C* at the southwest corner, but it is 65 feet 8 inches wide and 111 feet long. The assembling and driving of the steel piling was begun on April 27th and completed on May 31st. The piling was all driven to hardpan or rock, except that for the west wall, which was only driven down to about elevation 488.0, or 15 feet below the bottom of the pit. The piling was unlocked at three places in this pit, and at one place it was pushed so far into the pit that it had to be burned off several times as the excavation proceeded. It was also apparent that the steel piling in the north wall had deflected very badly when it was driven, as it was found to be in particularly bad alignment before the failure of the timber bracing. Along the north wall for a distance of about 30 feet from the west end of the pit the piling was pushed into the pit as much as 9 feet. Along this distance of 30 feet the cross-section of the north tube was flattened in order to obtain sufficient thickness for the north wall, which at this point was reinforced with 40-pound rails.

The excavation was begun on June 4th and was completed on August 3rd. No water entered the pit until the excavation was nearly finished, when water began coming up from the bottom at the rate of about 50 gallons per minute.

The wales were Douglas fir 14 by 14 inches, 18 by 20 inches, 20 by 22 inches, 22 by 24 inches and 24 by 24 inches. Between them and the ends of the struts were placed 8- by 20-inch hardwood corbels. The transverse struts were Douglas fir 14 by 14 inches, 16 by 16 inches and 18 by 18 inches, were all strong enough to act as unsupported columns and were placed in position in full length pieces 60 feet 4 inches to 62 feet long. They were as far as possible tied together in pairs at the centre and supported by 12- by 12-inch piles as in pit *D*. On account of using full length struts there were no through longitudinal struts, consequently the end walls had to be supported by a system of diagonal bracing, which did not prove very satisfactory under heavy loading in the lower tiers.

No trouble developed in excavating the pit until elevation 505.0, (two feet from the bottom of the pit), was reached. On July 28th, when the excavation had been carried down to elevation 505.0, the hardwood corbels in tiers *F* and *K* failed at the centre of the west wall, and the longest diagonal strut across the southwest corner in tier *G* broke. The failure of these timbers was mainly, if not entirely, due to the settling of the steel sheet piling in the west end wall, as shown in figure No. 15. The settlement of this sheet pile wall was evidently due to this piling, in driving, taking an outward slope, so that when the interior of pit *H* was excavated this wall carried the weight of the triangle of material inside the vertical line from the bottom of the piling as driven, and, being unsupported at the bottom, due to the piling not being driven to rock, this added weight forced the piling wall to move vertically, until it came in contact with the hardpan or rock below. This settlement of the piling not only threw the entire west end of the bracing system out of its horizontal plane, but set up destructive torsional stresses in many of the wales of the lower tiers. On July 28th the west end wall of piling settled 4 inches at the centre of the wall, and during that night a further settlement of 8 inches occurred. On the 29th there were a series of failures which made it look as if a complete collapse of the pit were imminent.

Additional 18- by 18-inch struts were placed across the east and west ends in the seven lowest tiers of wales. Three of these extra struts in the east end and four in the west end subsequently failed. At the east end the hardwood corbels, supporting the diagonal struts in tiers *K*, *L* and *M*, failed in a similar manner as they did in tiers *F* and *M* at the west end. In the north wall near the west end wale *M*,

Figure No. 16.—View showing Failure of Timbers in Pit H, August, 1927.

24 by 24 inches, failed and was eventually reduced to a mass of splinters. Another strut in tier *M* failed by crushing. In the north wall the 24- by 24-inch wales in tiers *K*, *L* and *M* rotated about 25 degrees around their longitudinal axis, due to the distortion of the diagonal struts. Many of the diagonal struts across the west end that had not actually failed were showing such signs of distress as to appear to be on the point of collapse. Timber piles were then driven and capped with heavy timbers in an effort to stop the sagging of the wales at the west end. On August 2nd the steel piling of the west wall had settled 4.5 feet at the centre of the wall, but there was no settlement at the two ends of the wall, as the piling at these points in the north and south walls had been driven to hardpan or rock. At this date all the wales on the north side below wale *G* for 50 feet from the northwest corner were broken, the steel sheet piling was wrapped part way around them, and all the diagonal struts in the west end below wale *H* were broken and wale *H* had kicked out. Figures Nos. 16, 17 and 18 show some of the damage to timbers in pit *H*.

Driving the bearing piles was begun on August 2nd and completed on August 4th. The material was so soft that the piles penetrated it 15 feet under the weight of the hammer. It was similar to that found in the preceding pits down to elevation 505.0 and from there to grade elevations 503 and 500 it was very much softer. Borings showed it to be very soft to elevation 485.0.

Every effort was made to get the first layer of concrete, 3 feet deep, laid over the bottom of the pit as soon as possible, and on August 3rd this was begun and completed across the west end of the pit that evening. As soon as this layer of concrete was laid across the west end of the pit for a width of about 20 feet all settlement of the west wall immediately stopped. No attempt was made to remove any part of the bottom tier of timber bracing. It was embedded in the concrete. The concrete was completed to elevation 535.0, (top of tubes), by September 3rd, and to elevation 550.0, (top of wells), by September 20th.

Pit F

Pit *F* is located at the southeast corner of the culvert area and is similar in shape to pit *B* at the northwest corner, but is 65 feet 8 inches wide and 104 feet long. The assembling and driving of the steel sheet piling was begun on June 11th and completed on June 28th. Piling 89 feet long, in two lengths of 50 feet and 39 feet, was used for the east and south walls, 83 feet long for the north wall and 78 feet long for the west wall. In order to prevent settlement of the west wall, such as had occurred when pit *H* was being excavated, every second pair of piles was driven further by adding 6-foot lengths of steel piles and driving them, when possible, until their tops were flush with those not re-driven. The general elevation of the top of the steel piling was elevation 571.0. As the pit was excavated it was noted that the steel piling had deflected badly in driving at several places, and that its alignment was also very irregular in places, there being a deviation of 6 feet in a width of ten piles at one point in the west wall, and in the southeast corner it was found to be very badly deflected; along the east wall it was found bulged as much as 4 feet at elevation 510.0. These irregularities necessitated a great deal of blocking and wedging between the piling and wales. At four points in this pit the steel piling had unlocked at elevations 532.0, 533.0, 536.0 and 539.0.

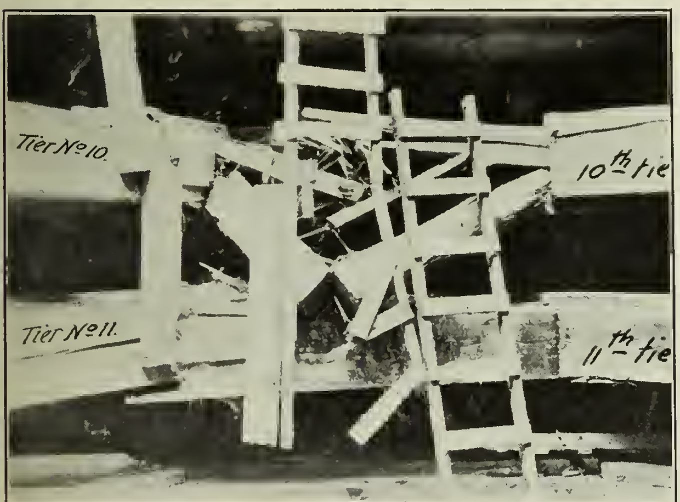

Figure No. 17.—View Showing Failure of Timbers in Pit H, August, 1927.

Figure No. 18.—View showing Failure of Timbers in Pit H, August, 1927.

The excavation was begun on July 4th and completed to elevation 501.5 on September 9th. Due to the deflection of the steel piling and the failure of diagonal struts and corbels in the southeast corner, it was not deemed advisable to carry the excavation down to elevation 500.0 in the east end of the pit. When the excavation had reached elevation 504.0 water began to come in from the bottom. The quantity was small at first, but in less than a week it had increased to about 225 gallons per minute. Pumping this water had the effect of drawing the water away from the pits previously excavated, and these pits have been practically dry ever since, except the test pit, where a small quantity continues to enter the pit.

On August 27th two of the long hardwood corbels in the southeast corner of the pit at tiers *G* and *H* failed, and when the excavation in the east end of the pit had been taken out to elevation 501.5 the wales in tiers *K*, *L* and *M* around this oblique corner also failed badly, due primarily to the failure of the long hardwood corbels supporting the diagonal struts. In order to strengthen the bracing at this point additional 18- by 18-inch struts were placed across the pit at about the centre of the east end pocket in tiers *F*, *G*, *H*, *K* and *L*.

The driving of bearing piles was begun on September 7th and finished on the 9th. They penetrated the soft clay about 15 feet under the weight of the hammer, and after the first few blows the driving was fairly stiff to ultimate refusal. The placing of concrete was begun on September 9th and was completed to elevation 535.0 on October 6th and to elevation 550.0 on October 13th, 1927.

Pit K

Pit *K* formed the connecting link between pits *A* and *H*, and, like the latter, was 65 feet 8 inches wide but only 60 feet long. The assembling and driving of the steel piling was begun on April 27th, but was not completed until September 3rd. The top of the piling was at elevation 565.0 and was 83 feet long in the north wall and 78 feet in the south wall. In the north wall some of the piles either struck boulders or very hard material, as it was found impossible to drive the tops of them lower than elevation 585.0. Excavation was begun on September 9th and completed on October 7th. No trouble was experienced with the timber bracing and no water came into the pit through the floor, but some entered the pit from pit *A* when the steel sheet pile wall between the pits was pulled out. The bearing piles were driven between October 10th and 14th, and the placing of concrete was begun on the 15th and completed on the 31st.

Pit E

Pit *E* forms the connecting link between pits *C* and *F*, and, like the latter, is 65 feet 8 inches wide and is 159 feet long. The assembling and driving of the steel sheet piling was begun on June 29th and completed on September 9th. Before the excavation in the pit was begun there was considerable discussion over the advisability of opening up such a large area at once. At first it was decided to divide it into two sections. This meant that the section which was excavated first would have to be supported at one end by diagonal struts, and as the experience with these struts in pits *H* and *F* had been far from satisfactory, there was, naturally, a desire on the part of all concerned to avoid a repetition of it if at all possible. Excavation was therefore begun throughout the entire length of the pit, with the proviso that if timbering and other conditions developed unfavourably the pit could then be divided and the balance of the excavation completed in two sections. At the end of October the excavation had been taken out to elevation 535.0. After wales in tiers *C* and *D* had been placed, the struts in these tiers began to show signs of severe stress, as their ends were crushing into the hardwood corbels. At this stage a survey of the cellular cofferdam south of pit *E* showed that it was tilting northward, that the top of the north and south walls of pit *E* were also moving northward, and that the material in the culvert pit between pits *E* and *A* was also being pushed northward on to the top of the tube in pit *A*, notwithstanding the bank of gravel 10 feet high that had been placed behind the north wall of pit *E* before excavation of the pit was begun. The material in the foundation of the culvert is very soft at the west end of pit *E*. The northward movement of the pit walls and the weight of the gravel behind the north wall squeezed the soft material up and on to the top of the tube in pit *A*. During October the tops of cells Nos. 3 and 4 of the cellular cofferdam had deflected northward 3.7 feet, and the top of the steel sheet pile walls of pit *E* 4.8 feet. To stop this movement the tops of the cells of the cellular cofferdam were anchored to the masonry of the aqueduct, and the north wall of pit *E* was buttressed by inclined 24- by 24-inch struts supported by the steel sheet piling on the north side of Pit A. These remedial measures stopped further movement of the cellular cofferdam and displacement of the walls of pit *E*. If no further trouble develops it is expected that the excavation in pit *E* will be completed by January 15th.

Date of Completion

The work will be carried on continuously throughout this winter, and it is anticipated that the structure will be completed by midsummer of 1928, provided no unforeseen troubles develop, and that there is sufficient gravel on hand at the close of navigation to meet the requirements of the contractor's concrete operations during the winter.

Excavation

The excavation in the pits has been done as far as possible with 1 and 1½ cubic yard Owens clamshell buckets operated by travelling derricks located on top of the construction trestle surrounding the perimeter of the culvert pit. The thin walls of clay left under the struts, and wales have been undermined by hand and allowed to fall over so that the mass could then be picked up by the clamshell buckets.

The results obtained during the construction of the culvert demonstrate what can be done with arch web steel sheet piling in long units, 83 feet, by carefully preassembling the piling before driving, and by skilful and careful work and close attention in putting simple rigid bracing in place as the excavation proceeds, and that similar work could be carried to a greater depth than obtained in the excavation for the syphon culvert.

Central Concrete Mixing Plant

The concrete is mixed at a central plant of the standard type, consisting of material bins and two one cubic yard Smith mixers. The concrete is transported in cars of 3 cubic yards capacity from the mixers and deposited in place by chutes from the top of the service trestle. The concrete is made from lake gravel and mixed with about 6½ bags of cement to the cubic yard of concrete. The bags contain 87½ pounds of cement each. The gravel is obtained from the bed of lake Erie about 8 miles west of Port Colborne and is delivered on the work by steam hopper barges that pump the gravel into and out of their hoppers.

There will be about 93,000 cubic yards of concrete in the culvert, and at the end of October about 50,000 cubic yards, or 54 per cent, had been built.

Contractors

The building of the syphon culvert is included in the contract of section No. 6 of the Welland ship canal, now being constructed by the Atlas Construction Company and the O. E. Leahey Company, who are jointly the contractors for the execution of all the works embraced in section No. 6. The construction of the culvert is being carried out by the Atlas Construction Company, who have a large plant on the ground consisting of derricks, pile drivers, locomotives, cars, concrete mixers, etc. The four travelling derricks operating on the service trestle surrounding the foundation pit of the culvert have capacities of 15 to 20 tons, and are equipped with 75-h.p. electric motors and 10- to 20-h.p. swinging motors. The contractors' manager on the work, Mr. John Horgan, deserves great praise for the fearless, energetic and efficient manner in which the work has been carried out during the past four months under very trying conditions. Messrs E. P. Johnson, division engineer; D. E. O'Brien, senior assistant engineer, and H. Wellwood, assistant engineer on section No. 6, have all, by their close attention and interest in the work and by their excellent spirit of co-operation, materially assisted in carrying the work through to a successful issue.

The author also desires to express his appreciation of the great interest and close supervision given the work by Mr. E. G. Cameron, principal assistant engineer, and to Mr. E. P. Johnson and Mr. J. B. McAndrew, structural engineer, Welland ship canal, for their assistance in the preparation of this paper.

Bridges Over the Welland Ship Canal

An Outline of Preliminary Investigations, Specifications, and Designs and Construction Features of the Substructures and Superstructures of the Various Bridges—of which there will be Two Swing, Seven Rolling Lift and Twelve Vertical Lift, Bridges

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Paper to be presented at the Annual General Professional Meeting of The Engineering Institute of Canada, at Montreal, Que., February 16th, 1928

The Welland ship canal, which on completion will supercede the present Welland canal, connects lake Ontario at Port Weller with lake Erie at Port Colborne, the difference in water level being 326.5 feet. It crosses the Niagara peninsula about ten miles west of Niagara falls, is approximately twenty-five miles long, and has seven lift locks between Port Weller and Thorold, each with a lift of 46.5 feet; a guard gate above lock No. 7 and a guard lock No. 8 at Port Colborne. Locks 1, 2, 3, 7 and 8 are single locks, whereas locks 4, 5 and 6 are twin locks in flight. The lock chambers are large enough to accommodate vessels 820 feet long by 80 feet beam with a draft of 30 feet.

The Niagara peninsula is rightly termed the *Garden of Canada*. The district at present is highly developed in agriculture and has many towns and industries, with prospects of still greater increase due to the large amount of electrical power available from Niagara Falls; furthermore, trunk highways and railroads between the United States and Canada are intersected by the canal. All this necessitates providing many movable bridges over the canal which, due to the requirements of navigation and bridge traffic, have to be of a high grade.

Twenty-one bridges will be provided over the ship canal. Bridges Nos. 1, 3, 6, 7, 9 and 19 will be, respectively, over the entrances of locks Nos. 1, 2, 4, 7, the guard gate and lock No. 8. All the other bridges will be over the prism of the various reaches of the canal, with the exception of bridge No. 8, which spans the opening between the flaring upper entrance walls of lock No. 7.

Investigation into the question of the type or types of bridges to be used on the canal had started as early as 1912, and by 1914 a decision had been arrived at between J. L. Weller, M.E.I.C., the then engineer-in-charge of the Welland ship canal, and the late W. A. Bowden, M.E.I.C., chief engineer of the Department of Railways and Canals, that swing spans were undesirable over the locks and that their use on the canal reaches would offer serious obstruction to navigation by reason of the guard piers required; furthermore, the cost of the substructure required either for single or double swing bridges would cause the bascule type of bridge to be more economical. By 1914 it was practically settled that all the bridges, with the exception of bridges Nos. 4, 8 and 15, would be single rolling lifts or heel trunnion bascules, and some substructures were built to accommodate either type. The substructure for bridge No. 4 was built to accommodate a double leaf deck rolling lift or double leaf deck heel trunnion bridge. Bridge No. 8, which was to be located at the then proposed site of the guard gate and would thus have a guard pier, was built as a swing span. The swing span bridge No. 15 had been built in 1910 by the Michigan Central Railroad over that part of the present canal which will form part of the Welland ship canal.

Substructures

The use of the ship canal by vessels of large tonnage requires that all substructures bordering on the channel be of massive character to withstand glancing blows from passing shipping. The substructures for the 80-foot spans form part of the lock walls, but those over the reaches require piers to be built for them, with the exception of bridges Nos. 20 and 21, whose piers form part of the sidewalls to the canal at Port Colborne.

The piers for bridges Nos. 2, 5, 10, 11 and 12 were built with wing walls curving around into the banks; so that these when backfilled form an admirable protection to a bascule or vertical lift bridge and do not require fenders up and down stream. The piers for bridges 2, 5 and 10 were built in the dry, but those for bridges 11 and 12, on account of being on the present canal, had to be built in the wet. Those for bridge No. 11 were founded on rock, but those

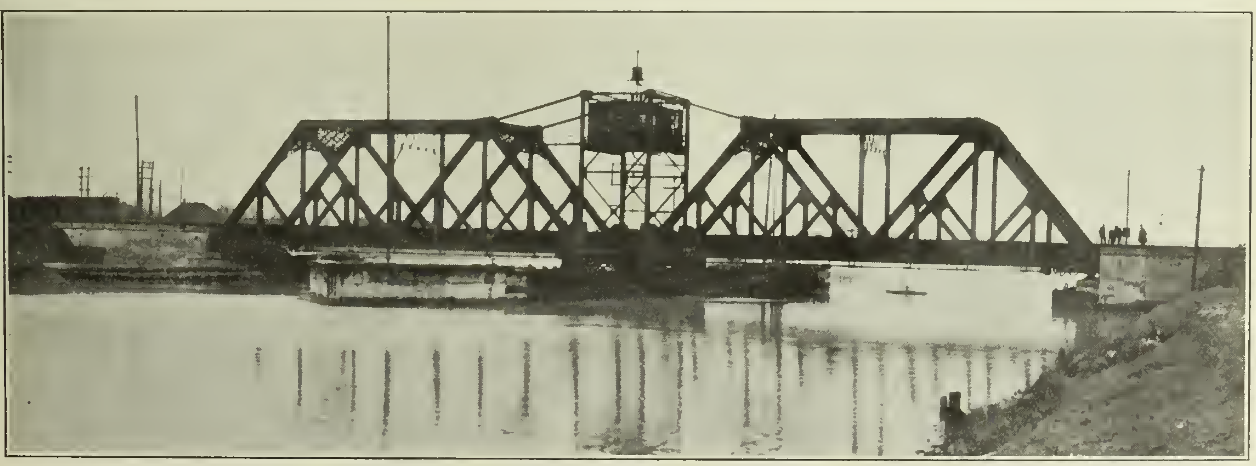

Figure No. 1.—Bridge No. 15.—Side View of Bridge Closed.

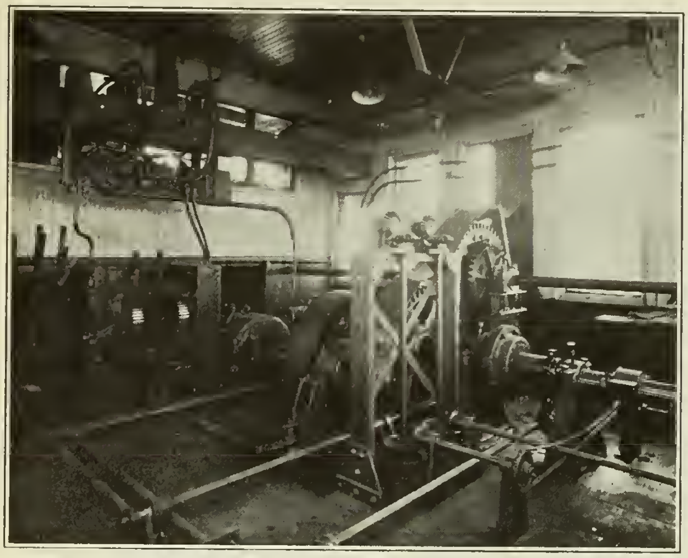

Figure No. 2.—Bridge No. 15.—View Inside of Machinery House.

for bridge No. 12 were on piles, and so much trouble and expense was encountered in building the piers for the latter bridge, due to the long lengths of sheet piling required and the difficulty of keeping the excavation unwatered, that the use of this type of pier was abandoned for bridges Nos. 13, 14, 16, 17 and 18 and oblong channel piers without backfill were substituted.

The new type of piers are built as reinforced concrete caissons with removable watertight timber bottoms. They are built adjacent to the bank of the present canal at an especially prepared construction site. The caisson is built up to a height of 14 feet, supported in what might be called a floating box composed of a shallow pontoon about 10 inches deep as the bottom and four detachable vertical timber walls about 9 feet high as the sides. The area enclosed by the walls corresponds to the size of the flared base of the caisson, and the whole is made watertight and suitably braced against the concrete as it is built up. When the caisson is built up 14 feet it has sufficient buoyancy to float itself, so water is let into the spaces between the floating box and the outside of the caisson. Under this condition the buoyancy of the box, due to weights placed upon the pontoon, is just sufficient to float it. The detachable walls are removed, the pontoon sinks and the caisson is floated down to the bridge site. Here it is built up 23 feet higher and then landed in its permanent position on its piles, which have been previously cut off under water to accurate level elevation. The timber bottoms are removed, the excavated area surrounding the outside of the piles filled up to prism grade with broken stone and the caisson partly filled with concrete poured through a tremie for a height of about 12 feet. The caisson is then unwatered, filled in the dry with concrete and the pier completed to its finished elevation.

Many of the bridge substructures have their footings on rock; others have them on bearing piles driven to refusal. All piles were driven by steam hammer. At certain locations on the canal, the canal banks showed evidence of being unstable, and at the bridge sites in this vicinity the banks were flattened, thus necessitating an increase in the length of the crossing. The practice has been adopted of backfilling abutments and excavation around piers with stone.

Some substructures have caused trouble and anxiety,

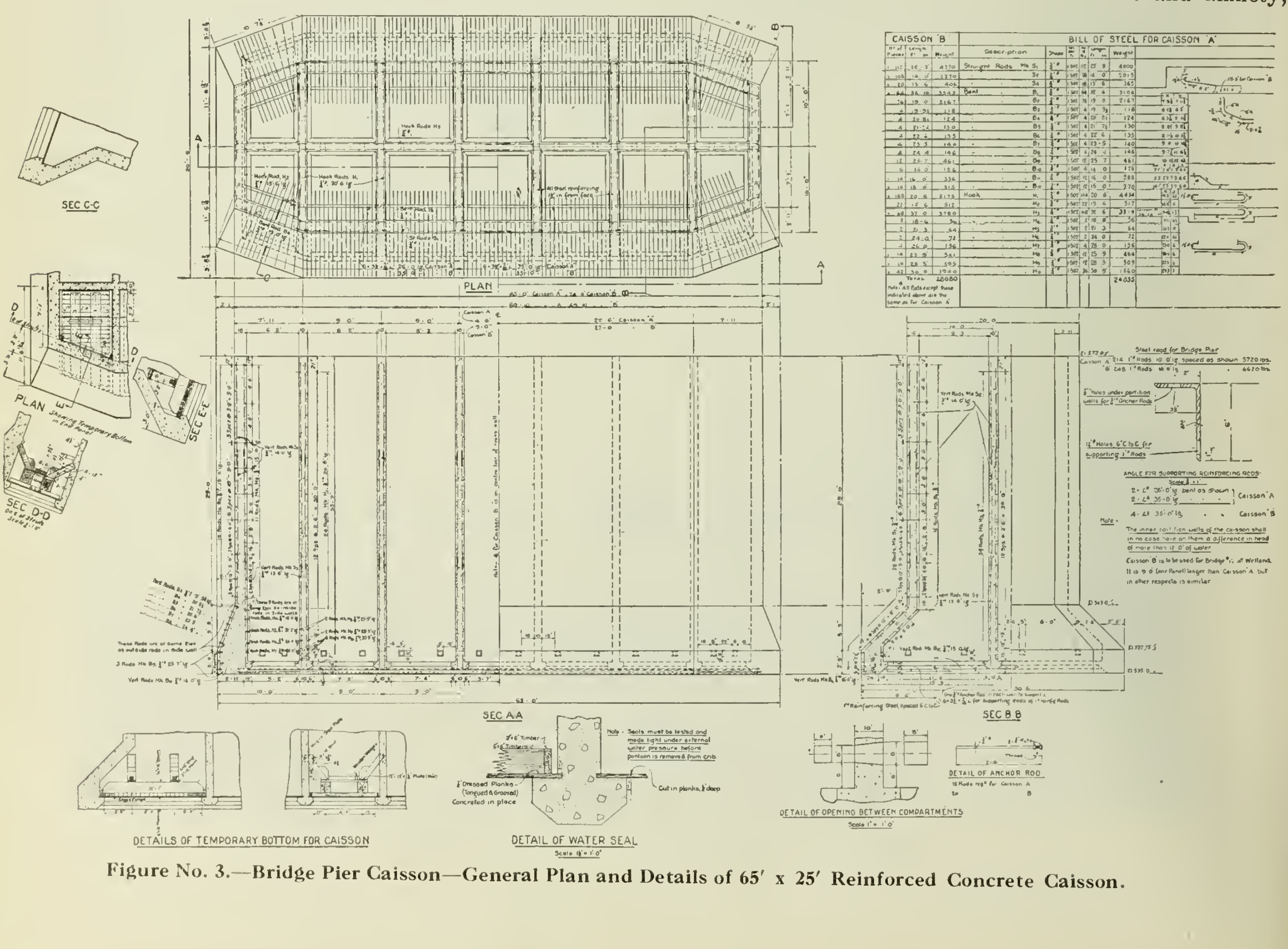

Figure No. 3.—Bridge Pier Caisson—General Plan and Details of 65′ x 25′ Reinforced Concrete Caisson.

and one in particular, bridge No. 4, seemed to have a nemesis. The two old type channel abutments were built at the beginning of the war. Some time later, when the construction of the canal had ceased on account of the Great War, the canal bank on the east side gave way, flowed down and knocked the east channel abutment over. In 1920, after work on the canal had started again, the east bank was flattened out, the old abutment removed and a new pier was put in that required no backfill. Later, in 1926, when driving piles for an extension behind the old west abutment, it was discovered that the monoliths of the abutment were being pushed out. The slopes were flattened out, and three flanking spans will be used at each end of the bridge. The west pier was underpinned and batter piles in the form of cylindrical steel shells were jacked down in front of it with 100-ton jacks and these shells filled with concrete. The piles under the pier were jacked down until they withstood a pressure of 100 tons; and the footing concreted in again and thoroughly grouted. A large trench was dug behind the pier leading out to the canal prism, and this trench was rock-filled so as to provide a drain in case the canal reach is unwatered.

Competitive Designs

After construction of the Welland ship canal had been started again in 1919, Alex. J. Grant, M.E.I.C., who had been appointed engineer-in-charge, kept pressing the Department for a decision on the type of bridges which would be used at the various crossings. Mr. Bowden had in the meantime been giving consideration to bridges of the vertical lift type, and it was finally decided that it would be very desirable to secure, from certain consulting firms, competitive designs for three typical crossings on the canal, for rolling lifts, heel-trunnion bascules and vertical lifts, thoroughly worked up, before actually deciding on the types to be used for the various crossings over the ship canal. On August 31st, 1923, an Order-in-Council was passed authorizing the calling of competitive designs covering rolling lift bascules, heel-trunnion bascules and direct lift spans for the following typical highway bridges:—bridge No. 3, Carleton street, over lock No. 2; bridge No. 4, Queenston road, and bridge No. 12, Port Robinson, and Mr. Bowden, chief engineer of the Department, gave instructions for the preparation of the necessary specifications, plans and data. The bridges on

List of Bridges Over the Welland Ship Canal

Bridge Number	LOCATION NAME	Type of Superstructure	Kind of Traffic	Width of Roadway	Distance C. to C. of Trusses or Girders	Distance C. to C. of End Bearings of moving span	Distance C. to C. of Tower Span or length of Roll	Height of Tower from base of shoe to C.L. of sheave or radius of Roll	Height of Lift or Angle of opening	Welland Ship Canal chainage in feet from outer end of Port Weller Harbour	Angle from Canal C.L. to Bridge C.L. looking S.	Channel width along Bridge C.L. between Piers	Ordinary H.W. level	Elevation of Crown of Roadway or Base of Rail	Weight of Moving Span and counterweights in Tons	Theoretical Maximum H.P. required to run under case (a) or (b).		Channel Pier Foundations Rock=R; Piles=P.
																Electric Motors	Gasoline Engine	
1	Lakeshore Road.	R.L.	H.Y. & S.T.E. R.R.	17'5" and S.T.	37'-7"	93'-7½"	28'-9"	20'-0"R	82°21'47"	106+43C.L. Track	85°18' R	80'-3¼"	291.0	295.5	770	83	26	P
2	Parnell Crossing.	V.L.	Highway........	20'	24'-0"	208'-8¼"	45'-9"	....	....	144+85.3	79°54'R	203'-1¾"	291.0	298.0	1,200	200	106	P
3	Carleton Street..	R.L.	Highway........	20'	23'-6"	90'-0"	22'-4"	15'6"R	82°33'18"	200+09	90°00'	80'-0"	337.5	341.63	530	84	26	P
4	Queenston Street	R.L.	H.Y. & S.T.E. Ry............	30'	28'-6"	220'-0"	20'-1"	16'-4"R	70°27'2"	296+92.24	79°35'R	203'-4$\frac{3}{16}$"	337.5	369.75	2,060	147	70	P
5	Merriton-St. Davids Rd....	V.L.	Highway........	20'	24'-0"	208'-8¼"	40'-0"	167'-0"	113'-6"	372+10	90°00'	200'-0"	384.0	395.0	1,200	200	106	R
6	C.N. Ry. Main Line...........	R.L.	D.T. Ry. E.-60..	D.T.	31'-0"	98'-2$\frac{7}{16}$" 98'-9$\frac{9}{16}$"	29'-0"	21'-0"R	79°7'23"	399+88.97	81°11'L	80'-11½"	384.0	437.4	2,000	196	71	R
7	Peter Street.....	R.L.	Highway........	20'	23'-6"	90'-0"	22'-4"	15'-6"R	82°33'18"	459+27.4	90'-0"	80'-0"	570.0	579.66	530	84	26	R
8	N.St.C.&T.R.R.	S.S.	S.T.E. Ry.......	S.T.	19'-0"	220'-8"	....	....	90'-0"	473+23	88°57'L	80'-0$\frac{3}{16}$"	570.0	594.65	437	47	....	R
9	Thorold-Allanburg Rd.......	R.L.	Highway........	24'	27'-10"	90'-0"	24'-0"	16'-6"R	....	502+70	90°00'	80'-0"	570.0	581.75	620	100	32	R
10	C.N. Ry. Welland Division..	V.L.	D.T. Ry. E.-60.	D.T.	31'-6"	219'-0"	48'-0"	181'-2"	114'-6"	553+00	80°00'L	203'-1"	570.0	581.5	2,245	293	157	R
11	Allanburg.......	V.L.	Highway........	30'	34'-6"	209'-0"	....	....	....	630+51.7	90°00'	200'-0"	570.0	587.5	1,750	290	154	R
12	Port Robinson...	V.L.	Highway........	20'	24'-0"	208'-8¼"	....	....	....	766+83.0	83°40'R	201'-2¾"	570.0	584.8	1,200	200	106	P
13	Main Street, Welland	V.L.	H.Y.&S.T.E.Ry	30'	34'-6"	231'-5⅝"	70'-0⅛"	175'-0"	....	977+93.86	67°35'30"R	216'-4"	570.0	585.0	2,300	373	195	P
14	Lincoln & Water St. Do........	V.L.	Highway........	20'	24'-0"	214'-2"	60'-0"	166'-0"	112'-6"	1007+98	87°45'L	200'-1⅞"	570.0	582.0	1,270	208	111	P
15	M.C. Ry. Main Line............	S.S.	D.T. Ry. E.-60.	D.T.	31'-8"	262'-8"	....	....	90°0"	1033+02	87°08'R	92'-8⅜" 100'-1½"	570.0	586.6	1,096	169	.....	P
16	Ontario St., Welland S.	V.L.	Highway.... ...	20'	24'-0"	214'-2"	60'-0"	166'-0"	112'-6"	1045+07	90°00'	200'-0"	570.0	582.0	1,270	208	111	P
17	C.N.Ry. Wabash Division.......	V.L.	S.T. Ry. E.-60..	S.T.	18'-0"	215'-0¾"	60'-0"	169'-7"	109'-7"	1135+36	90°00'	200'-0"	570.0	586.0	1,160	150	85	P
18	Forks Road.....	V.L.	Highway........	20'	24'-0"	218'-0¾"	107'-6"	166'-0"	112'-6"	1143+32	79°05'L	203'-8¼"	570.0	582.0	1,400	250	130	P
19	Humberstone....	R.L.	Highway........	20'	23'-6"	90'-0"	22'-4"	15'-6"R	82°33'18"	1312+10	90°00'	80'-0"	570.0	589 0	530	84	26	R
20	C.N.R. Buffalo to Goderich...	V.L.	S.T. Ry. E.-60..	S.T.	18'-0"	228'-10⅛"	40'-0"	174'-3"	114'-1"	1364+80.77	88°22'R	220'-1$\frac{1}{16}$"	574.0	585.54	1,325	192	80	R
21	Clarence St., Pt. Colborne......	V.L.	Highway........	30'	34'-6"	232'-10½"	40-0"	175'-0"	115'-2"	1367+91.71	85°10'30"R	220'-9⅜"	574.0	584.5	1,920	312	164	R

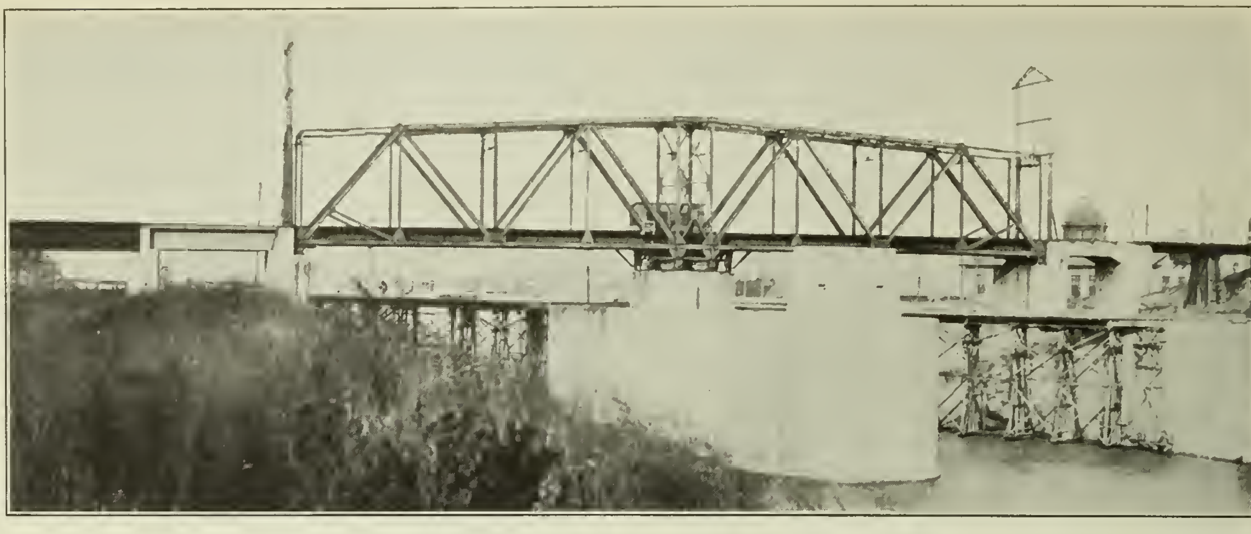

Figure No. 4.—Bridge No. 8.—Side View of Bridge Closed.

the canal come under the head of fixed and movable bridges for the accommodation of traffic from railroads, electric railways and highways, and, as there seemed no suitable specification available, Mr. Bowden authorized F. E. Sterns, M.E.I.C., and M. B. Atkinson, M.E.I.C., respectively designing engineer and structural engineer of the Welland ship canal, to write a complete bridge specification. At the same time, Mr. Bowden permitted double leaf bascule designs for highway crossings to enter the competition, and he set the vertical overhead clearance for the vertical lift bridges at 120 feet above water.

In writing the specifications, full use was made of, and great help obtained from, the specifications of the Canadian Engineering Standards Association and of the American Railway Engineering Association. Early in December 1923 the specifications were sent to the chief engineer, together with the necessary plans and data, and on December 10th, 1923, Mr. Bowden issued these, with invitations to compete, to the Scherzer Rolling Lift Bridge Company, the Strauss Bascule Bridge Company and the firm of Harrington, Howard and Ash. A time limit for the reception of designs was set at March 31st, 1924, but this was subsequently extended to June 1st, 1924. Mr. Bowden died on February 3rd, 1924, and was succeeded as chief engineer by Colonel A. E. Dubuc, D.S.O., M.E.I.C.

On April 12th, 1924, an Order-in-Council was passed appointing a Board of Engineers to examine and report upon the competitive designs submitted. This Board consisted of Colonel C. N. Monsarrat, M.E.I.C., as chairman, with F. E. Sterns, M.E.I.C., and M. B. Atkinson, M.E.I.C., of the Welland ship canal staff. Designs were received from the three competing firms, as follows:—

Strauss Bascule Bridge Company, bridge No. 3, none; bridge No. 4, none; bridge No. 12, a double leaf through truss heel-trunnion design.

Scherzer Rolling Lift Bridge Company, bridge No. 3, a single leaf through truss rolling lift design; bridge No. 4, a double leaf deck truss rolling lift design; bridge No. 12, none.

Harrington, Howard and Ash, bridge No. 3, a single leaf through girder rolling lift design and a through truss vertical lift design; bridge No. 4, a

Figure No. 5.—Bridge No. 3—(Left) Rear View of Bridge Open. (Centre) Front View of Bridge Closed. (Right) Side View of Bridge Open.

double leaf deck truss simple trunnion design and a through truss vertical lift design; bridge No. 12, a double leaf through truss rolling lift design and a through truss vertical lift design.

The designs submitted included structural stress sheets, calculation sheets and general design plans of the structure in sufficient detail to enable the general and detail design and the operation of the bridge to be thoroughly reviewed and checked over, together with estimates of quantities.

All the designs were investigated, checked and compared. Where they did not fully comply with the department's specifications, suitable corrections in the estimated weights were made in order to bring them to a common basis. The drawings and quantities of material for the various designs were sent to certain bridge companies in Canada, who were asked to furnish the Board with unit prices for each item of material for each design. The Board, in estimating the first cost of the superstructures for the different designs, used for each item a unit price which was an average of the unit prices received for this item from the bridge companies. Reports covering the complete designs for each bridge and recommended amendments to the Department's specifications to be used for contract designs were submitted by the Board to Colonel Dubuc, chief engineer of the Department.

During the competition, W. Chase Thomson, M.E.I.C., submitted to the chief engineer, for consideration, a design of the double swing type for a typical highway crossing similar to bridge No. 12. At the request of Colonel Dubuc, a report covering this type of bridge was submitted to him

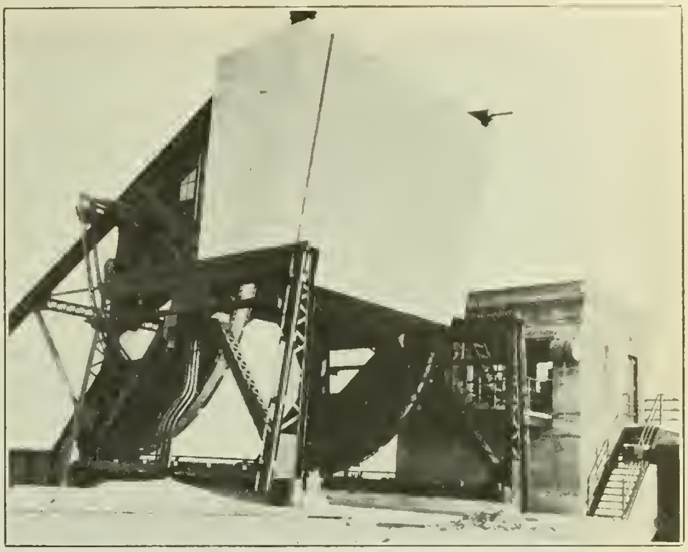

Figure No. 7.—Bridge No. 3—Rear View of Bridge Closed.

from Messrs. Grant, Sterns and Atkinson. Two designs were investigated, as follows:—type *A*, which had the pivot piers placed as close together as the prescribed navigation clearances permitted, on the assumption that fenders composed of pile clusters and floating booms would be considered as giving adequate protection to the bridge and would not necessitate the building of heavy concrete protection;

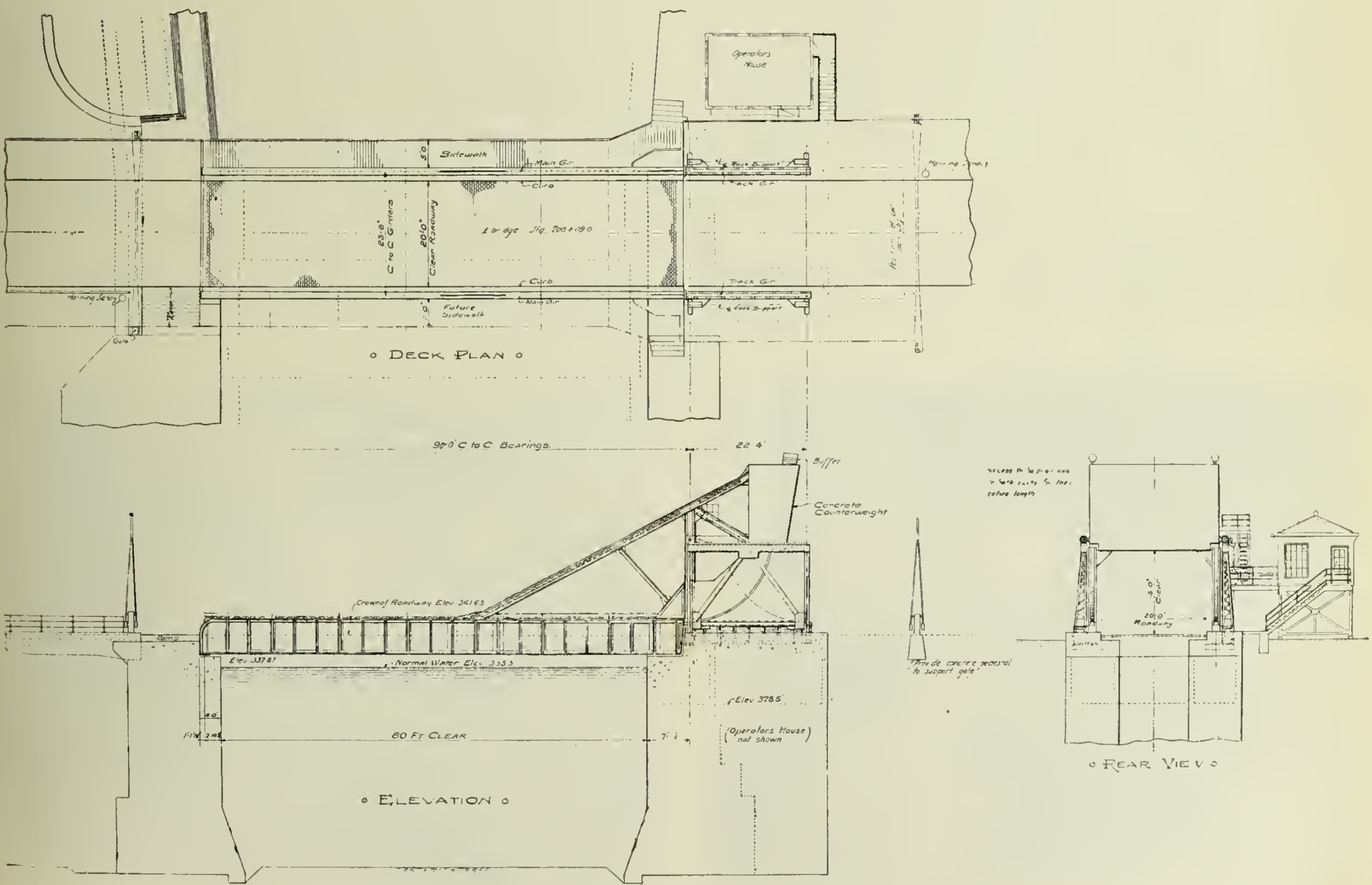

Figure No. 6.—Bridge No. 3—General Plan.

Figure No. 8.—Bridge No. 3—Side View of Bridge Closed.

type *B*, which was designed on the assumption that the piers could be placed far enough up on the slopes of the canal prism as to avoid the need for fenders, (an assumption the acceptance of which was very doubtful). The writer is aware of only two double swing bridges that have been built. one at Teignmouth, England, of about 30 feet clear span, which has been replaced by a single swing, and another at Columbus road, over the Cuyahoga river at Cleveland, Ohio. It is interesting to note that the latter bridge, which is 150 feet centre to centre of pivot piers and has equal arms, was designed by the city engineer's office and built in 1895. Seemingly, this bridge has operated satisfactorily, and yet, so far as the writer is aware, not another bridge of this type has since been built.

Specifications

The specifications were amended and issued for use as "The General Specifications for Steel Bridges Fixed and Movable for Railway or Highway Traffic, 1925, for the Welland Ship Canal, Department of Railways and Canals." The general requirements are in substantial agreement with the findings of recognized technical associations. Below are given some of the general governing features.

The overhead clearance for navigation under vertical lift bridges is 120 feet above water. Overhead clearances for railway and highway traffic are respectively 22 feet 6 inches and 16 feet.

Materials in general have to conform to the American Society for Testing Materials standards. Concrete has to conform to the requirements of the Joint Committee of the American Society of Civil Engineers, American Society for Testing Materials. American Railway Engineering Association, Portland Cement Association and American Concrete Institute, and is to develop a minimum compressive strength of 2,000 pounds per square inch at an age of twenty-eight days. Wire ropes are to have six strands of nineteen wires each and be of the grade known as special plough steel; the wire to have a strength from 225,000 to 270,000 pounds per square inch, and the ropes a strength of $87{,}200D^2 - 6{,}400D^3$ where D is the nominal diameter of the rope in inches.

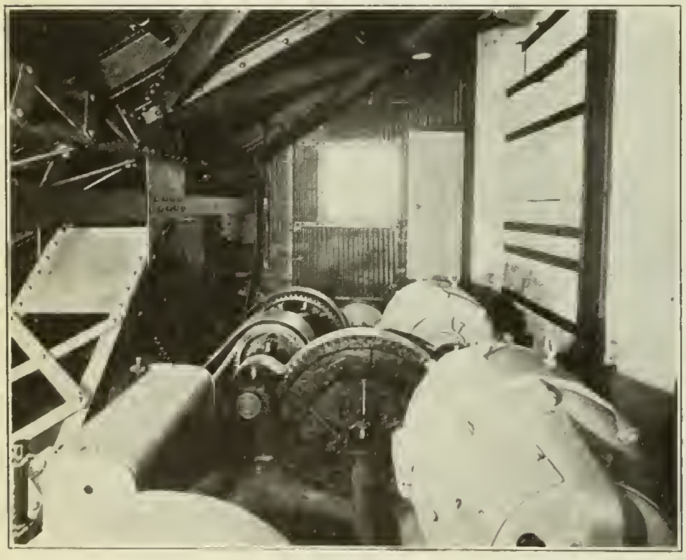

Figure No. 9.—Bridge No. 3—View Inside Machinery Enclosure on Leaf.

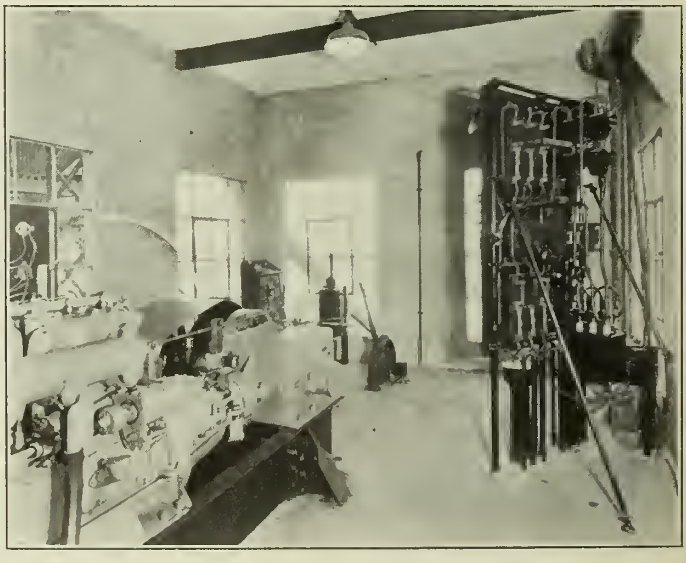

Figure No. 10.—Bridge No. 3—View Inside Upper Storey of Operator's House.

Unit Stresses in Pounds per Square Inch for Structural Parts.

	Axial Tension	Compression	Bending	Shear	Bearing
Structural Steel	16,000	12,500 or 15,000-50 1/r	16,000	10,000	24,000
Pins	......	......	24,000	12,000	24,000
Steel castings	......	14,000	12,000	......	24,000
Iron castings	......	10,000	3,000	......	......
Power driven shop rivets	......	......	......	12,000	24,000
Power driven field rivets	......	......	......	10,000	20,000
Turned bolts	......	......	......	8,000	16,000
Plate girder webs gross section	......	......	......	10,000	......
Hard bronze sliding expansion bearings	......	......	......	......	1,000
Expansion rollers (d= dia. in inches)	......	......	......	......	600 d
Segmental Girders line bearing (d=dia. in inches)	......	......	......	......	3,200 $\sqrt{d}$
Segmental girder bearing on area covered by planes at 45 degrees	......	......	......	......	13,000
Concrete	......	......	......	......	600

Unit Stresses in Pounds per Square Inch for Machinery Parts.

	Axial Tension	Compression	Bending	Shear	Fixed Bearing
Structural steel	12,000	12,000-40 1/r	12,000	8,000	18,000
Rolled or forged steel	12,000	12,000	12,000	10,000	20,000
Steel castings	9,000	11,000	9,000	7,500	20,000
Iron castings	2,000	8,000	2,500	1,500	14,000
Phosphor bronze	6,000	6,000	6,000	4,000	9,000
Brass	......	3,000	2,000	1,500	4,500
Keys	......	......	......	8,000	14,000

For stresses reversing in direction, the above unit stresses are to be multiplied by the factor, $(1 - n \div 30)$, but not less than 0.67, where n equals the number of reversals per minute.

Bearing Pressures at Slow Speed

Swing bridge pivots, hardened tool steel or phosphor bronze	3,000
Bascule trunnion, forged steel on phosphor bronze	1,500
Counterweight sheave journals on phosphor bronze	1,200
Wedges, steel on steel	500
Screws	200
Steel journals on bronze bushings	1,000
Steel journals on babbitt metal	600
Steel journals on cast iron	400

Bearing pressures where speed exceeds 100 feet per minute:—

Journals	$300,000 \div nd$	but not more than 900
Pivots	$100,000 \div nd$	" " " " 600
Collars	$50,000 \div nd$	" " " " 300

Where n = r.p.m. d = diameter of journal, pivot or mean diameter of collar.

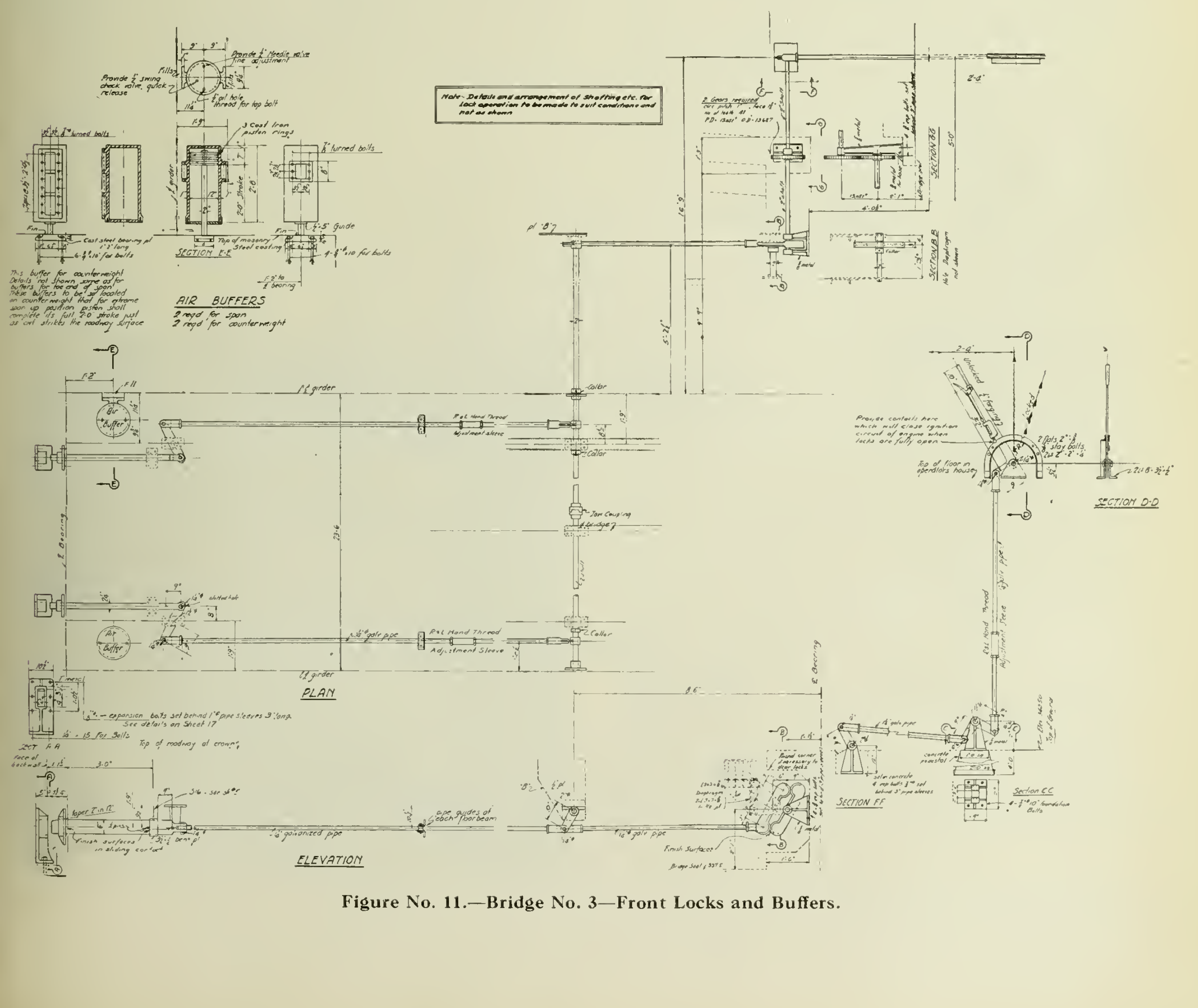

Figure No. 11.—Bridge No. 3—Front Locks and Buffers.

	Forged steel	Cast steel	Bronze
Unit stresses in cut gear teeth reduced by Lewis formula......	20,000	15,000	8,000

Wire Ropes

	Counterweight Ropes	Operating Ropes
Total unit tensile stress...........	43,600-3,200D	72,667-5,333D
Unit stress from direct load	21,800-1,600D	36,333-2,667D
Unit stress from bending $= E \times d \div 2R$		

Where $E = 28{,}500{,}000$ and d = diameter of wire, R = radius of curvature, D = diameter of rope, all in inches.

The ratio of the sheave or drum to the diameter of the rope shall not be less than 75 and 45 respectively for counterweight ropes and operating ropes, the preferable ratios are respectively 90 and 55.

Sockets for counterweight ropes	6,500
Sockets for operating ropes	11,000

Impact

Impact is allowed for in the unit stresses for machinery parts.

Frictional Resistances to be Overcome by Machinery

	For Starting	For Motion
Trunnion friction, one or more revolutions......	0.135	0.09
Trunnion friction, less than one revolution......	0.18	0.12
Centre discs..	0.15	0.10
Segmental girder rolling friction..................	0.009	0.006
Collar friction at ends of conical rollers..........	0.15	0.10
Bending of wire ropes for each sheave in terms of direct tension on the rope; d and D are respectively diameter in inches of rope and sheave	$\frac{d^2}{3D}$	$\frac{d^2}{3D}$

Rolling friction of solid rollers where r = radius of roller in inches.

In contact with one surface only................	$\frac{3}{200r}$	$\frac{3}{200r}$
In contact with two surfaces....................	$\frac{3}{100r}$	$\frac{3}{100r}$
Sliding friction for end and centre wedges		
Top surface..	0.15	0.10
Bottom surface.....................................	0.20	0.15

Friction of Machinery Parts

Efficiency of pairs of gears, including journal friction:—

Spur gears..	0.93
Bevel gears, collar friction included..............	0.85
Friction between worm and wheel....................	0.09
Friction at worm thrust collars....................	0.12
Friction at screw threads	0.15
Friction at screw collars	0.15

Live Loads

The live load for the highway bridges is specified as a uniform load of 100 pounds per square foot on the roadway and sidewalks, to be taken without impact, or a 20-ton auto truck with 30 per cent added for impact, to be taken with no uniform load on the roadway. Electric trolley car loading is specified as 50-ton cars with the percentage added for impact governed by the formula $15{,}000 \div (30{,}000 + L^2)$. Cooper's E.60 engine loading is specified for railroad bridges with the percentage added for impact governed by the A.R.E.A. formula $30{,}000 \div (30{,}000 + L^2)$. The various combinations of co-existing loads are treated in substantial agreement with standard specifications.

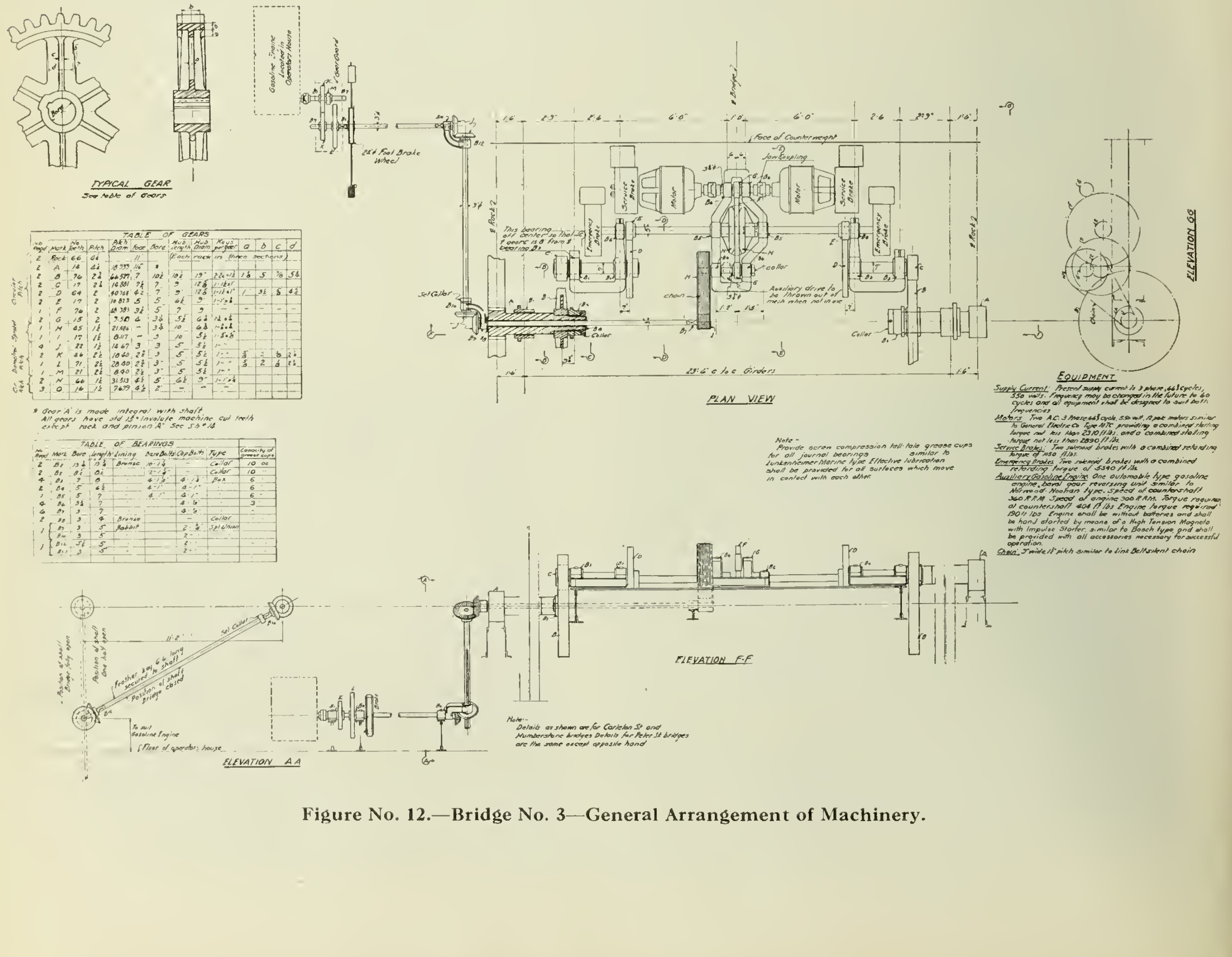

Figure No. 12.—Bridge No. 3—General Arrangement of Machinery.

Combination of Stresses for Bascule Bridges

Case 1. Dead load only, bridge in any position.
Case 2. Dead load only, bridge closed.
Case 3. Wind load only, bridge in any position. The wind being taken at 30 pounds per square foot on the vertical projection of all exposed surfaces of the entire structure, the wind acting in any horizontal direction and at any period during the operation of the bridge.
Case 4. Live load only, bridge closed.

The following combinations are to govern:—

Case 3. Plus 25 per cent for impact, together with increments for reversal, including all effects of stresses from the machinery.
Case 1. With case 3, (structure in any position, but not moving).
Case 2. With case 4, including all increments for impact and reversal due to live load, together with other co-existing loads and forces.

Combination of Stresses for Vertical Lift Bridges

Case 1. Dead load only, span in any position.
Case 2. Wind load only, span in any position. Wind load shall be taken at 30 pounds per square foot on the vertical projections of all exposed surfaces of the entire structure, acting in any horizontal direction and at any period during the operation of the bridge.
Case 3. Live load only, bridge closed.

The following combinations are to govern:—

Case 1. Plus 25 per cent for impact, together with any stresses from the machinery.
Case 1. With case 2, (span in any position but not moving).
Case 1. Bridge closed with case 3, including all increments for impact and reversal due to live load, together with all other co-existing loads and forces.

Bridge Torque Curves

The theoretical power requirements to be used in plotting the bridge torque curves have been taken as sufficient

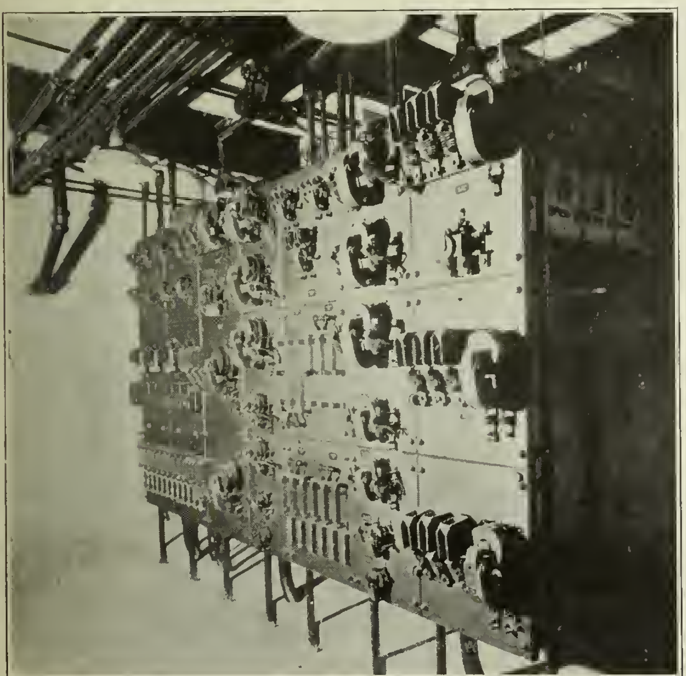

Figure No. 13.—Bridge No. 3—View Inside Lower Storey of Operator's House.

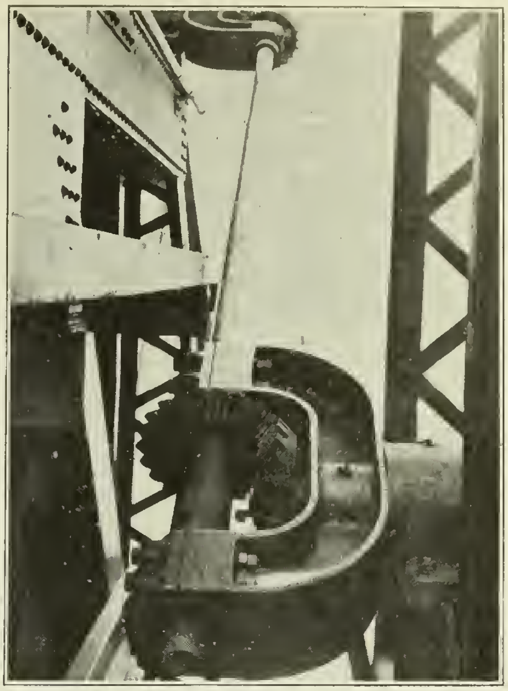

Figure No. 14.—Bridge No. 3—View of Auxiliary Shaft and Yokes.

to move the bridge under the following conditions:—

Case (*a*) In the normal time for opening against frictional resistance, inertia and a wind load of $2\frac{1}{2}$ pounds per square foot on the floor plane area and acting normally to the floor.
Case (*b*) In twice the normal time for opening against the frictional resistance and inertia, together with, in the case of a bascule bridge, a wind load of 10 pounds per square foot on any vertical projection, together with an ice load of $2\frac{1}{2}$ pounds per square foot of floor plane area, and, in the case of a vertical lift span, together with a load of $7\frac{1}{2}$ pounds per square foot of floor plane area.

The prime movers furnished must be capable of delivering the bridge torque curves torques plus 25 per cent, and are to be so governed that they cannot deliver more than the bridge torque curves torques plus 37.5 per cent.

The service brake sets or the emergency brake sets are each to be capable, when aided by 50 per cent of the moving friction and losses in machinery efficiency, of exerting a force on the structure which will overcome the maximum external loads, previously specified, together with the force required to accelerate the span in the normal time for opening. The brakes are to be tested to insure that their coefficient of friction is neither too high nor too low.

The unit stresses given for machinery are used for loads resulting from the bridge torque curves loads. The machinery is also designed to take a load fifty per cent greater at unit stresses twenty-five per cent higher, on the assumption that this results from the maximum torques that the prime movers can possibly deliver to the machinery. The machinery is also designed for the effect of the simultaneous action of the service and emergency brakes helped by one hundred per cent of the moving friction and loss in efficiency with the span travelling at full normal speed, at unit stresses fifty per cent higher than those used for the bridge torque curves loads.

Award of Work

Orders-in-council were passed awarding the work for the preparation and supply of design plans, detail design plans, calculations and data, together with assistance in the supervision of the fabrication and erection of the bridges in accordance with the department's 1925 specifications, as follows:—

October 8th, 1924, to Harrington, Howard and Ash, for four through girder rolling lift bridges,—bridges Nos. 1, 3, 7 and 19 respectively over locks Nos. 1, 2, 7 and 8, and here it should be noted that bridges 3, 7 and 19 are practically duplicates of each other.

April 18th, 1925, to the Scherzer Rolling Lift Bridge Company, for a double leaf deck-truss rolling lift bridge,—bridge No. 4, Queenston road.

September 7th, 1925, to Harrington, Howard and Ash, for two through girder rolling lift bridges,—bridges Nos. 6 and 9, being respectively over locks No. 4 and the guard gate above lock No. 7.

September 7th, 1925, to Harrington, Howard and Ash, for twelve vertical lift bridges,—bridges Nos. 2, 5, 10, 11, 12, 13, 14, 16, 17, 18, 20 and 21.

The bridges included in the foregoing orders-in-council, together with bridges Nos. 8 and 15, which had previously been built, cover all the bridges for the Welland ship canal. The designing firms were furnished by the Welland ship canal office with plans, specifications and data sheets giving all information necessary for the preparation of designs. Below is given a table of bridges showing certain pertinent information for each bridge.

The designing firms prepare for each design, detail design plans, including electrical wiring diagrams, stress sheets, calculation sheets and estimates of quantities and costs. These drawings, calculations, etc., are checked by the canal staff. The tracings when finally completed are signed as approved by Mr. Grant and Colonel Dubuc, after which prints are sent out with tender forms and special specifications to prospective bidders.

Status of the Work

The status of the work on October 31st, 1927, was as follows:—

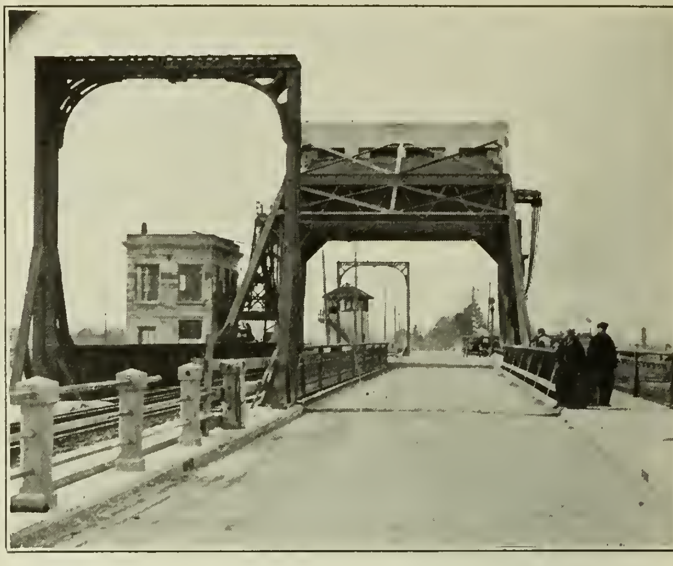

Figure No. 16.—Bridge No. 1—Front View Bridge Closed.

Bridges Nos. 1, 3, 7 and 19 were awarded to the Hamilton Bridge Works on May 18th, 1925,—bridge No. 3 has been operated and the erection of the other three bridges was nearly complete, except for the installation of the electrical equipment.

Bridge No. 17 was awarded to the Canadian Bridge Company on August 25th, 1926, and went into commission on May 23rd, 1927.

Bridge No. 4 was awarded to the Hamilton Bridge Works on December 31st, 1926, and fabrication was about fifty per cent completed, false work was placed and erection would start in November 1927. It is expected to have this bridge completed next spring.

Bridges Nos. 14 and 16, which are duplicates of one another, were awarded to the Canadian Bridge Company on September 12th, 1927, the shop drawings

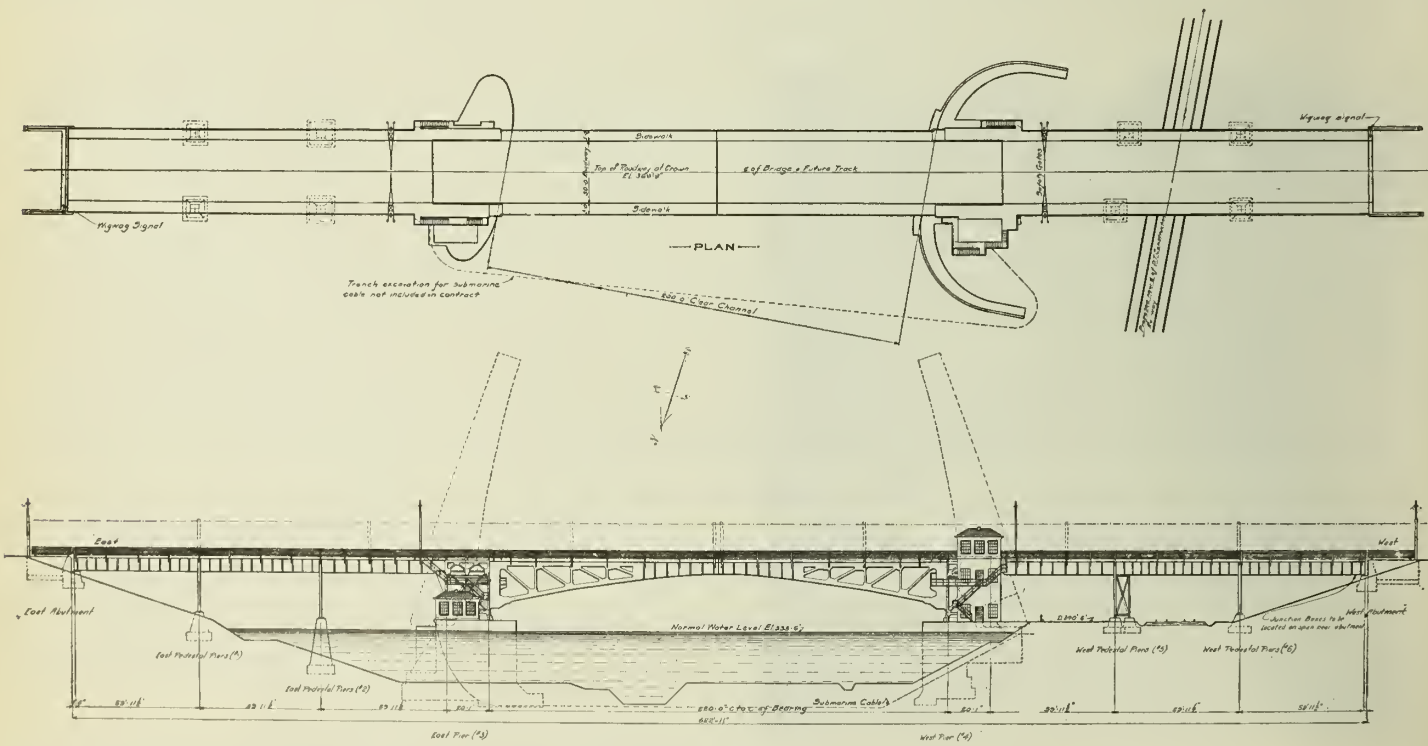

Figure No. 15.—Roller Lift Bridge, Queenston Road—General Plan.

were about ninety per cent approved, fabrication is proceeding and these two bridges will be put into commission about April 15th, 1928.

Bridge No. 20 was awarded to the Hamilton Bridge Works on September 3rd, 1927, but very little progress had been made. The design drawings for bridges Nos. 10 and 21 had been made and were about ready to issue for bids. The design drawings for bridge No. 6 had been made and were being checked in the canal office. The designs for bridges Nos. 5 and 18 were in progress in the office of the designing firm, and that for bridge No. 13 had just been started. The designs for bridges Nos. 2, 9, 11 and 12 had yet to be proceeded with.

General Features for Superstructures

The primary power for operating the bridges will be by means of electric motors of the slip ring induction type; two motors capable together of fulfilling the maximum requirements are provided for each moving leaf or span.

The electric power supply available on the transmission line up and down the canal is three-phase, 22,000-volt at 66 2/3 cycles, which may in the future be changed to 60 cycles. All electrical equipment is designed to work satisfactorily at both frequencies. At the canal locks and at locations suitable to the bridge grouping there will be substations transforming the 22,000-volt current to three-phase, 550-volt current for the electric motors and brakes. At the canal locks, current will also be transformed at the substations to single-phase, 220/110-volt current, the former being used for control and the latter for lights. For the long span bridges the 550-volt current delivered to the bridge will be transformed at the bridge to 220/110-volt for use for control and lighting. The whole electrical equipment of a bridge is so interlocked that it will operate in a pre-determined order for both opening and closing the bridge, and is fully protected against failure of power, overload, under voltage, phase failure, phase reversal and the failure to function of any part of the equipment.

There are about 5,000 through boat passages per annum on the present canal, and it is reasonable to expect a large increase in the future. It is therefore very necessary to provide for operating the movable bridges under mechanical power in the event of failure of the electrical power supply or equipment. This is accomplished by means of an automobile type of gasoline engine which is installed for each movable span or leaf. The use of hand power for auxiliary operation was considered out of the question and is not provided. The times of opening for case (*a*) under electric and gasoline power are respectively one minute and three minutes for the bridges over the locks and 1½ minutes and three minutes for bridges over the canal prism; the times of opening for case (*b*) under electric power is two minutes for bridges over the locks and three minutes for bridges over the prism. The time of opening for case (*b*) under gasoline power will be determined by the torque of the engine and change gear speed.

Racks and gears are of cast steel and pinions of forged steel. All teeth are cut and preferably of the 15-degree involute type. Shafts larger than six-inch diameter have to be forged; below that diameter they may be hot rolled. In order to obtain strength with reasonable size, in some cases, pinions are forged as an integral part of the shaft. In general, the machinery is segregated so that it would be mounted on self-contained cast steel frames to facilitate erection and maintenance of accurate shaft alignment between bearings.

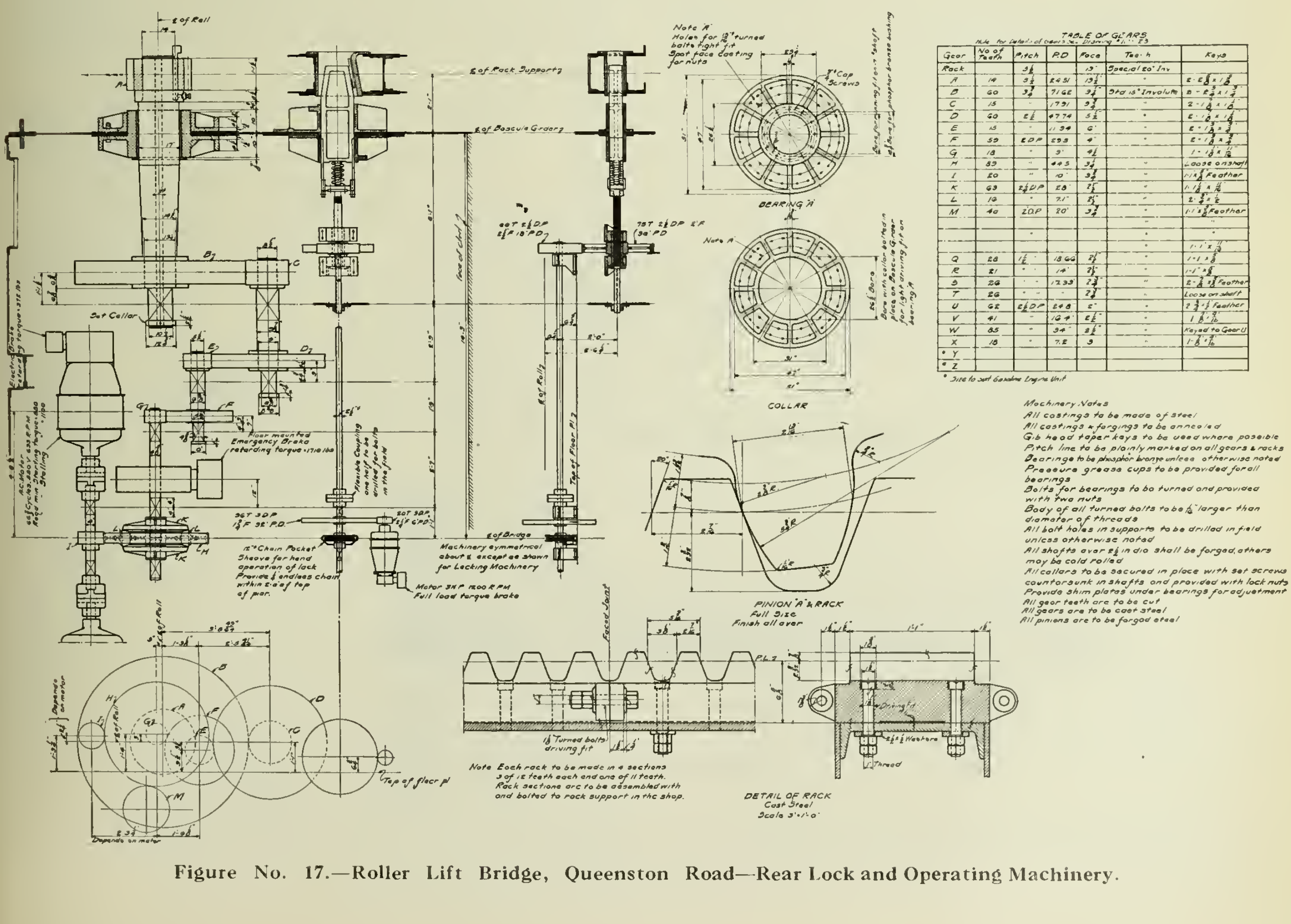

Figure No. 17.—Roller Lift Bridge, Queenston Road—Rear Lock and Operating Machinery.

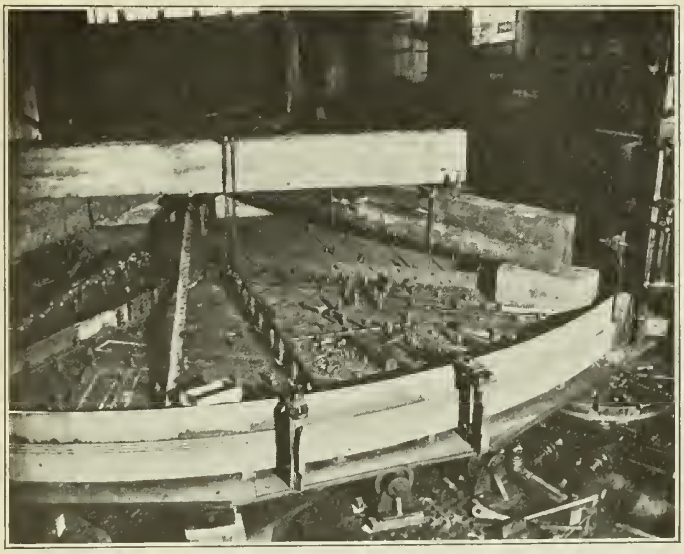

Figure No. 18.—Bridge No. 4—Finishing Segmental Girder.

Lubrication on some of the bridges is performed by the use of screw compression grease cups, but on the remainder of the bridges the Alemite method of lubrication will be used. To secure better maintenance and to reduce noise and vibration to a minimum, the machinery units were shop assembled and put in dynamic balance.

Traffic is warned by sirens. Signal gates and wigwags are provided to warn highway bridge traffic, and railway traffic is warned by the customary railway signals. The gates and signals are interlocked with the bridge locks, the latter being interlocked in turn with the control of the electric motors and the gasoline engine.

Rolling Lift Bridges

The through rolling lift spans over the canal locks have embedded in the concrete substructure two horizontal track girders on which roll two segmental girders forming part of the moving leaf. The forward arm of the leaf consists of a through plate girder span, connected at the heel end to the segmental girders and supported at points towards the centre of the girders by ties sloping back to the top of the trussing built on the segmental girders. The trussing supports an overhead concrete counterweight by means of structural steel framing embedded in the concrete and spanning between the segmental girder trussing. Immediately in front of the counterweight, and above the roadway clearance, there is a machinery house which contains the operating machinery and electric motors. Outside each truss there is a horizontal rack supported by steel framing connected at the bottom to the track girder; these racks are engaged by projecting pinions situated at the centre of roll. The moving leaf must be so balanced that its centre of gravity is on the line passing through the centres of the two pinions; as these pinions are revolved by the operating machinery, they travel horizontally along the racks, causing the leaf to roll back on the track girders. The alignment of the rolling span is maintained by staggered outside slots in the heavy tread plates on the segmental girders, engaging the staggered teeth of the track castings on the track girders.

The two-storey concrete house for the operator is situated outside the track girder towards shipping approaching the canal lock; the operator is placed in the upper storey with the gasoline engine and electrical control; the lower storey is occupied by the electric switch boards. The electric power is delivered to the moving span by means of flexible cables. The power from the gasoline engine is delivered through a gear train to an articulating shaft, hung by a yoke from the near rack pinion shaft through which another

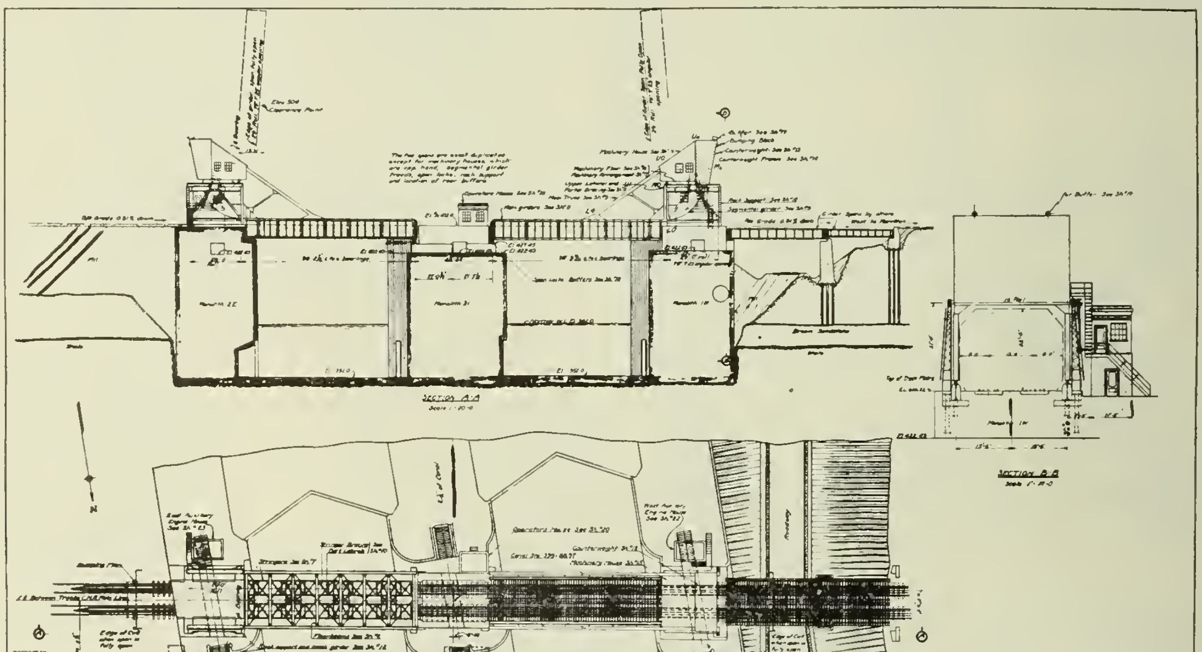

Figure No. 19.—Bridge No. 6—General Plan and Elevation.

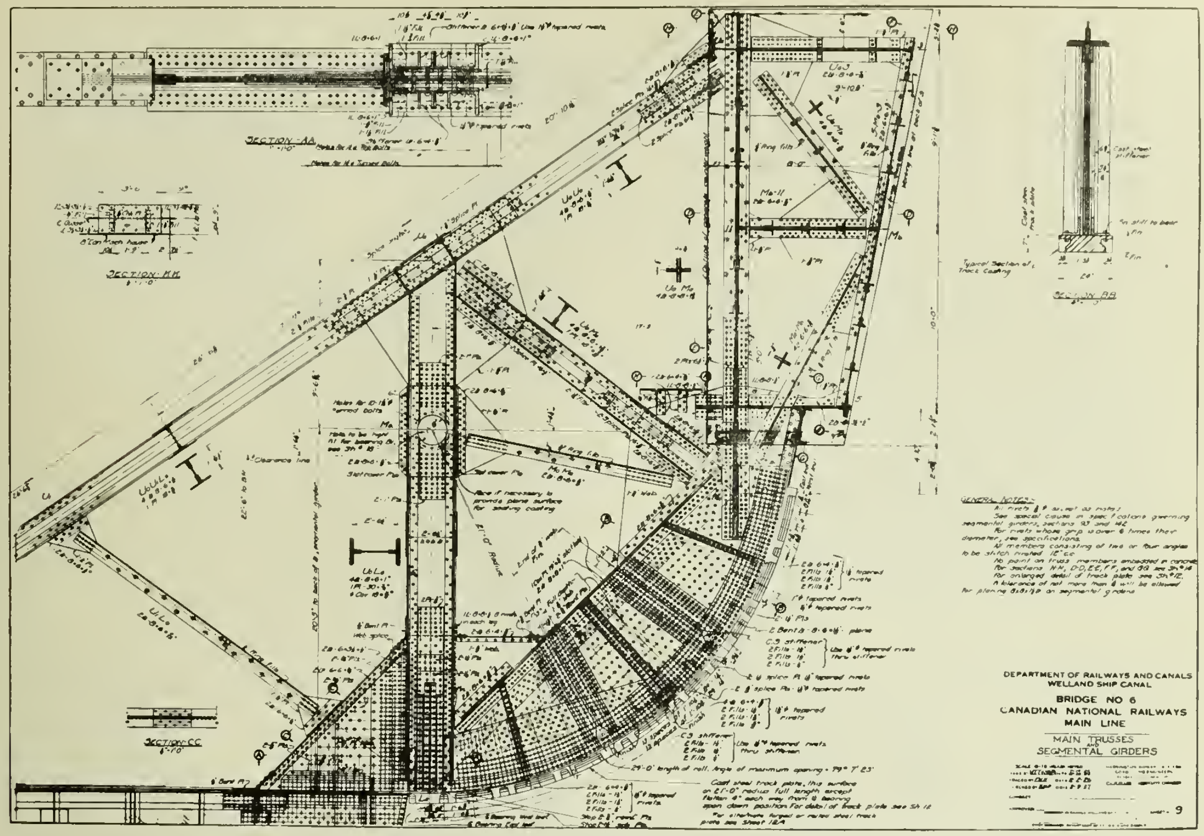

Figure No. 20.—Bridge No. 6—Main Trusses and Segmental Girders.

shaft passes transmitting the auxiliary power to the main machinery by chain drive to a pinion which can be put in or out of mesh. The articulating shaft is carried at each end by yoke castings containing mitre gearing, the shaft sliding on a feather through its lower mitre gear. The lower yoke is so located that the articulating shaft is in a vertical position when the moving leaf is open half way.

The bridges are locked by plunger locks at the toe end, connection being made at the heel end between the mechanism on the span and that on the lock wall by means of a double knuckle bell crank joint which disengages as the span is opened. The bridge is so interlocked electrically with the canal lock gates that the bridge cannot be opened until the lock gates are open, and vice versa. Air buffers are provided under the toe end of the leaf and on top of the counterweight to cushion the moving span when seating or fully opening. The structural steel frames for the concrete counterweight have a sufficient number of angle lugs in two directions to support the counterweight in bearing without depending on any bond between structural members and concrete; reinforcing rods are provided wherever thought advisable. The floor decks are made of creosoted timber, the highways having four-inch blocks on four-inch planking.

The general features of the structural and machinery work for the bridges follow the general lines of good bridge shop practice. There are, however, some special features dealing with the segmental girders which are out of the ordinary. The various designing firms had proposed segmental girders with the bottom flange angles having polygonal peripheries, with steel castings for tread plates having open joints, as this was the practice obtaining in the United States. The Board of Engineers preferred designing the segmental girders with circular peripheries, using rolled steel slabs or forgings for tread plates, with their ends faced to bear against each other; the tread plates were not considered in the design as part of the flange area, but enough bolts were provided to use them as such. Cast steel stiffeners with heavy outstanding legs are provided on both the segmental girder and track girder at the joints in the tread and track plates to distribute the load over and past the joints. The recommendation of the board was carried out, and, although the bridge company at first had considerable trouble in cold bending the curved flange angles and finishing them without planing off more than one-quarter inch of metal, the difficulties met with have been overcome, and the amount taken off runs between ⅛ and 3/16 inch.

A track girder is planed top and bottom with its web and side plates flush with the back of angles before the track castings and the sole plate are riveted on. The sole plate is planed on the surface which is against the girder flange and its two ends are planed on the bottom side where it rests on the planed grillages which are set to accurate position and elevation in the substructure. The rack frames are connected in the field to the track girders and have anchorages into the concrete to take the uplift received from the action of the rack pinion when the combined brakes are applied. There is no bracing between the two track girders, as they are well concreted in place in the slots left for them in the substructure.

The curved flange angles for the segmental girders are bent cold in a bending machine, and, after being carefully checked over to see that they have no warped surfaces and are to proper curvature, are assembled on the girder and rivetted up with the web and side plates projecting. The girder is then set with its side truly horizontal on a carriage which allows it to be rotated horizontally about the centre of roll before a slotting machine, which finishes the outstanding legs of the flange angles with the edges of the side plates and web to accurate radius. The girder is rotated after each cut automatically, and the vertical cutting tool is adjusted by hand.

The rolled slabs used for the tread plates were received bent to approximate radius from the Canadian Steel Foundries and Forgings Company, Limited, set up on an espe-

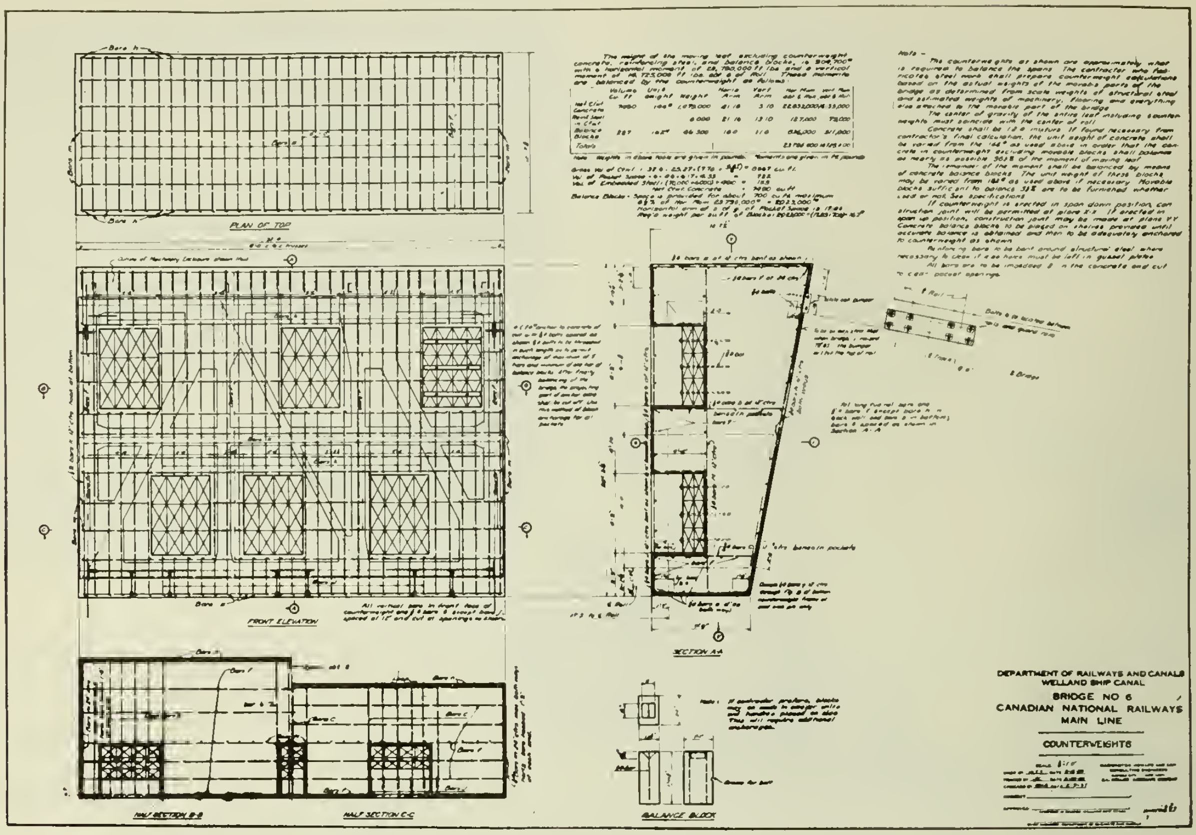

Figure No. 21.—Bridge No. 6—Counterweights.

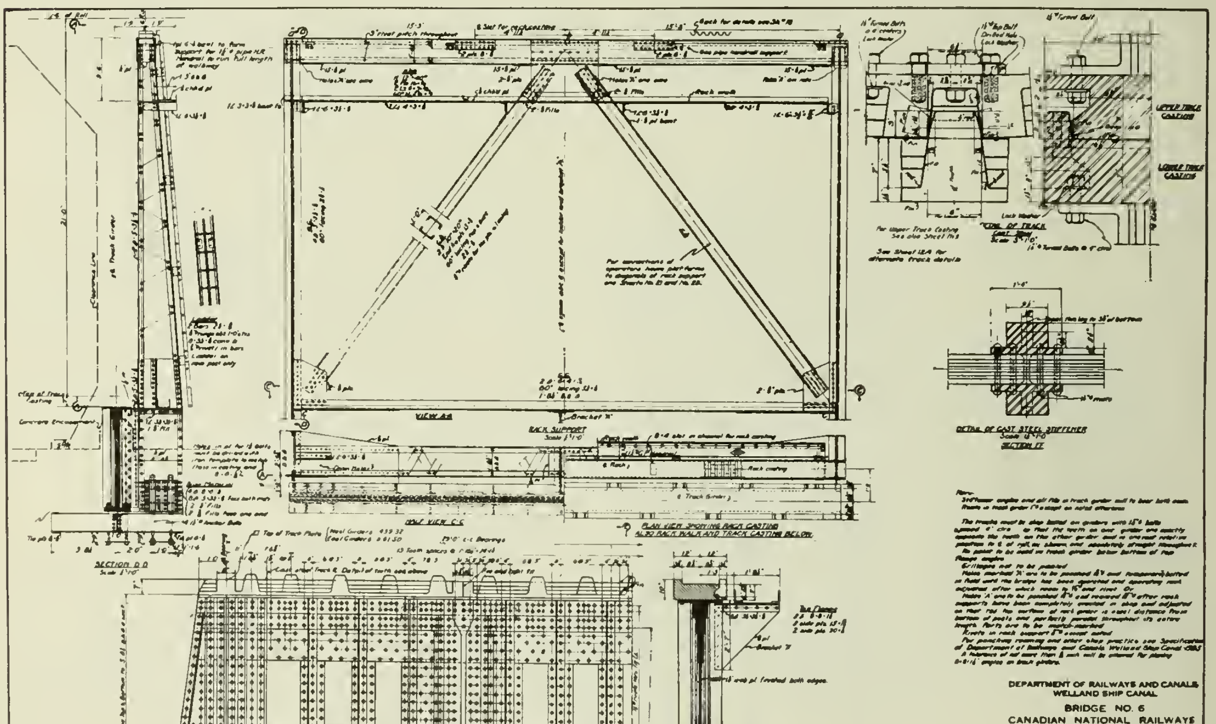

Figure No. 22.—Bridge No. 6—Track Girders, Rack Supports, and Tracks.

cially prepared jig and finished to accurate radius, inside and out, in a manner similar to that used for the segmental girders. A special machine was improvised to cut the slots in the tread plates to fit the teeth of the track castings. They were then accurately mounted on the girder and the holes for the $1\frac{1}{8}$-inch bolts, attaching them to the girder, were drilled from the solid for a driving fit and the plates bolted on.

The track and rack castings had their bottom surfaces planed, after which they were assembled in groups on the bed of the planer, so that their top surfaces and the surfaces of the teeth would be all finished true to shape and plane. The track castings were accurately assembled on the track girder, the holes of the $1\frac{1}{8}$-inch diameter rivets drilled from the solid and the castings riveted on.

Bridge No. 3

Bridge No. 3, which is similar to bridges Nos. 7 and 19, carries the traffic of Carleton street over lock No. 2 on a 20-foot roadway and one 5-foot sidewalk, the eccentric effect of the sidewalk being balanced by cast iron counterweights bolted to the girder on the side away from the sidewalk. The general outline of the structure is shown in the cuts exhibited. It should be noted, however, that the one-storey stucco house on a steel frame has been changed to a two-storey concrete house. The radius of roll is 15 feet 6 inches, and the thickness of the rolled steel tread plates and the cast steel track plates is 6 inches for each and the length of line bearing 11 inches. The bearing thickness of the segmental girder and track girder is $4\frac{3}{8}$ inches, the flange angles for the former are 8 by 8 by $1\frac{1}{8}$ inch and for the latter 8 by 8 by $\frac{7}{8}$ inch. There are two electric motors having a common pinion engaging an equalizing gear which gives flexibility to the gear trains running to each rack. The two electric motors are so controlled as to give combined torques in pounds-feet as follows:—starting, 2,300; running, for case (*a*) at 627 r.p.m., 753; running for case (*b*) at 244 r.p.m., 2,290; the two running torques respectively represent a theoretical output of 90 and 106 horse power, but the Canadian Westinghouse Company rated the two motors provided at 70 horse power each. The gasoline engine is a four-cylinder Sterling engine model FC4; cylinder bore $5\frac{1}{2}$ inches, stroke $6\frac{3}{4}$ inches, governor speed 900 r.p.m. with electric starter, charger and Sterling multiple disc clutch; the maximum torque required of the engine at 900 r.p.m. is 237 pounds-feet, equivalent to 41 horse power. The electrical brakes are of the Cutler Hammer type, each pair of service brakes and each pair of emergency brakes respectively are to furnish combined torques of 1,050 and 5,540 pounds-feet. A hand brake is provided for operation with the gasoline engine.

The bridge was erected in the closed position and presented no difficult features of erection or balancing, and the operation of the bridge shows it to be functioning properly in every particular; of course, it is yet too early to make a proper power analysis, but the power consumed on the trial runs shows very reasonable results. The electrical equipment was furnished and installed by the Canadian Westinghouse Company.

Bridge No. 1

Bridge No. 1, which carries a roadway 17 feet 5 inches wide and a single track of the Niagara, St. Catharines and Toronto Railway, is wider than No. 3 and is designed to carry, over the track, 55-ton coal hopper cars. The electric motors and gas engine used are the same as those for bridges Nos. 3, 7 and 19, the machinery train being so geared that the bridge would be moved at speeds in accordance with the torques furnished. The tread and track plates are each 6 inches thick with a line bearing of 14 inches, the radius of roll being 20 feet; the bearing thickness and flange angles for both upper and lower girders being respectively $6\frac{1}{4}$ inches and 8 by 8 by $1\frac{1}{8}$ inch.

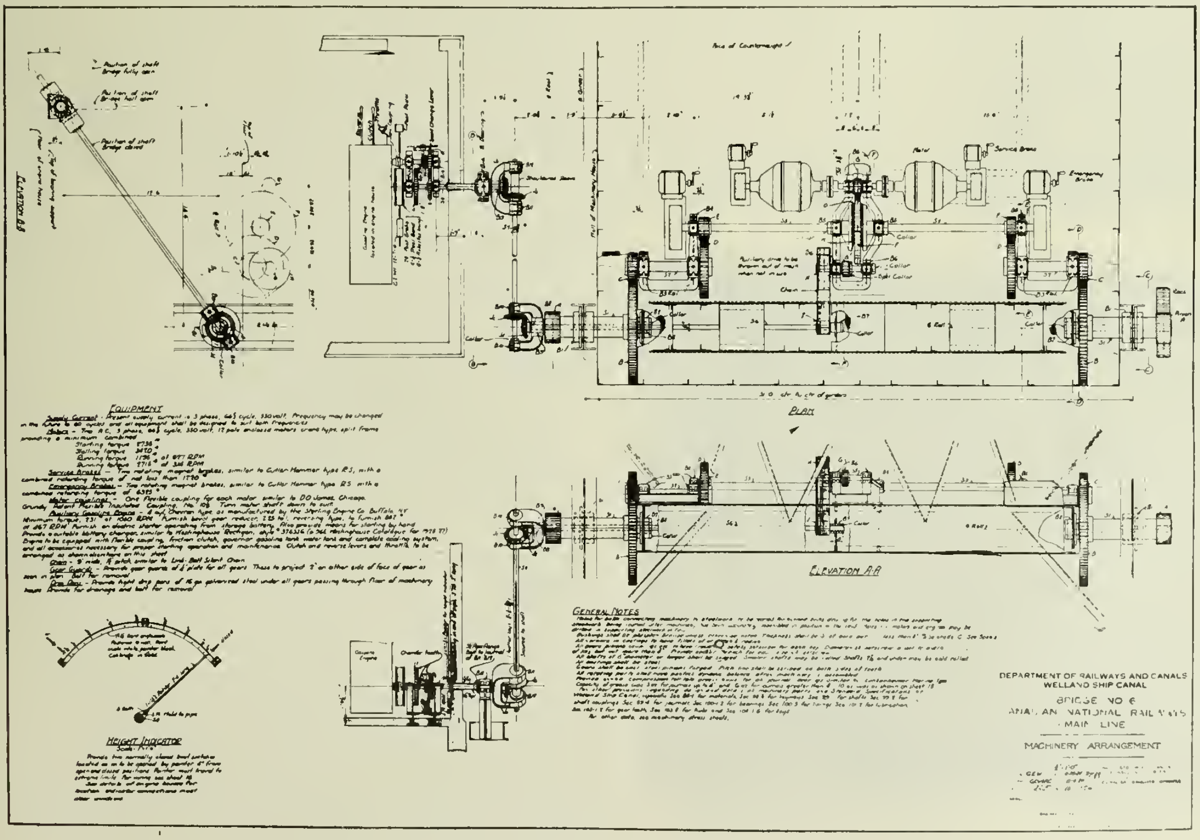

Figure No. 23.—Bridge No. 6—Machinery Arrangement.

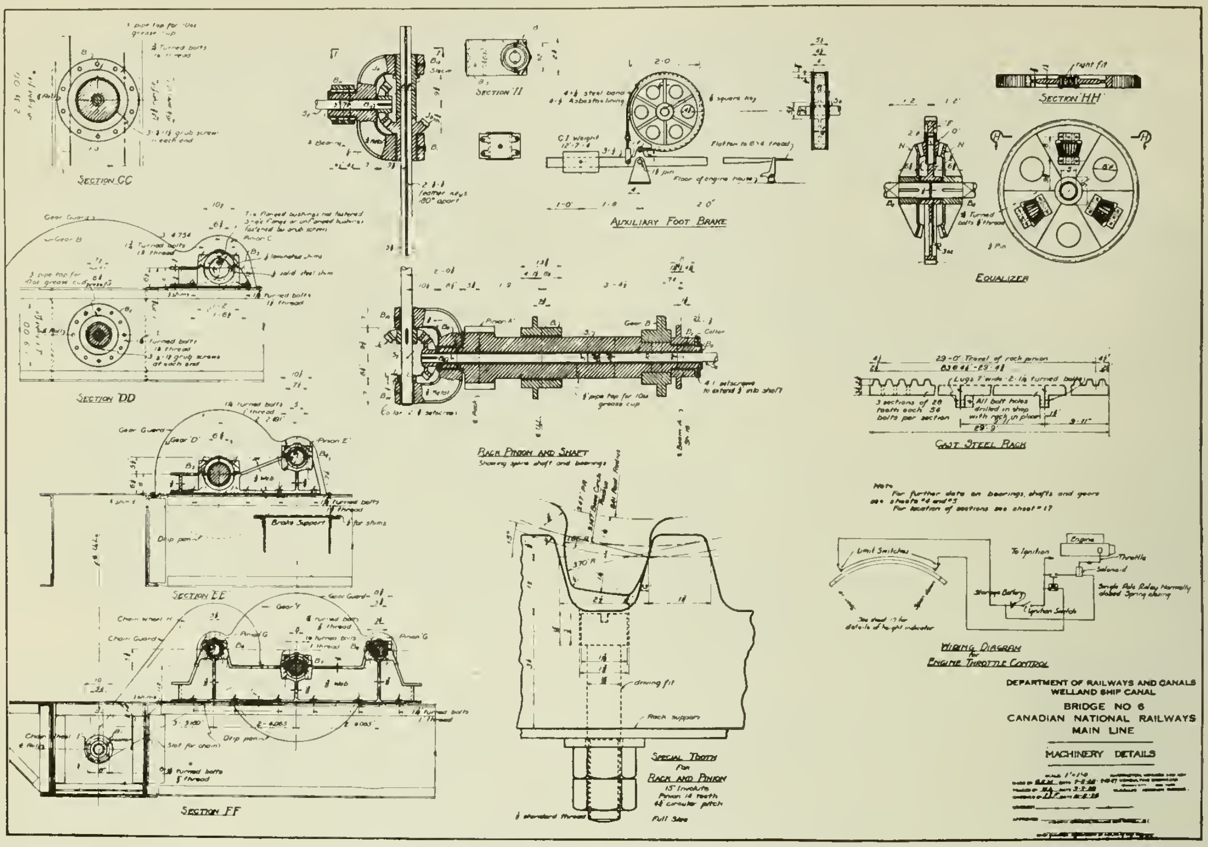

Figure No. 24.—Bridge No. 6—Machinery Details.

Bridge No. 4

Bridge No. 4, which carries the traffic of the Queenston road, is a deck bridge crossing having a 30-foot roadway with a 5-foot sidewalk on each side, and is designed to take a future electric trolley line as well as the regular highway traffic loading. The bridge consists of a 220-foot double leaf rolling lift span with three deck plate girder flanking spans at each end, carried on single bents at the intermediate supports. The bents next to the abutments have pin bearings at the bottom to reduce the bending stress from the accumulated expansion and contraction of the spans, the sliding ends being at the abutments.

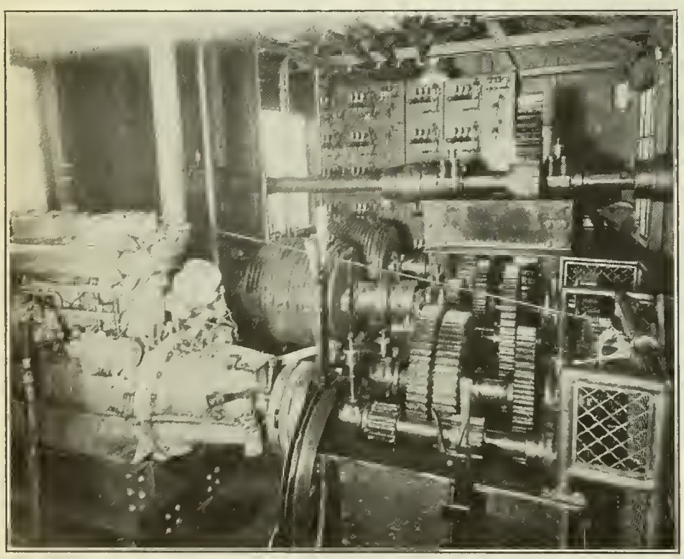

Figure No. 25.—Bridge No. 17—View Inside of Machinery House.

In order to secure direct distribution of load from the counterweight to the trusses and for purposes of maintenance, the trusses of the moving leaves were made single webbed instead of double webbed, that is, they have single gussets at the joints, thus making it necessary for practically all the members to be butt spliced. Out towards the toe ends of the leaves where they become shallow, plate girder construction takes the place of the trussing. The segmental girders are made of solid plate and angle construction from the top chord to the treads, the girder construction being carried out to the rear for the support of the counterweight and its framework. The counterweight is restricted in size in order to keep it out of the water when the bridge is fully open, and this necessitates using a large quantity of punchings to increase the unit weight of concrete in order to balance the forward arm.

The live load on a forward leaf is carried by cantilever action to the front bearing on the track girder, and the moment so generated is resisted by an anchorage girder which projects out laterally from the rear end of the counterweight, bearing against the main girder bottom flanges of the adjacent flanking spans. The girders of the adjacent flanking span connect to columns which extend, for anchorage purposes, deep down into the substructure concrete. Recesses are left in the masonry for the introduction of all substructure metal work belonging to the superstructure, and the metal work will be accurately adjusted in proper position and then concreted in place by the bridge company.

As traffic is carried on the leaf arm back of the centre of roll, it is necessary to provide motor driven tail locks for stability under traffic. The shear lock at the toe ends of the leaves consists of a jaw on one end and a tongue on the other, engaging at the nearly closed position and meshing as the completion of roll moves the two leaves towards each other; this shear lock requires no mechanism, the main

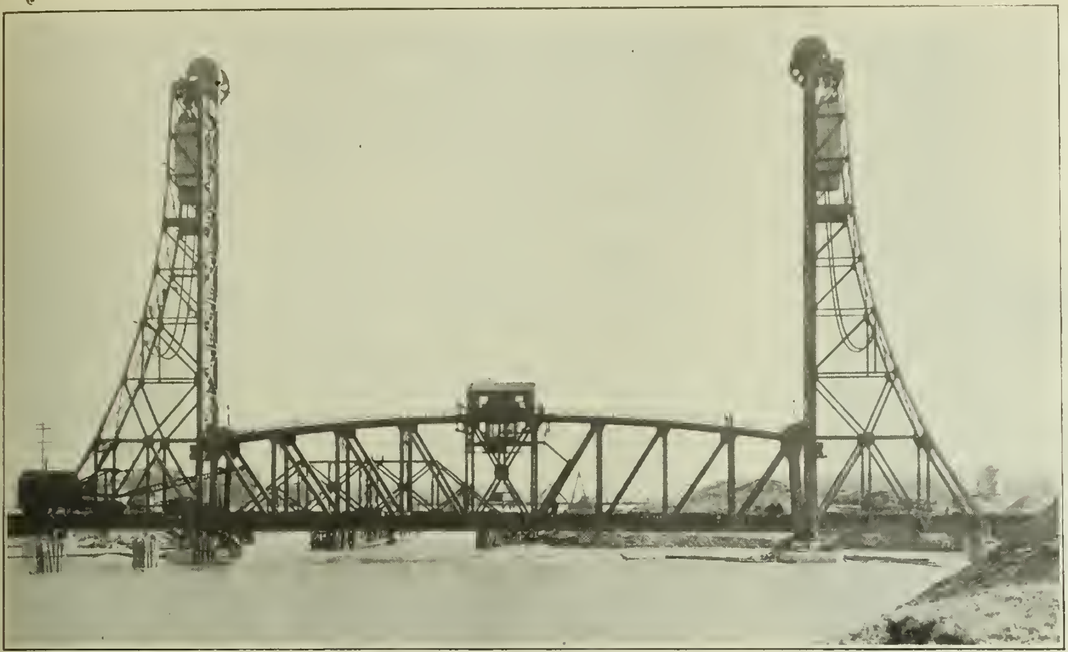

Figure No. 26.—(above) Bridge No. 17—Side View of Bridge Closed.

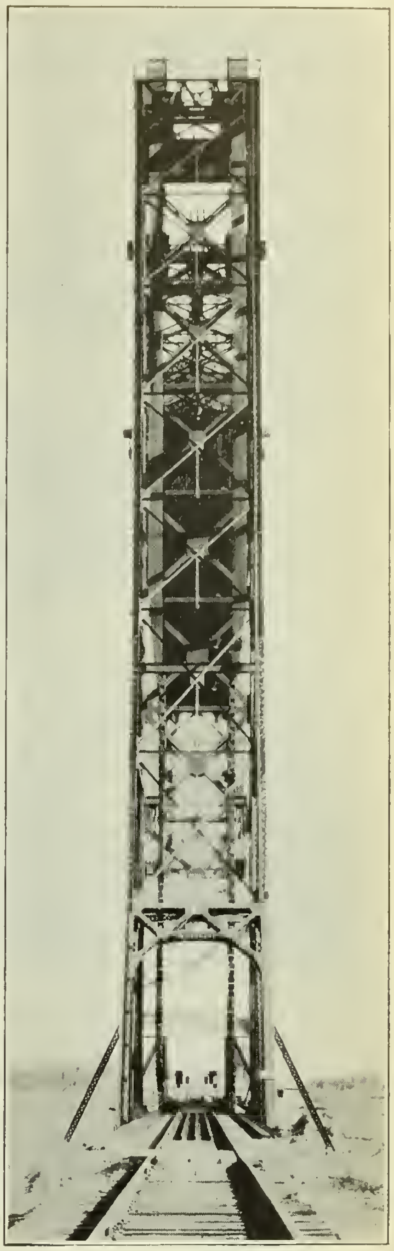

Figure No. 27.—(Right) Bridge No. 17—End View of Bridge Open.

motors being automatically controlled to stop the leaves in the proper position for engaging.

A three-storey reinforced concrete house, on the west channel pier, houses in the top storey the bridge operator and the electrical control for the two leaves, the switchboards in the second storey and the gasoline engine and hand brake for the west leaf and the submarine cable switches in the bottom storey. There is a one-storey concrete house on the east channel pier which houses the gasoline engine and hand brake for the east leaf and the switches for the submarine cable. The general layout of the operating machinery on each leaf is similar to that previously described, and it is housed in an enclosure immediately in front of the counterweight and below the roadway deck. Stairways and platforms are provided for ready access to the houses, machinery and racks, etc. The racks are below the deck and their frames also support the bridge sidewalks from the point where they stop on the moving leaves, at a point about 7 feet in front of the centre of roll in the closed position. The tail end of each leaf, from the point where the sidewalks stop to the rear end, has a width of about 31 feet, and, as the leaf rolls back, the tail moves downward, thus providing a gap in the fixed part of the structure into which the moving leaf can roll.

The tread plates for this bridge are made of forged steel and the methods used for fabricating the various parts of the structure are similar to those used for the other rolling lifts. The radius of roll is 16 feet 4 inches and the thickness of the tread and track plates is 13 inches for each and the length of line bearing 21 inches. The bearing thickness of the segmental girder and track girder is 4¼ inches and flange angles for the segmental girder and track girder are respectively 8 by 8 by 1 inch and 8 by 8 by ⅞ inch. The two electric motors for a leaf will be so controlled as to give combined torques in pounds-feet as follows:—starting, 1,760; running, for case (*a*) at 633 r.p.m., 592; running, for case (*b*) at 274 r.p.m., 1,730; the two running torques respectively represent a theoretical output of 72 and 90 horse power. The gasoline engine for each leaf is the same as provided for bridges Nos. 1, 3, 7 and 19; and the maximum torque required of the engine at 900 r.p.m. is 275 pounds-feet, equivalent to 48 horse power. Electric brakes are of the Cutler Hammer type, each pair of service brakes and each pair of emergency brakes are respectively to fur-

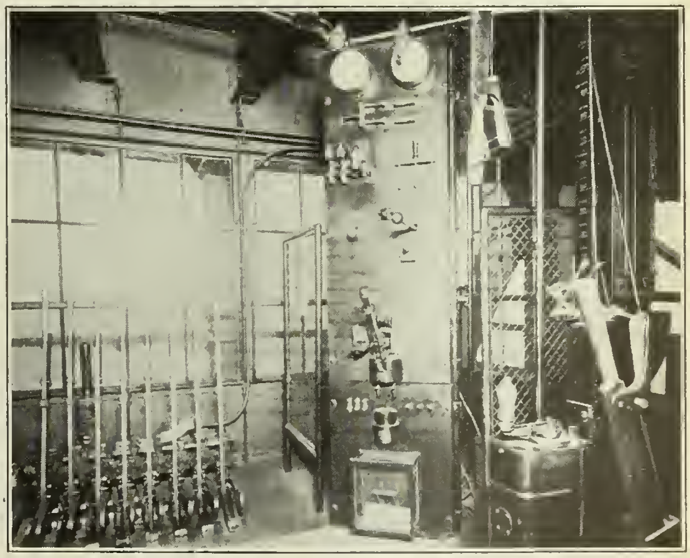

Figure No. 28.—Bridge No. 17—View Inside of Operator's House.

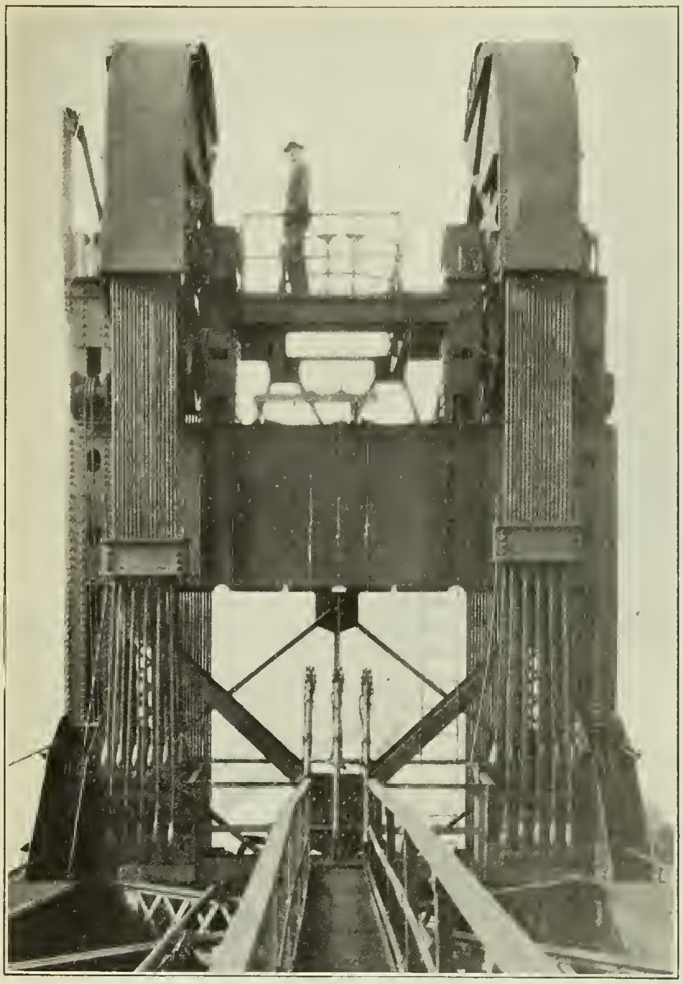

Figure No. 29.—Bridge No. 17—View from Top of Lift Span showing Trolleys, Sheaves, Ropes, etc.

nish combined torques of 744 and 3,430 pounds-feet. A hand brake and mechanical indicator to show the position of the leaf is provided for operation under gasoline power, in which case a bridge operator will be needed for each leaf. Only one operator is needed for electrical operation and the whole equipment for both sides is properly interlocked, with the proper sequence of operation functioning indicated by prismatic bench lights.

Bridge No. 6

Bridge No. 6 consists of two single leaf double track rolling lift through plate-girder spans placed over the entrances to the chambers of lock No. 4. The spans are made duplicates of each other in detail, but the bridge is on a grade of 0.97 per cent, and the track girders will be set horizontal, so that the two spans will differ slightly in the distance centre to centre of end bearings. It is designed to carry Cooper's E 60 loading. The two leaves will be operated electrically by an operator situated in a house on the centre wall, but for operation under auxiliary gasoline power two other operators will be needed, one on each side wall, in the houses containing the gasoline engines. The central operator handles, both under electrical operation and gasoline operation, the mechanical bridge locks and the railroad signals, which will be fed from a storage battery and controlled by an interlocking machine. The electric power used for operating the bridge will be a.c. current, as for the other bridges. The two electric motors for each leaf will be so controlled as to give combined torques in pounds-feet, as follows:—starting, 2,735; running, for case (a) at 627 r.p.m., 1,195; running, for case (b) at 314 r.p.m., 2,715; the two running torques respectively represent a theoretical output of 143 and 162 horse power. The gasoline engine for each leaf will be a four-cylinder Sterling engine type Chevron cylinder bore $5\frac{1}{2}$ inches, stroke $6\frac{3}{4}$ inches, governor speed 1,050 r.p.m. The torque required of the engine is 231 pounds-feet. The combined torques required for the pair of service brakes and for the pair of emergency brakes for each leaf are respectively 1,220 and 6,325 pounds-feet. The

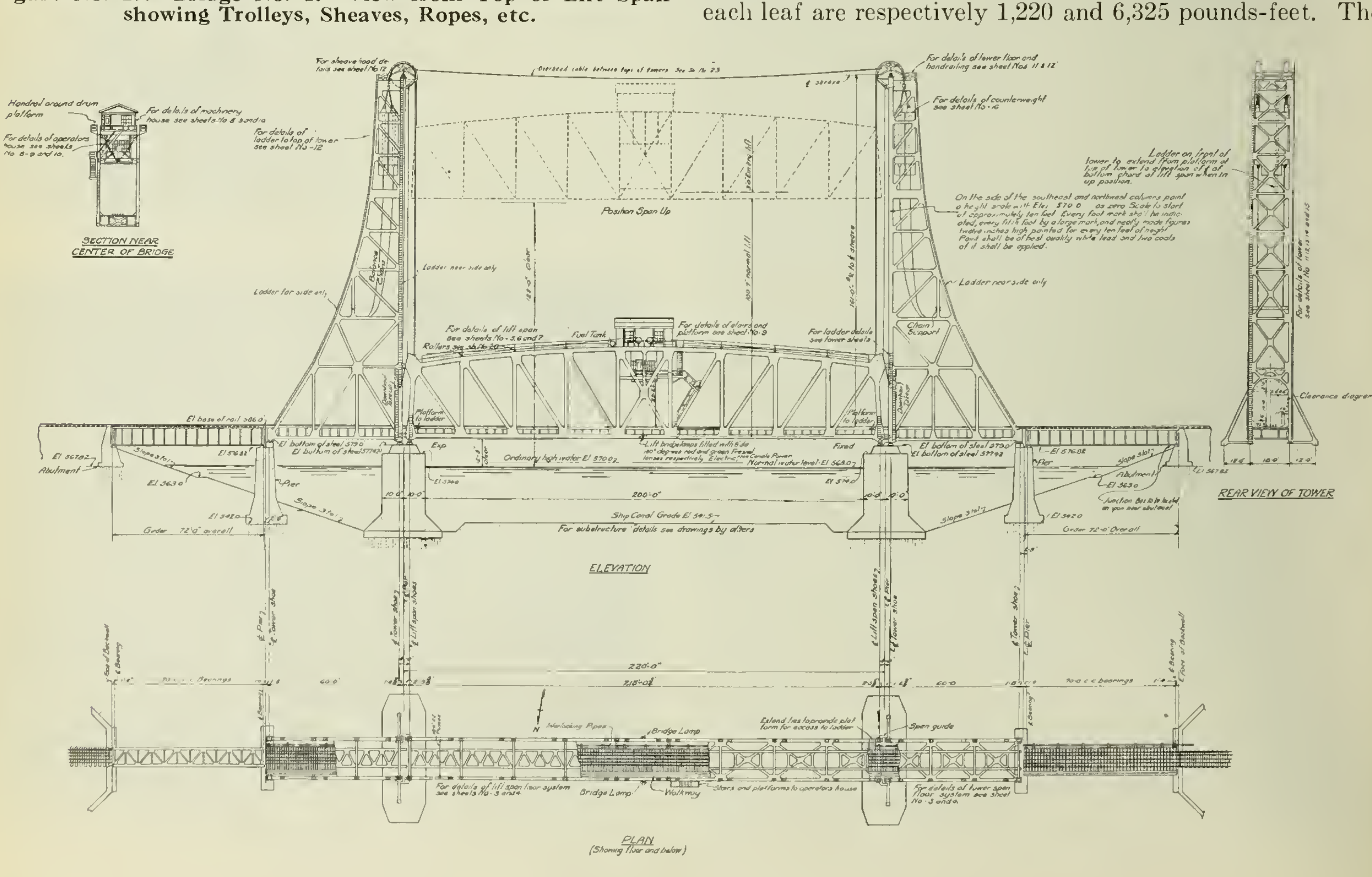

Figure No. 30.—Bridge No. 17—General Plan and Elevation.

Estimated Costs for Superstructures of Rolling Lift Bridges Nos. 1, 3 and 4 Based on Contract Prices.

Item	Unit	Bridge No. 1, Lake Shore Rd. Single Leaf			Bridge No. 3, Carleton St. Single Leaf			Bridge No. 4, Queenston Rd. Double Leaf		
		quantity	unit price	amount	quantity	unit price	amount	quantity	unit price	amount
Structural steel and all other metalwork not included in other items	lb.	660,000	0.0956	$63,096	353,000	0.0956	$33,747	2,267,000	0.0973	$220,579
Reinforcing steel	lb.	......	......	......	......	......	......	108,000	0.045	4,860
Machinery castings and forgings	lb.	115,000	0.325	37,375	82,000	0.325	26,650	170,000	0.359	61,030
Cast steel tracks	lb.	......	......	......	......	......	......	67,000	0.18	12,060
Rolled or forged steeltreads	lb.	......	......	......	......	......	......	78,000	0.195	15,210
Scrap metal in counterweight	lb.	......	......	......	......	......	......	290,000	0.013	3,770
Counterweights and other concrete work	bulk sum	......	......	12,742	......	......	8,810	......	......	28,160
Timber floor decks and walks	do	......	......	4,555	......	......	5,190	......	......	19,560
Electrical equipment	do	......	......	24,123	......	......	24,123	......	......	55,851
Auxiliary power equipment	do	......	......	4,200	......	......	4,200	......	......	9,400
Houses for operators and machinery	do	......	......	5,500	......	......	6,000	......	......	8,000
Signals	do	......	......	1,717	......	......	1,717	......	......	2,600
Highway gates	do	......	......	1,858	......	......	3,714	......	......	3,500
Total cost of superstructure				$155,166			$114,151			$444,580

hand brake for auxiliary operation has to deliver a torque of 254 pounds-feet. The radius of roll is 21 feet, the thickness each of tread and track plate 7 inches, length of line bearing 17.5 inches and bearing thickness for the upper and lower girder 7 inches. Mechanically operated rail locks will not be needed, for cast manganese steel rails project out at the toe end of the leaf, and, from the substructure at the heel end, these pieces nest into cast steel chairs on the substructure at the toe end and on the heel end of the span. As the span rolls back the rails are disengaged from their chairs.

Bridge No. 9

Bridge No. 9, which is over the north entrance to the guard gate, will be similar to bridge No. 7, except that its width of roadway will be 24 feet instead of 20 feet.

Vertical Lift Bridges

The vertical lift bridges, which will all be over the canal prism in the reaches, have on each side of the channel a structural steel tower supporting, on a cross girder at the top, the cast steel counterweight sheaves over which pass the special plough steel wire ropes. The ropes are connected

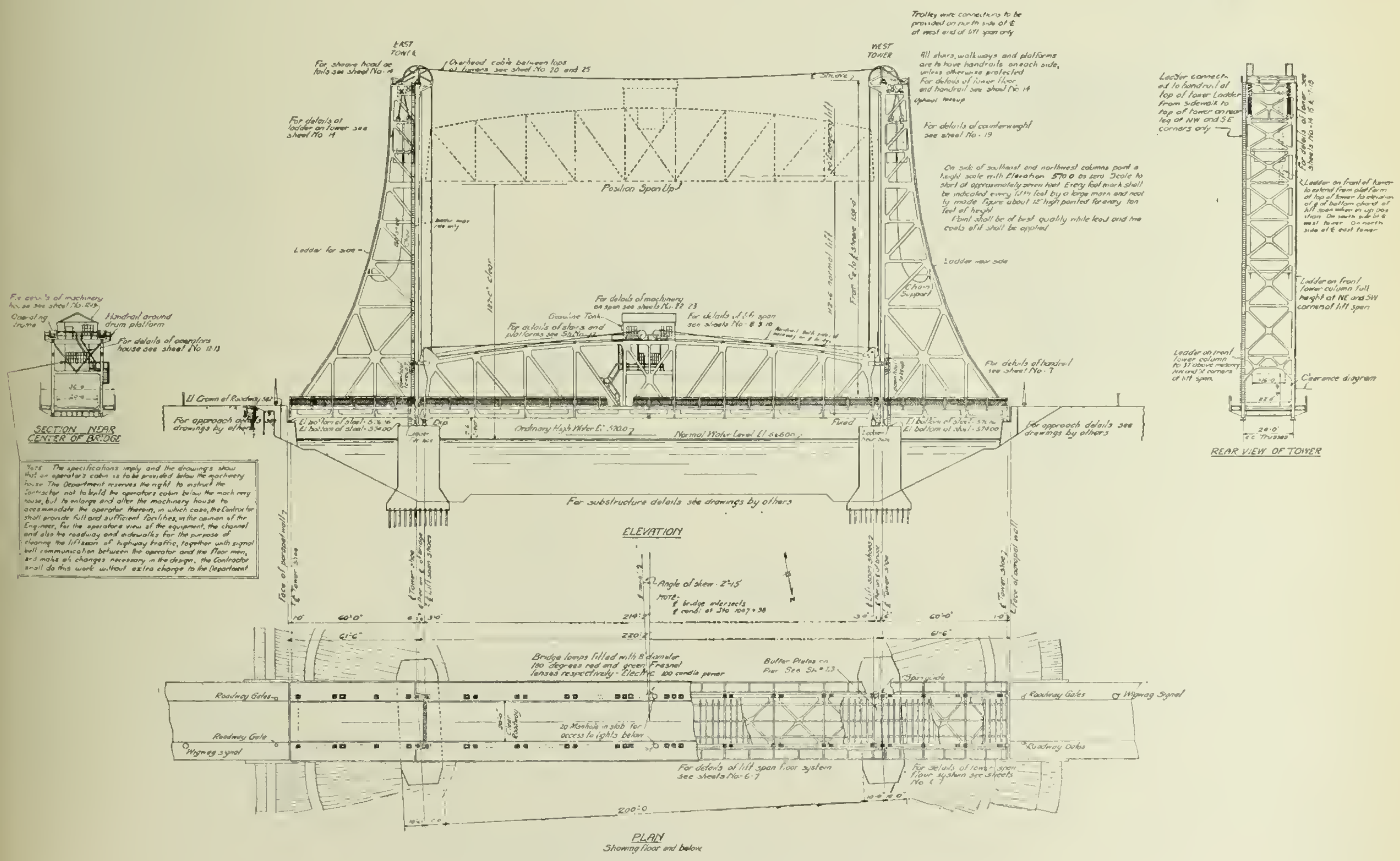

Figure No. 31.—Bridge No. 14—General Plan and Elevation.

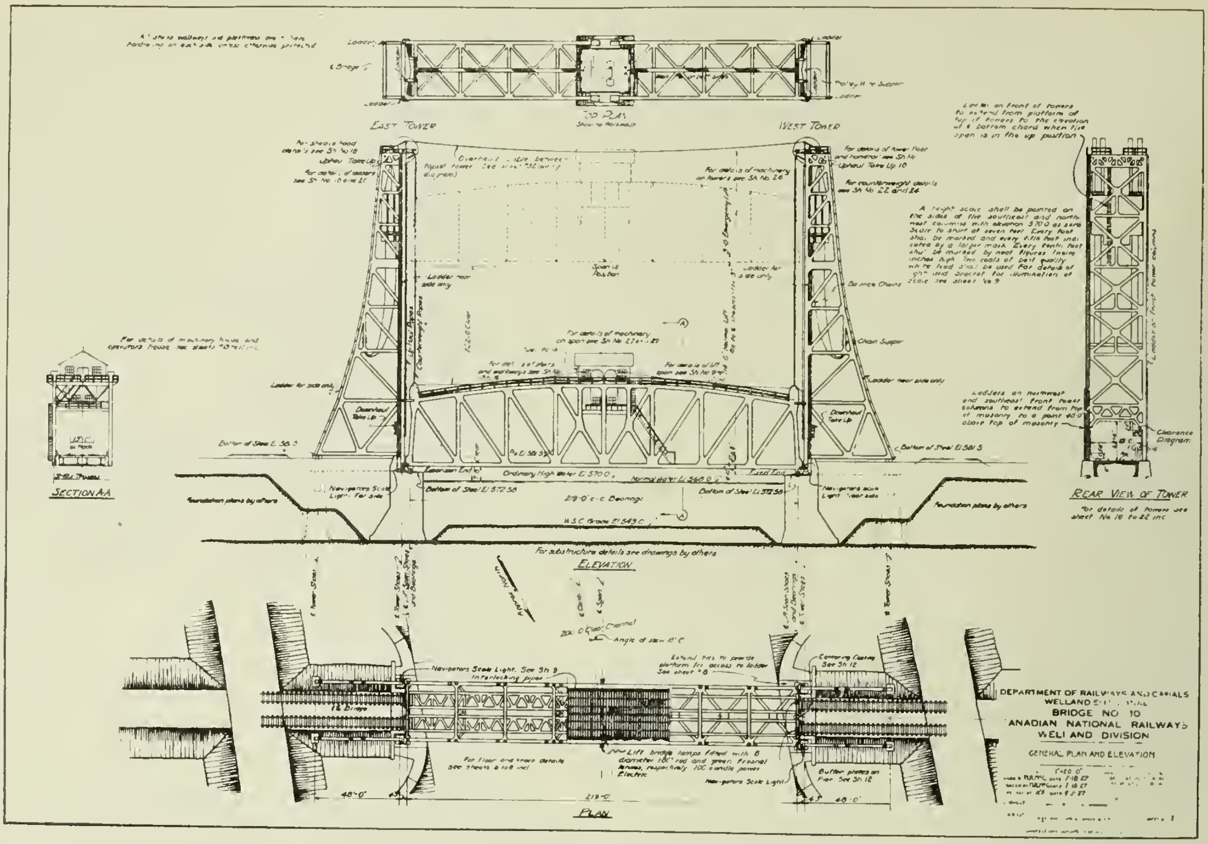

Figure No. 32.—Bridge No. 10—General Plan and Elevation.

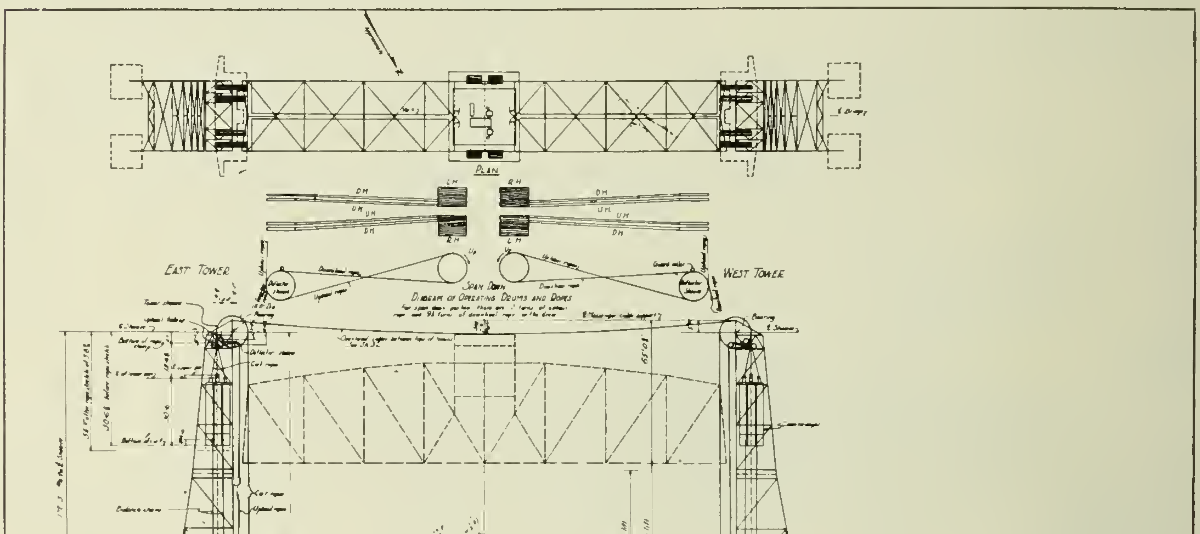

Figure No. 33.—Bridge No. 10—Machinery Layout.

at one end to a cross girder between the two top chord end panel points of a through truss vertical lift span and at the other end to balancing concrete counterweights which move up and down inside the tower. The height of the towers is such as to permit a stretch in the counterweight ropes of 2 per cent of their figured length. The electric motors, main switch boards, gasoline engine and operating machinery are situated in a house on top of and at the centre of the span. The main operating shaft runs across the span near the span centre line. By means of its pinion and an idler pinion, this shaft operates at each end two double threaded grooved drums situated on each top chord, there being four drums in all. Two uphaul and two downhaul operating ropes are fastened to each drum, and, after making a suitable number of turns, lead off one end of the drum, the former off the top and the latter from underneath the drum, from whence they travel along the top chord to two double chord by means of wooden idler rollers mounted in bearings set over the panel joints. After the bridge went into operation it was found that the rollers stuck, wore out rapidly and gave very unsatisfactory service; so they have since been replaced by wooden platforms running along the top chord and composed of longitudinal birch planks fastened to timber cross pieces hook bolted to the chord. Up to date, these platforms have given satisfactory service.

The weight of the lift span is balanced by the counterweights moving vertically inside of the tower in the opposite direction to the movement of the span. In order to provide for balancing the weights of the counterweight ropes, for any position of the span, cast iron counterweight chain loops are attached to the towers and to the bottoms of the concrete counterweights. Vertical guides on the outside and inside of the front tower column retain in proper position respectively the lift span and the counterweights, by en-

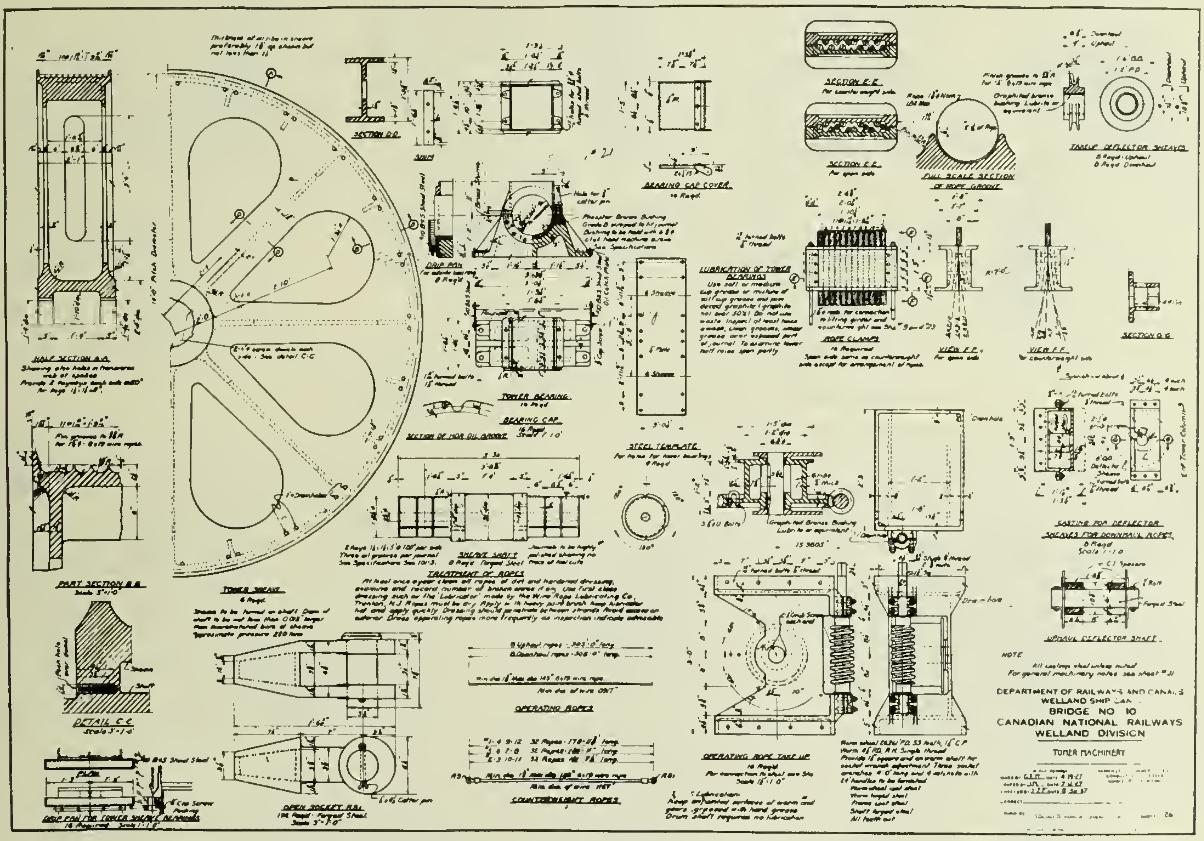

Figure No. 34.—Bridge No. 10—Tower Machinery.

grooved sheaves turning on a common axle mounted between the gusset plates at the end panel top chord joint. The uphaul ropes pass under their sheave and up to the top of the front tower post, while the downhaul ropes pass over their sheave and down to the foot of the tower post. Each rope is fastened to the tower post by means of a take-up arrangement composed of an idler sheave and another sheave geared to a hand operated worm, the rope being fastened to the latter sheave. By means of these take-ups, the ropes can be adjusted to proper tautness. The operation of each pair of drums by the meshing of the main shaft pinion with the one drum gear, and with the idler pinion meshed with the other drum gear, causes all the uphaul ropes to wind on, and all the downhaul ropes to wind off, or vice versa, according to the direction of rotation of the drive shaft, thus raising or lowering the balanced span. The design drawings for bridge No. 17, which is now built, called for the operating ropes to be supported on the top gaging suitable guide castings on the moving parts. The lift span when lifted is held longitudinally at the fixed end only.

The lift span is locked in the down position by plunger locks, at top chord corners of the lift span, engaging with castings on the tower posts. These locks are manually operated through a pipe and bell crank system by the bridge operator, who is situated in a cabin immediately below the machinery house, from where he can operate the bridge under electric or gasoline power. The pier members for the fixed end of the lift span each have a transverse pin, on to which nests the lift span cast steel shoe provided with tapering sides to guide it into its proper longitudinal position as the span is lowered. Pinned to the expansion ends of the lift span trusses are segmental rockers which rest on steel castings and are provided with springs to force the rocker to plumb position when the span is lifted. The span guides on the tower posts taper out laterally towards the bottom while those at the fixed end also taper out longitu-

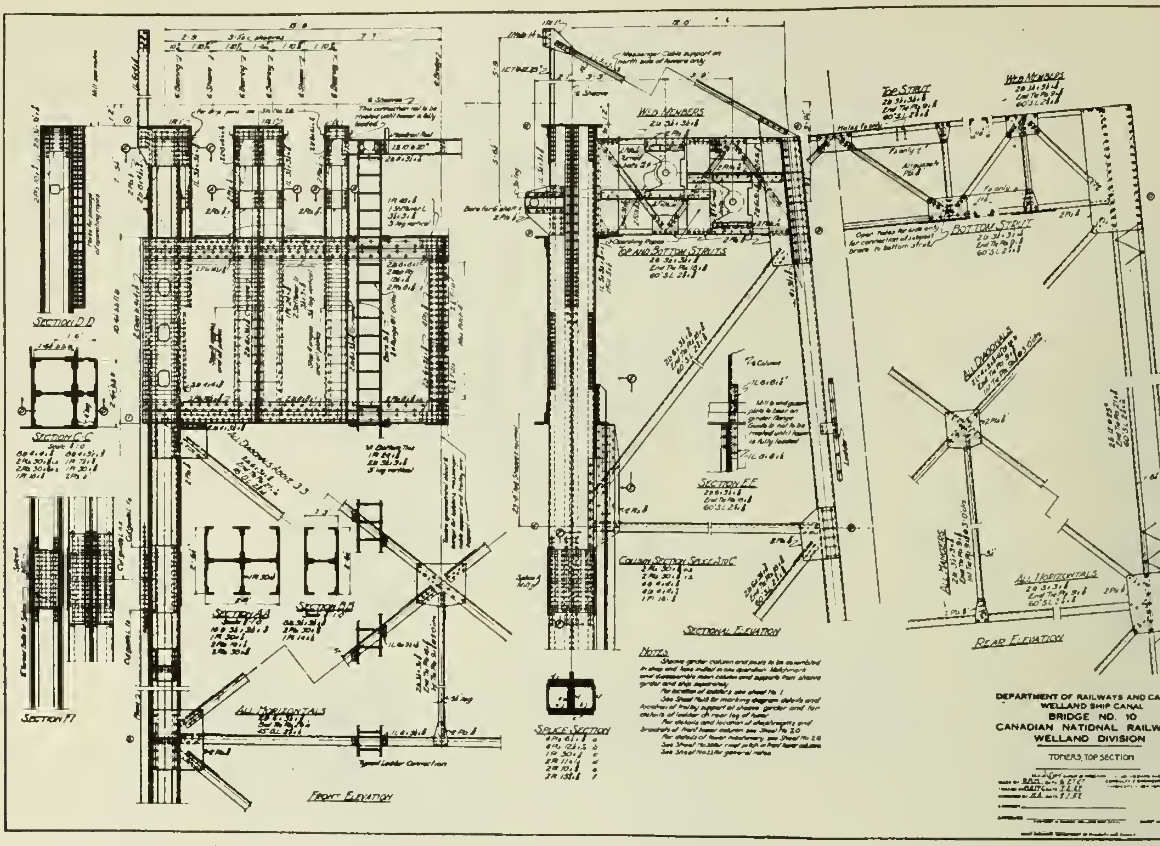

Figure No. 35.—Bridge No. 10—Towers—Top Section.

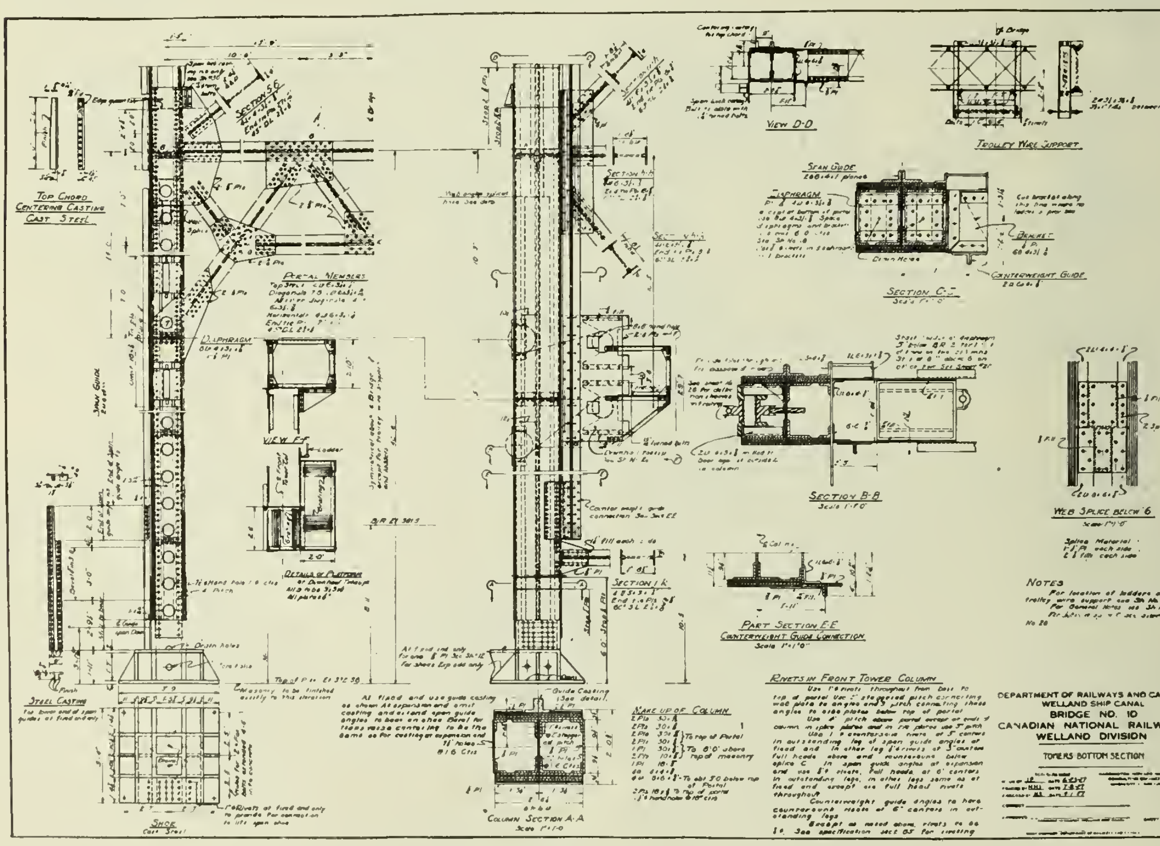

Figure No. 36.—Bridge No. 10—Towers—Bottom Section.

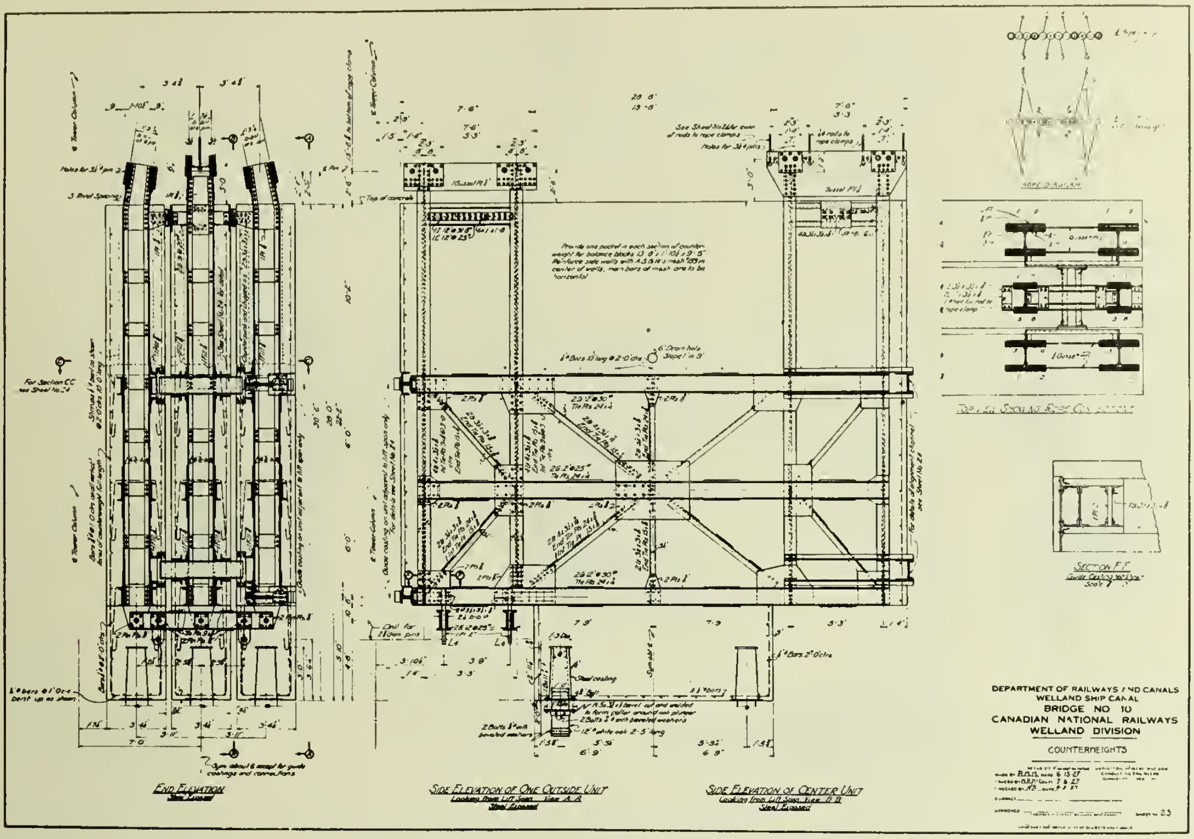

Figure No. 37.—Bridge No. 10—Counterweights.

dinally towards the bottom, all to an amount sufficient to insure accurate seating of the lift span.

The 550-volt current is transferred from the tower to the lift span by a vertical three-wire trolley system. The 110-volt current for the operation and control of bells, signals, gates and wigwags is transferred at each end of the moving span to a tower by means of a flexible cable travelling loop hanging at the side of the tower.

In order to reduce the weight of the floors on the highway vertical lift spans, Haydite concrete is used for the roadway and sidewalk slab, the roadway having a wearing surface of asphaltic concrete one inch thick. The burnt clay aggregate is manufactured by the Haydite Company of Kansas City, who furnish it in sizes to suit requirements; the concrete made from this aggregate, to give 2,000-pound concrete, will weigh only 104 pounds per cubic foot.

Toothed steel castings are used at the break in the floor between the expansion end of the lift span and the tower span, but concrete unfaced with metal is used at the break in the floor for the other end of the lift span.

Bridge No. 17

Bridge No. 17, which carries the single track of the Wabash division of the Canadian National Railways over the canal, has, at each end, a 70-foot deck plate girder span and a 60-foot tower span with a 215-foot lift span over the channel, the whole crossing having a length of 491 feet $\frac{3}{4}$ inch face to face of the abutment parapet walls. This crossing was originally designed without the girder approach spans, but when the design plans were about ready to issue for tenders, slips occurred in the canal embankment in the vicinity of the bridge, so it was considered advisable to flatten the canal banks to a 3 to 1 slope and lengthen out the crossing by adding the girder spans. The heights of the centre line of the counterweight sheaves above base of rail, top of masonry and water level are respectively 161 feet, 169.58 feet and 177 feet. The bottom of the span is 10 feet 5 inches above water level, and the lift to give 120 feet overhead clearance is 109 feet 7 inches.

There are four cast steel counterweight sheaves having a pitch radius of 6 feet 1 inch. Each sheave was grooved to take sixteen $1\frac{1}{2}$-inch diameter wire ropes and was pressed on to its axle with a forced fit of about 200 tons. Two sheaves weighed 22,000 pounds each and the two others 21,000 pounds each. The axles, which weigh 3,130 pounds each, were turned to give an oversize of 0.012 inch over the sheave bore. The journals are $13\frac{1}{2}$ inches in diameter and $18\frac{1}{2}$ inches long and transfer a bearing pressure to the bronze bushings of 1,200 pounds per square inch. Very excellent castings were obtained from the Dominion Steel Foundries, Hamilton, and the machine work, which was done by the John Bertram Company of Canada, was all that could be desired.

The sixty-four counterweight ropes, averaging 164 feet in length, were manufactured by the Dominion Wire Rope Company at Montreal, where the forged steel sockets made by the Canada Steel Foundries and Forgings Company at Welland, Ont., were attached, so that their finished lengths centre to centre of pinholes, while the rope was under a tension of 4,000 pounds, did not vary from the theoretical length required by more than 3/16 inch plus or minus. Before attaching the sockets, the ends of the ropes were broomed out, the wires hooked and cleaned in kerosene, wiped and dried and dipped in muriatic acid, then dried again and dipped in molten tin; after tinning, a socket was put on and adjusted in proper position, after which the basket in the socket was filled with pure molten zinc and allowed to cool slowly. The ropes had to develop an ultimate strength of 174,645 pounds, and specimens about 5 feet centre to centre of socket pinholes were tested to destruction at McGill University. The ropes are pin connected to the structural steel frame work embedded in the concrete counterweights and to the lifting girders on the lift span. The effect of the flare of the ropes necessary for connection

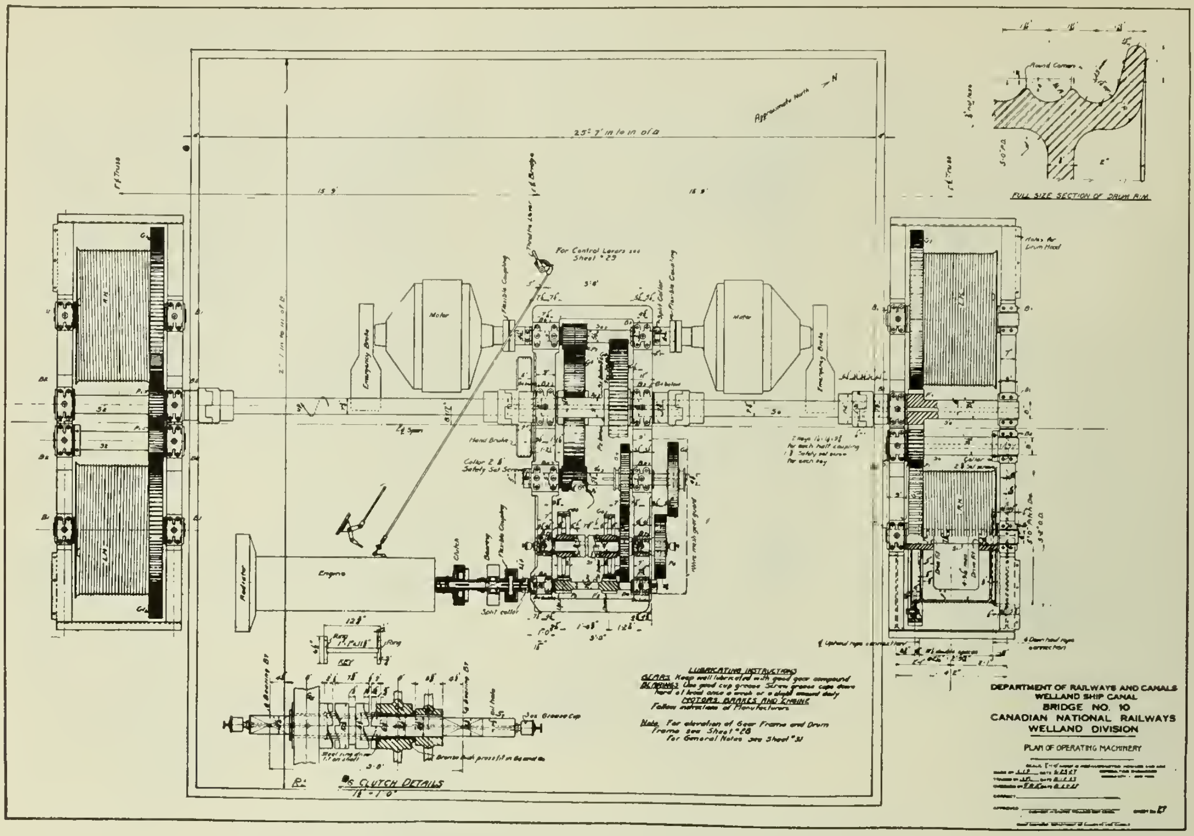

Figure No. 38.—Bridge No. 10—Plan of Operating Machinery.

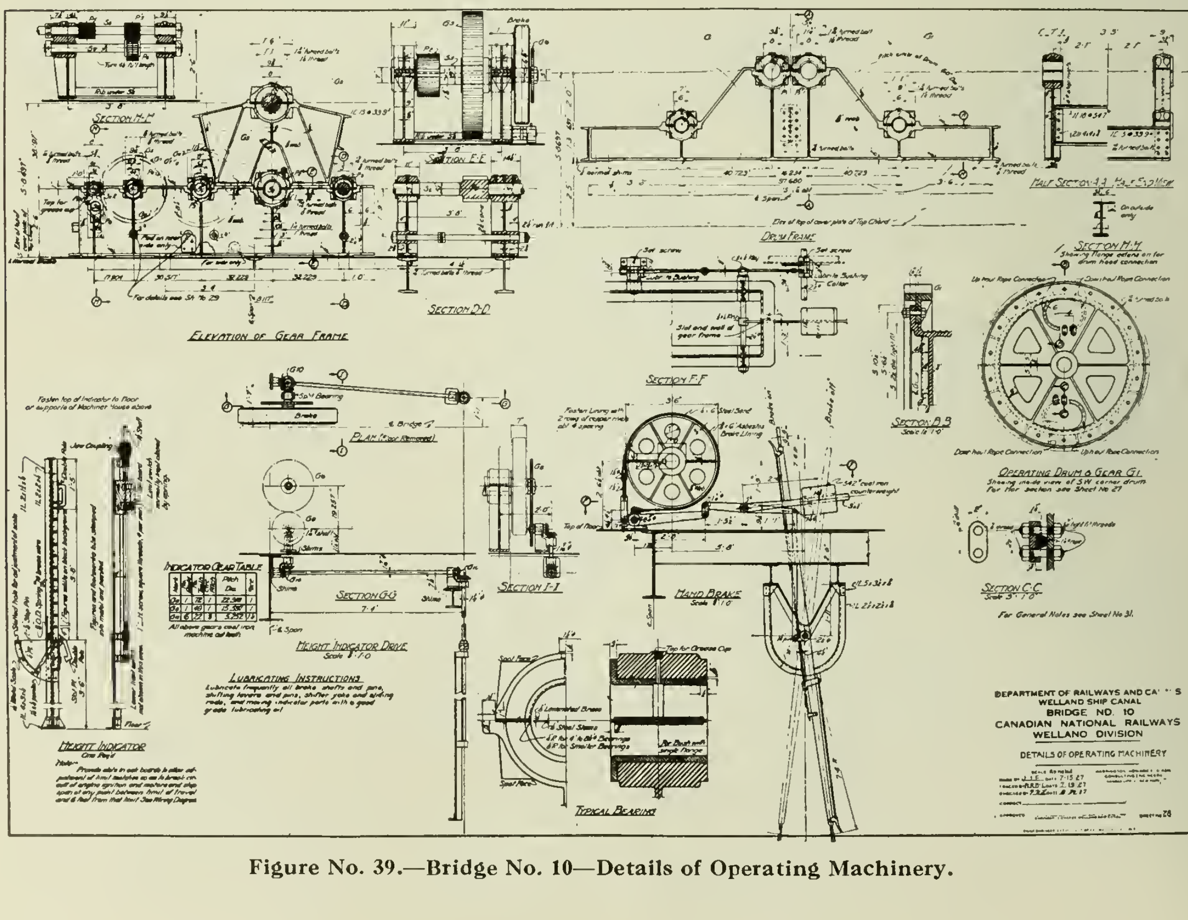

Figure No. 39.—Bridge No. 10—Details of Operating Machinery.

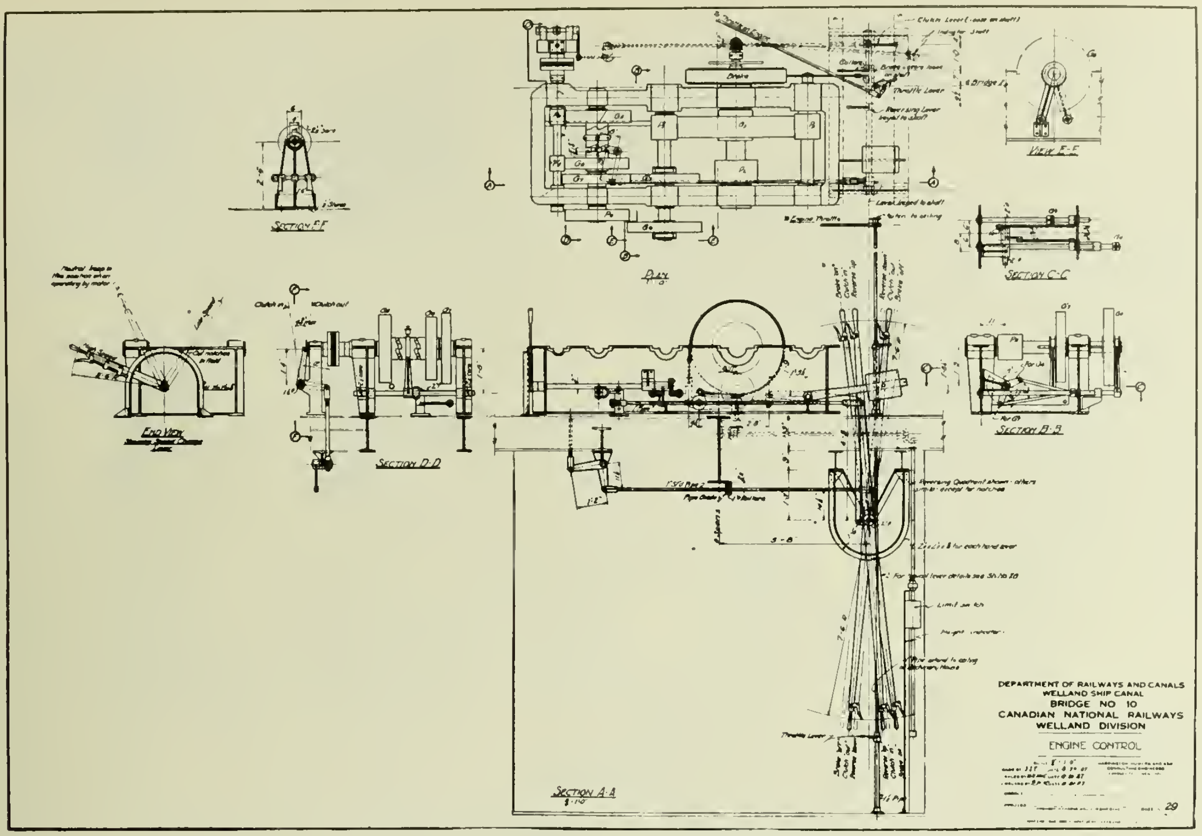

Figure No. 40.—Bridge No. 10—Engine Control.

is taken care of by cast steel flare collars and heavy cast steel rope clamps grooved to fit the ropes and bolted together.

The concrete counterweight consists of twin concrete blocks extending across the inside of the tower. Each concrete block is built around a structural steel frame work suspended from the ropes and the concrete is well reinforced with steel rods. The two blocks are linked together at the top and guide aligned together at the bottom. The block next to the tower front columns has cast steel jaw guides which engage vertical guide angles fastened to the front columns so that the counterweight is kept in proper alignment when moving up or down.

A tower front post is built up of plates and angles to form two channels with their flanges turned in and connected by a central vertical diaphragm, the whole being stayed by horizontal diaphragms spaced at 6-foot intervals. The outer corner of the column has a continuous plate and angle projecting to form a guide for the lift span. This position of the guides allows the use of outside braces from the portal to the masonry, to eliminate the bending in the posts from transverse wind and give a wider base against overturning. On the double track railway bridges and the highway bridges the side braces will not be used, so the span guides are set on the transverse centre line of column and the column below the portal proportioned to take bending from wind.

The bridge was designed to carry Cooper's *E* 60 engine loading. Creosoted Douglas fir ties, 10 by 12 inches, support the 100-pound A.R.A. running rails, with three inner lines of 80-pound steel guard rails and two lines of outside 6- by 8-inch spacer timber; at the ends of the lift span the traffic is carried by manganese steel castings projecting out and nesting into cast steel chairs on the tower span, thus obviating the necessity of having mechanically operated rail locks.

The total load, including counterweights, to be moved by the operating machinery is 1,160 tons. The times for opening under electric and gasoline power are respectively 1½ and 3 minutes for case (*a*) and 3 and 4½ minutes for case (*b*). The uphaul and downhaul pull at each corner of the span is taken by two ⅞-inch diameter wire ropes operated with drums and deflector sheaves 3 feet 6 inches in diameter, the drums having double threaded grooves for a length of 2 feet 6 inches; this, when the span is down, allows two turns of the uphaul ropes and twelve and one-quarter turns of the downhaul ropes, with one-half turns clear between them. There are provided for electrical operation two Canadian General Electric Company motors, capable of giving combined torques in pounds-feet as follows:—starting, 2,930; running at 627 r.p.m., 1,550; and running at 314 r.p.m., 2,550; the two latter torques corresponding to a theoretical horse power output of 186 and 150. The motor brakes, which are of the Cutler Hammer type, furnishing a combined retarding torque of 730 pounds-feet, act as emergency brakes, the service braking being done by means of a positive 4,200 pounds-feet torque mechanical brake whose pressure is released by hand. The gasoline engine is a Sterling four-cylinder, type G.R.C., giving a torque of 542 pounds-feet at 1,200 r.p.m., which corresponds to a theoretical horse power output of about 125. The machinery, which runs very smoothly, is mounted as a unit on a cast steel frame. No equalizing gear is used, but the motors and gasoline engine are connected to the shafting by flexible couplings and the cross drive shaft to the drums has three jaw couplings. The railway signals are operated manually by means of an interlocking machine interlocked with the bridge locks, which in turn are interlocked with the motors and engine. Change over gears are interlocked to prevent simultaneous meshing with the main drive. The machinery house is on top of the span, and the operator is situated in a house immediately below it, where he can view the channel and track and controls the operating equipment.

Owing to the fact that navigation had to be maintained from April 15th to December 15th, the bridge had to be erected during the winter. A derrick car was used to erect the lift span on falsework, placed in the channel after the close of navigation. The derrick car also erected the bottom of the towers up to a height of 65 feet, after which a guyed derrick with a 100-foot mast and a 90-foot boom was used to erect the rest of the tower. No great difficulty was experienced by the contractor, but the method used was slow, due to the long delays caused by the three shifts up of the derrick, and the writer understands that the contractor has devised a much simpler and quicker method for erecting other towers. The counterweights were erected in the up position, supported on blocking on temporary steel transverse beams resting on girders forming part of the lower longitudinal bracing; the span was jacked up in order to connect the counterweight ropes; the bridge swung; the operating ropes adjusted, and the temporary beams removed.

Bridge No. 20

Bridge No. 20, which is now under contract, is also a single track vertical lift bridge similar in construction to that of bridge No. 17, but having no approach or tower spans, the rear part of the towers resting on pedestals carried to rock and buried in the fill. The diameters of the main sheaves, counterweight ropes, operating ropes and drums are respectively 13 feet 3 inches, 1⅝ inch, 1 inch and 4 feet. Some improvements in the layout of the machinery and the control under auxiliary operation were made as a result of the experience obtained with bridge No. 17.

Bridges Nos. 14 and 16

Bridges Nos. 14 and 16, which are duplicates of each other, and also now under contract, are vertical lift highway bridges carrying a 20-foot concrete roadway between the trusses and a 5-foot concrete sidewalk outside each truss. The main dimensions of the structures are as follows:—the length of the crossing is 343 feet 2 inches face to face of parapet walls; the distance centre to centre of trusses, 24 feet; length of towers, 60 feet, centre to centre of end bearings; height of towers, 166 feet from top of masonry to centre line of sheaves; lift span, 214 feet 2 inches, centre to centre of end bearings; heights, centre to centre of chords, 25 feet 6 inches at hip and 35 feet at centre; clearance over roadway, 16 feet; the lift is 112 feet 6 inches. There are four counterweight sheaves, 13 feet 3 inches in diameter, each taking sixteen 1⅝-inch wire ropes which support a total load of 1,270 tons for span, counterweights and ropes. The pair of downhaul and uphaul ropes at each corner are 1⅛ inch diameter, their sheaves and drums have a pitch diameter of 4 feet 6 inches. Two three-phase, 12-pole, 550-volt at 66 2/3 cycles, slip ring induction motors are to be provided, with a combined nominal rating of 300 horse power, or 224 kilowatts; the maximum requirements stipulated are 428 kilovolt amperes and 450 amperes; the theoretical horse power output required for running under cases (*a*) and (*b*) are respectively 208 and 188. The gasoline engine to be furnished will be a six-cylinder Sterling engine of the Dolphin type with minimum torque of 683 pounds-feet at 1,200 r.p.m. The theoretical horse power output required for running the bridge with the engine is 126. Except for providing for the necessities of highway traffic instead of railway traffic, the general features are the same as for bridges Nos. 17 and 20, but, as before mentioned, the outrigger braces at the foot of the columns are omitted, the wind shear being transferred down from the portal by bending in the posts.

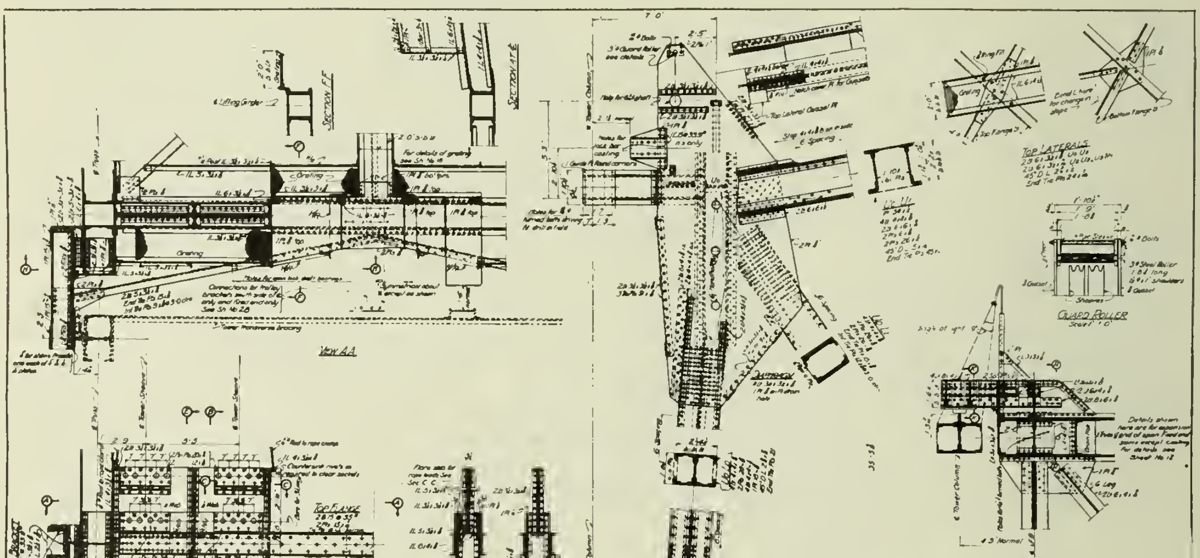

Figure No. 41.—Bridge No. 10—Lift Span, End Section and Lifting Girder.

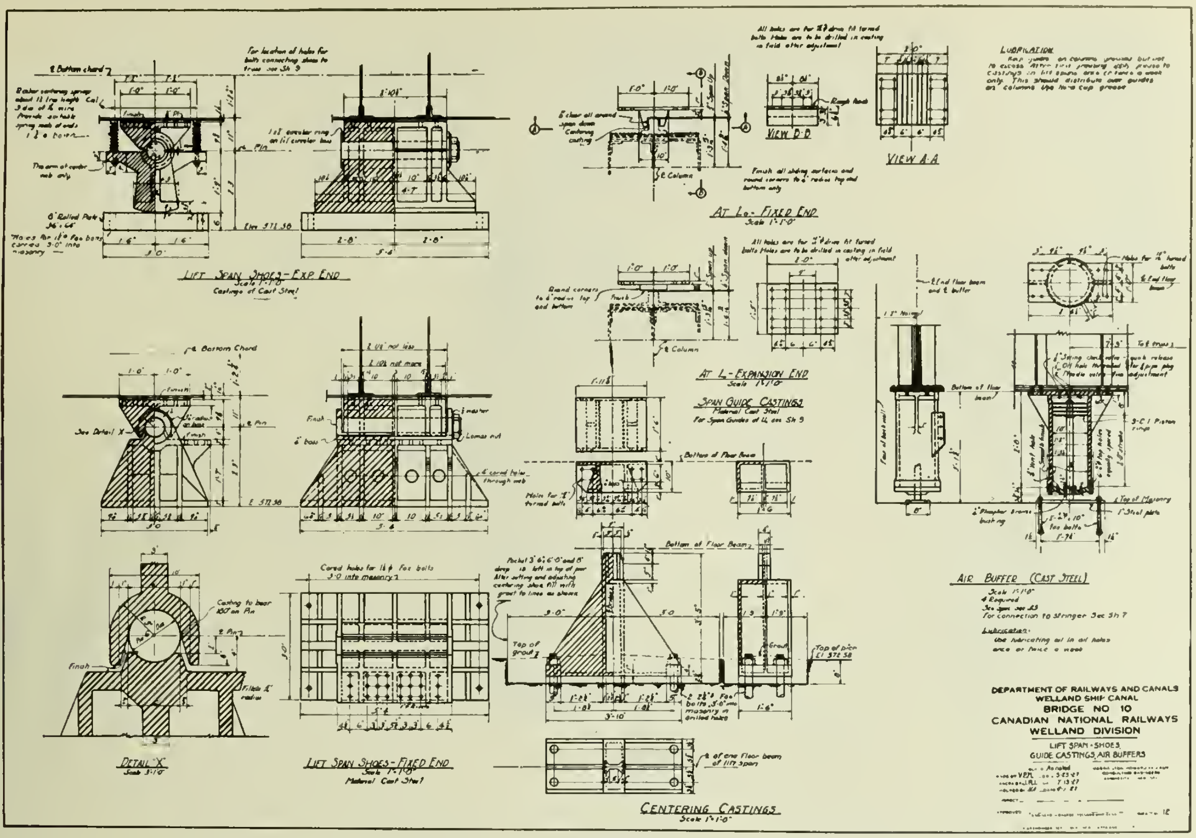

Figure No. 42.—Bridge No. 10—Lift Span, Shoes, Guide Castings, Air Buffers.

Bridges Nos. 10 and 21

Bridges Nos. 10 and 21 will be two of the heaviest vertical lift bridges, the former being for a double-track railway and the latter for a 30-foot highway and two 5-foot sidewalks. The weights of span and counterweights for the two bridges are 2,245 tons for No. 10 and 2,061 tons for No. 21, and it was decided to use the same counterweight sheaves and ropes on both bridges. There will be eight sheaves for each span, two for each corner; each sheave is 14 feet in diameter and carries twelve 1¾-inch diameter ropes; the weight per span of the counterweight sheaves with their axles and bearings will be about 130 tons. The counterweights are built in three sections, each section being supported by sixteen ropes. Although bridge No. 10 will be heavier than bridge No. 21, it will be necessary to provide more power for the latter on account of its having a greater floor area exposed for the unbalanced loads of 2.5 and 7.5 pounds per square foot. The theoretical horse power output required for running under the various conditions for No. 10 and No. 21 respectively are as follows:—case (*a*), 293 and 312; case (*b*), 228 and 276; with gasoline power, 184 and 185. Each span is provided with a 230 horse power

Estimated Costs for Superstructures of Vertical Lift Bridges Nos. 14, 17 and 20 Based on Contract Prices.

Item	Unit	Bridge No. 14—Ontario Street—Highway			Bridge No. 17—C.N.R. Wabash			Bridge No. 20—C.N.R. Buffalo to Goderich		
		quantity	unit price	amount	quantity	unit price	amount	quantity	unit price	amount
Structural steel and all other metalwork, if not included in other items	lb.	1,630,000	0.1075	$175,225	2,004,141	0.094	$188,389	1,820,000	0.1035	$188,370
Reinforcing steel	lb.	42,000	0.086	3,612	8,227	0.058	477	10,000	0.055	550
Machinery castings and forgings	lb.	225,000	0.375	84,375	221,063	0.346	76,488	230,000	0.381	87,630
Wire ropes and other attachments	lb.	61,000	0.29	17,690	49,671	0.286	14,206	61,000	0.288	17,568
Cast iron balance chains	lb.	79,000	0.093	7,347	63,965	0.094	6,013	77,000	0.09	6,930
Concrete in counterweights	cubic yds.	300	51.50	15,450	253	37.50	9,428	345	51.00	17,595
Concrete wherever required if not included in other items	cubic yds.	80	49.00	3,920	......	......	......	......	......	......
Haydite concrete	cubic yds.	132	62.00	8,184	......	......	......	......	......	......
Timber in floor decks, etc	m.f.b.m.	1	150.00	150	62	136.00	8,450	29	135.00	3,915
Electrical equipment	bulk sum	......	......	37,900	......	......	22,093	......	......	35,500
Auxiliary power equipment	do	......	......	7,350	......	......	4,900	......	......	6,200
Houses for operator and machinery	do	......	......	1,863	......	......	950	......	......	2,278
Signals	do	......	......	1,475	......	......	935	......	......	1,715
Highway gates	do	......	......	3,300	......	......	......	......	......	......
Taking down old span at bridge No. 17	do	......	......	......	......	......	1,950	......	......	......
Total cost superstructure	......	......	......	$367,841	......	......	$334,279	......	......	$368,851

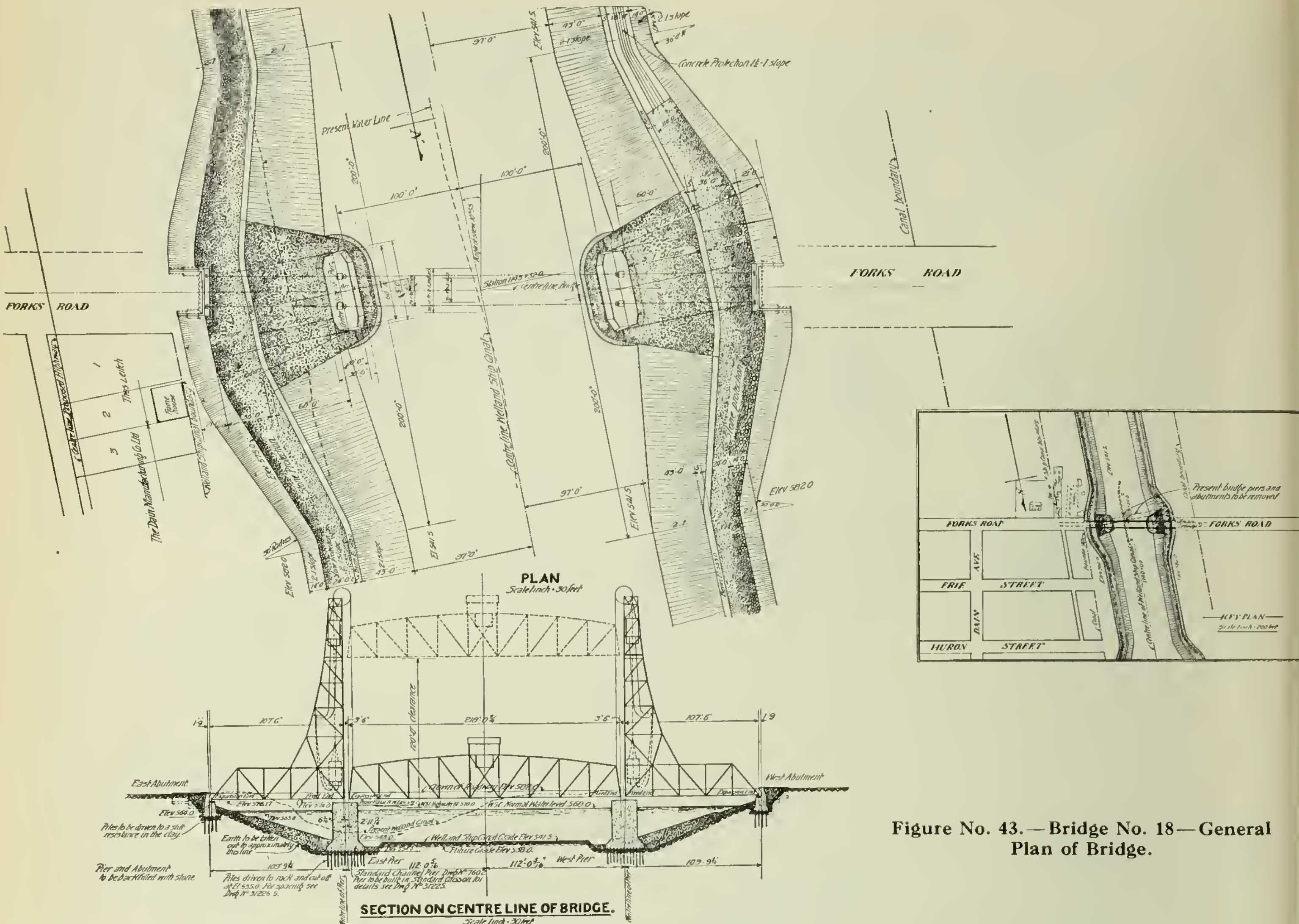

Figure No. 43.—Bridge No. 18—General Plan of Bridge.

Sterling eight-cylinder Dolphin type engine, with a minimum torque of 1,005 pounds-feet at 1,200 r.p.m. and the gear train designed accordingly. This will mean that the opening of bridge No. 21 will take slightly more time than that required for bridge No. 10. The electric motors for each bridge will be designed for the requirements of 1.5 minute under case (*a*) and 3 minutes under case (*b*), so that they will be different on the two bridges; the two for No. 10 being rated at 189 horse power each and the two for No. 21 at 220 horse power each.

Bridges Nos. 2, 5, 11, 12, 13 and 18

Bridges Nos. 2, 5, 12 and 18 will have lift spans similar to those of Nos. 14 and 16, except for variations in length to accommodate the angles of skew and the substructures. The traffic for Nos. 2 and 5 will be carried on the back fill behind the channel piers, but floors will be provided in tower spans for Nos. 12 and 18, the tower spans for the latter being made 107 feet 6 inches to accommodate the crossing to flattened slopes without intermediate piers as used for No. 17. Bridges Nos. 11 and 13 will have 30-foot roadways, the latter carrying a single track trolley line on the centre line of roadway. Bridge No. 13 will be the only bridge built with skew ends for the lift and tower spans, and will be a heavier bridge than No. 21.

From the foregoing narrative and descriptions, it can readily be seen that the task of designing and building the bridges for the Welland ship canal has occupied and will occupy the attention of many engineers in all lines of work. It would be impracticable for the writer to give in this paper a list of the personnel concerned, but he does here desire to record his appreciation of the kindly aid extended to the departmental engineers by other engineers situated in various cities of the United States and Canada, through visitations to different structures or information furnished. The various engineers on the staffs of the consulting engineers of the bridge company's different subcontractors have Hamilton Bridge Company, Canadian Westinghouse Company, Canadian General Electric Company and the engineers of the bridge companies' different subcontractors have throughout endeavoured to furnish good design, fabrication and erection of the superstructures, to the satisfaction of the Departmental engineers and the engineers of the Canadian National Railways. The substructures were built by the general contractors for the various sections of the ship canal under the supervision of the Department's division engineers in charge of the sections. The writer would bear witness to the conscientious endeavours of the staff of the Welland ship canal, both in the office and in the field, to secure proper execution of the work in the drawing office, mill, shops and at the site.

The construction of the Welland ship canal is under the jurisdiction of the Department of Railways and Canals, Dominion Government of Canada, of which the Hon. Chas. A. Dunning is minister, Major G. A. Bell, deputy minister, and Colonel A. E. Dubuc, M.E.I.C., chief engineer, and the work is being carried on under the direct control of Alex. J. Grant. M.E.I.C., engineer-in-charge of the Welland ship canal.

The Lock Gates of the Welland Ship Canal

A Description of the Locking Arrangements for the Canal, Types of Gates Chosen, General Features of the Gates, Details of Design, Fabrication, Erection and Cost of the Steel Gates, Operating Machinery, and Details and Fabrication of the Timber Gates

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Paper to be presented at the Annual General Professional Meeting of The Engineering Institute of Canada, at Montreal, Que., February 15th, 1928

The physical conditions which governed the location and arrangement of the locks of the Welland ship canal may be briefly outlined. The canal is 25 miles long from the shore of lake Ontario to the shore of lake Erie. Figure No. 1 shows the general plan and profile of the site. From Port Weller, on lake Ontario, to the foot of the Niagara escarpment, a distance of 6 miles, the canal traverses ground rising gently to an elevation of about 150 feet above the level of the lake. Within the next mile the ground rises steeply, some 190 feet higher, to the top of the escarpment, which is above the level of lake Erie. For the remaining 18 miles of its length, the canal traverses fairly level country between the towns of Thorold, at the top of the escarpment, and Port Colborne, on the shore of lake Erie. The low water level of lake Erie is 325.5 feet above the low water level of lake Ontario, and the difference between the low and high water levels of lake Erie is 12 feet.

In order to reduce the time spent by a ship in passing through the canal, it is desirable to keep the number of locks through which she must pass as small as possible, by making the lift of each as great as may be found to be practicable and advisable. It is also desirable to have the lift of all the locks the same, in order to use the lockage water efficiently and to have the lock gates interchangeable.

The adopted arrangement of locks provides seven locks of approximately 46.5 feet lift to overcome the total lift of 325.5 feet between the low water levels of the two lakes. These locks are 80 feet wide and have a usable length of 820 feet and a depth of 30 feet of water over the sill platforms. They are all located near the northern end of the canal, between Port Weller and Thorold. In addition to these, a guard lock is provided at Port Colborne. The long summit level between Thorold and Port Colborne will be kept at or near the low water level of lake Erie, and the guard lock will be used to overcome the small variable lift between this level and the actual level of the lake. This lift will usually be around 3 or 4 feet. The guard lock is of the same width and has the same depth of water over the sill platforms as the other locks, but its usable length is 1,355 feet. The increased length of this lock was adopted to expedite traffic by enabling two or more of the smaller ships to be locked through it at the same time.

To suit the profiles of the surfaces of the ground and of the underlying rock, the seven lift locks are located as follows:—Lock No. 1 is ½ mile from the shore of lake Ontario; lock No. 2 is 1¾ mile from lock No. 1, and lock No. 3 is 2¾ miles from lock No. 2. Locks Nos. 4, 5 and 6 are in flight, lock No. 4 being 1¼ mile from lock No. 3. The flight of three locks is ½ mile long, and lock No. 7 is ½ mile above lock No. 6. One mile above lock No. 7 a guard gate is provided to hold back the water in the long summit level in the event of the gates of lock No. 7 being carried

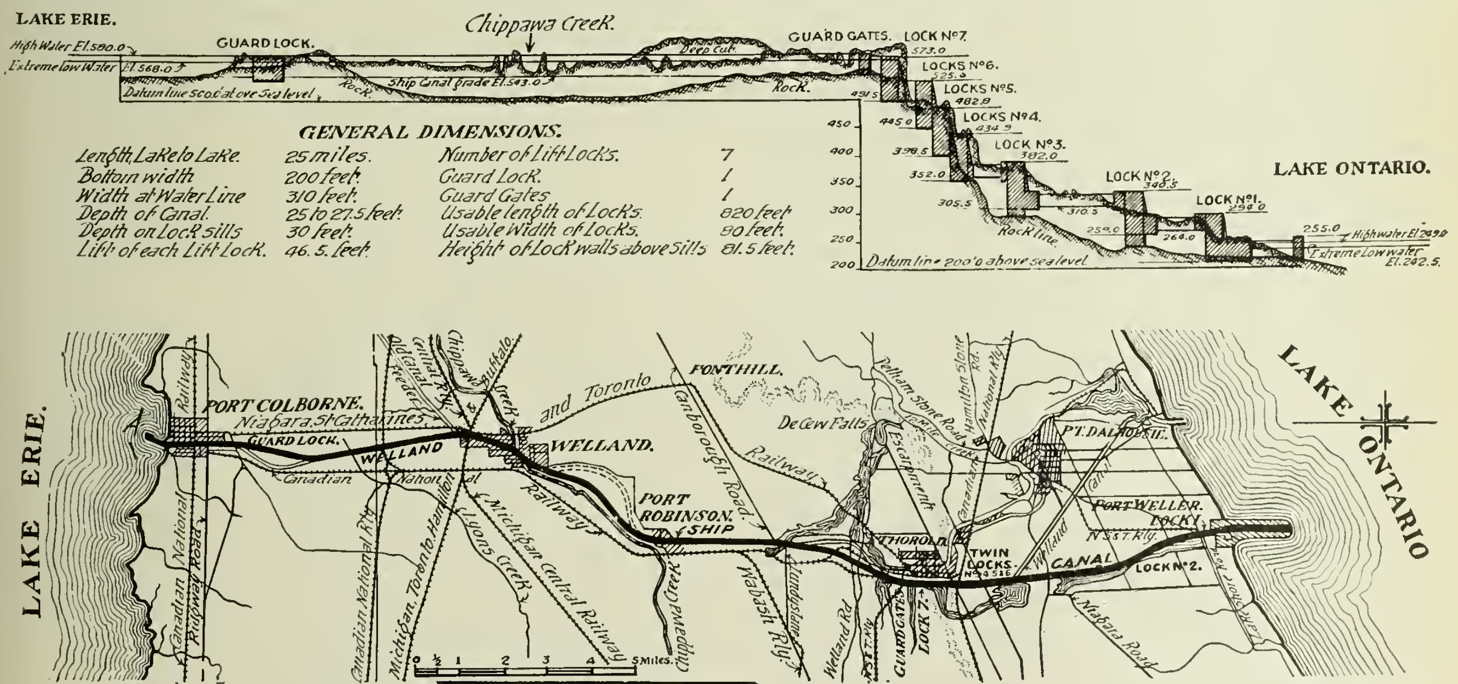


Figure No. 1.—Plan and Profile of Canal.

away. The guard lock No. 8 at Port Colborne is 15½ miles above the guard gate. As the three locks Nos. 4, 5 and 6 in flight could not pass ships in both directions without serious delays to navigation, twin flights side by side are provided so that upbound ships can be passed through one flight and downbound ships through the other.

Should the gates of locks Nos. 6, 7 or 8 be carried away, the canal works, under certain conditions, might be seriously damaged and navigation interrrupted for a period of some months. In these locks, therefore, a guard gate will be provided a short distance upstream from the service gate, both at the head and the foot of the lock, so that in locking at least two gates can always be kept closed, both of which would have to be carried away by a ship before free flow would be established through the lock. The other locks will have only the service gate at each end of the lock.

As a result of the doubling of the gates in lock No. 6, the plan area of its lockage prism is greater than that of either of the two locks in flight below it, by the area of the space between the two gates at its lower end, and, since locks in flight are equalized by emptying one into the next below, the lift of locks Nos. 4 and 5 will be greater, and the lift of lock No. 6 less, than their average lift of 46.5 feet. Locks Nos. 4 and 5 will each have a lift of 47.9 feet and lock No. 6 a lift of 43.7 feet.

The locks must be unwatered from time to time for the purpose of inspecting, painting and repairing the underwater portions of the lock gates, valves, etc. In most cases, this can be done by draining the water from the reaches above and below the locks, but the reaches below lock No. 1 and above lock No. 8 cannot, of course, be drained, as they communicate with lakes Ontario and Erie respectively. Also, the long summit level between lock No. 8 and the guard gate cannot be drained conveniently, on account of the large volume of water it contains, or safely, because its banks in some places are in unstable material. Under these circumstances, to enable locks Nos. 1 and 8 to be unwatered by pumping, an unwatering gate in the reverse position is required at the lower end of each of these locks. An unwatering gate will also be provided above the upper guard gate of lock No. 8, to enable the upstream side of the latter to be unwatered for painting, etc. The unwatering gates will be of timber construction, so that they themselves will not require to have their under water portions painted.

To enable either of the twin locks No. 4 to be unwatered during the navigation season, if desired, without entirely stopping navigation by draining the reach below them, an unwatering gate in the reverse position will be provided at the lower end of each of these locks.

The upstream side of the guard gate can be unwatered by closing the emergency dam above it to hold back the summit level. The downstream side of the guard gate and the upper gates of lock No. 7 can be unwatered by draining the reach between them. There is, however, some dockage on this reach, and it may therefore be inconvenient to drain the reach on some occasions when it may be desired to unwater lock No. 7 or the guard gate. Recesses, sills and supports will therefore be provided below the guard gate in which a spare gate can be temporarily set in the reverse position to enable the guard gate to be unwatered under such conditions. The upper guard gate and upper service gate of lock No. 7 can, if necessary, be used to unwater each other, by transposing them after one of them has been painted, or by dry docking the upper guard gate in the lock chamber.

Table No. 1 gives a list of the different gates which will be provided in accordance with the general scheme outlined above. The height of the gates given in the table is the distance from the top of the sill to the top of the coping of the lock wall, except in the case of the lower unwatering gate of lock No. 8, where the top of the gate is 9.0 feet below the top of the coping. The top of the sill is in all cases set 6 inches below the top of the sill platform, in order to prevent it from being damaged by contact with the keels of vessels.

Table No.1.—List of Gates to be Provided.

Lock No.	Name of Gate	Number Required	Height, Feet	Material
1	Unwatering	1	41.0	timber
"	Lower service	1	82.0	steel
"	Upper "	1	35.5	"
2	Lower "	1	82.0	"
"	Upper "	1	35.5	"
3	Lower "	1	82.0	"
"	Upper "	1	35.5	"
4	Unwatering	2	35.5	timber
"	Lower service	2	83.4	steel
5	" "	2	83.4	"
6	" "	2	82.0	"
"	" guard	2	82.0	"
"	Upper service	2	35.5	"
"	" guard	2	35.5	"
7	Lower service	1	82.0	"
"	" guard	1	82.0	"
"	Upper service	1	35.5	"
"	" guard	1	35.5	"
	Guard Gate	1	44.5	"
8	Lower unwatering	1	35.5	timber
"	" service	1	44.5	steel
"	" guard	1	44.5	"
"	Upper service	1	44.5	"
"	" guard	1	44.5	"
"	" unwatering	1	44.5	timber

Type of Gates

In deciding upon the type of lock gates to be used in a canal of such importance to navigation as the Welland ship canal, the most important features to be considered

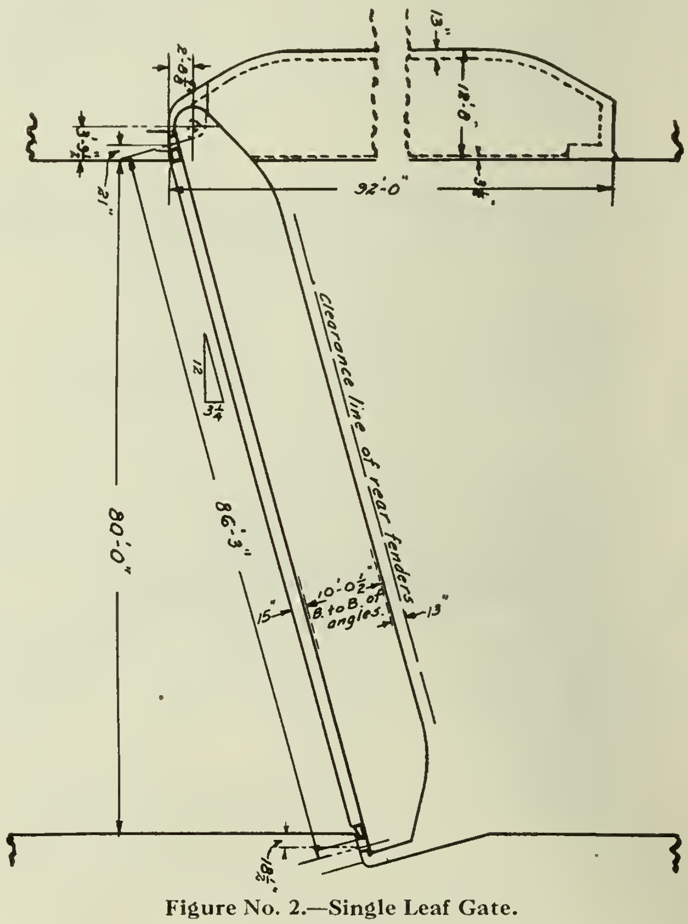


Figure No. 2.—Single Leaf Gate.

are those which affect the safety and speed of navigation, or which tend to prevent or to shorten interruptions of traffic. The difference in first cost of any of the available types of gates is not large, and is therefore of minor importance.

Mitering lock gates have been used more extensively than any other type in locks of all sizes, from the smallest up to the greatest, and have become the standard type. Single leaf gates of various types, distinguished by the manner and direction in which they move in opening are, however, in successful use, and these were also investigated. The form which swings about a vertical axis at one end was found to be the most suitable for use on the Welland ship canal, and was studied most carefully. In order to improve its speed of operation, the toe quoin was placed some 22 feet upstream from the heel quoin, thus making its angle of rotation 15° less than a right angle, at the expense of an increase of only 3½ per cent in the length of the leaf. Figure No. 2 shows the proposed outline of this gate and of its recesses.

Before proceeding with a statement of the relative merits of this type of single leaf gate and the mitering gate, it will be convenient to discuss in more detail the principal objection to mitering gates, viz., that they are easily unmitred under head and carried away as a result of being struck by a ship. Accidents of this sort can be minimized, (1) by measures tending to prevent the gate from being struck, (2) by so constructing the gate as to increase its resistance to being unmitred if it is struck, and (3) by providing two gates, so that if one is struck and unmitred the other will carry the water load and no serious harm will be done.

A very effective means for preventing lock gates from being struck by ships is to provide the lock with long approach walls so that ships can get out their lines at a distance from the gates and enter the lock under full control. Another useful measure is to have the ships equipped with effective modern compressors for snubbing their mooring lines. A very common cause of such accidents, the misunderstanding of engine room signals, can be removed by towing ships through the locks instead of allowing them to proceed under their own power. This, however, is expensive in equipment and labour, and tends to reduce the speed of locking. The danger of the upper gate being struck on its downstream side will be much less if the gate is placed upon the breastwall than if it is placed below the breastwall. Fenders, consisting of heavy chains or plate girders, have been used to prevent ships from coming too close to the gates and have proved useful.

In order to increase the resistance of the gates to being unmitred, safety horns, devised and patented by the late Mr. N. W. Gowan, have been experimented with on the upper gates of some of the locks of the present Welland canal, and have been found to be effective for the purpose. These horns are heavy castings, bolted to the mitre ends of the two leaves and projecting beyond them so as to overlap the mitre end of the mating leaf, so that one leaf must be moved upstream about two feet from the mitred position before it will clear the ends of the horns on the other leaf and leave it unsupported. The patent rights have been acquired by the Department of Railways and Canals.

The effectiveness of such safety measures, and the necessity for them, may be illustrated by considering two typical cases.

On the present Welland canal, accidents in which the mitering gates have been carried away as a result of being struck by vessels have been very frequent. As many as five such accidents have occurred in a single year. The locks were built practically without any of the safety features indicated above, and the only improvement made since their construction has been to install safety horns on the upper gates of 16 of the 26 locks. Only two of the locks have approach walls. The upper gates are below the breast walls. No fenders are provided. There is only one gate at each end of each lock. Furthermore, a large proportion of the vessels which now use the canal have been built of the full size of the locks. Since the safety horns were installed, accidents have been less frequent.

In contrast with the above may be cited another case where mitering gates are used: the locks at Sault Ste. Marie. These locks have carried an extremely heavy traffic for many years. They are provided with three safety features, viz., long approach walls, upper gates placed upon the breastwalls and two service gates at each end of each lock. The Canadian lock and the 3rd and 4th American locks are considerably longer than the longest ship on the lakes, but the value of this as a safety feature is greatly reduced by the practice of locking two or three ships through in one lockage. There has never been an accident of the kind in question at the American locks, and only one at the Canadian lock. This seems to indicate that when proper measures for their protection are taken, mitering lock gates are practically immune from serious accidents caused by ships colliding with them.

The principal advantages of the single leaf gate, shown in figure No. 2, in comparison with the mitering gate, are the following:—

(1) It is less likely to be carried away if struck by a ship. If the mitering gate be equipped with safety horns, the superiority of the single leaf gate in this respect will be reduced, and if reasonable provisions are made to minimize the danger of the gates being struck, the importance of this advantage will be correspondingly decreased.

(2) It cannot be improperly closed, but a mitering gate might be imperfectly mitred so as to carry a small water load, and then give way as the head on it increased. This could be prevented, however, by using safety horns on the mitering gate, as it could not then be improperly mitred.

(3) If it should be caught in a surge, or in a high wind, and get out of control in closing, it cannot fall over the sill as one leaf of a mitering gate could if not supported by the mating leaf.

(4) In the event of the lower gate of a lock being carried away by a ship before the upper gate is fully closed, the closing of the latter, if of the single leaf type, might be successfully completed, whereas a gate of the mitering type would almost certainly be lost. Means for gradually stopping the single leaf gate when it came close to its seat would, of course, be required to prevent its seating with a destructive shock.

The principal advantages of the mitering gate, in comparison with the single leaf gate, are:—

(1) It is more easily and quickly operated than the single leaf gate, on account of the smaller size of the leaves and the smaller angle through which they turn. This reduces the time required for a lockage, and increases the volume of traffic which the canal can handle.

(2) It decreases the total length of the lock chamber required for a given usable length. This decreases the time required to fill and empty the lock, and further increases the capacity of the canal.

(3) It is more easily handled in making replacements of damaged gates, as the floating crane required for the purpose is smaller and more manageable. Furthermore, there might be considerable difficulty and delay in removing a single leaf gate from the lock if the leaf were badly deformed in an accident, whereas with mitering gates the leaves could hardly be so badly deformed as to seriously interfere with their removal.

(4) The gate itself is somewhat less expensive than a single leaf gate, and it decreases the length and cost of the lock walls as well.

In 1913, the late Afred Noble, M.E.I.C., was retained by the Department of Railways and Canals to review and report upon the designs and methods proposed for the construction of the Welland ship canal. In regard to the relative merits of single leaf gates and mitering gates, he concludes as follows:—"After careful consideration of the two types, the relative advantages of either do not appear to me of decisive importance. If I were designing the work, I should adopt the mitering gates as being rather more manageable in ordinary operation, but both forms are in successful use and either will give good service."

However, J. L. Weller, M.E.I.C., who was engineer-in-charge of the Welland ship canal when the work was begun, and had been, for many years previously, superintending engineer of the present Welland canal, was firmly convinced that the greater safety of the single leaf gates outweighed their disadvantages, and they were adopted for use throughout the canal, except for unwatering gates and for the second gate in places where it was considered advisable to use two gates as an additional safety feature. For these gates, which are not so likely to be struck by ships, the cheaper mitering type was adopted.

Work on the construction of the canal was begun in 1913 and was carried on, under the handicap of war conditions, until the spring of 1917, when all work was stopped.

In 1919, work was resumed under the direction of A. J. Grant, M.E.I.C., as engineer-in-charge, who reopened the question as to the type of gates to be used. As no contracts had been let for the lock gates, and as onlv a small portion of the work on the locks had been done, it was still practicable to change the type of gates. Mr. Grant recommended that mitering gates should be used throughout instead of single leaf gates. The pricipal considerations leading to this decision were: the unprecedented size and weight of the single leaf gate required; doubt as to the success of the dash-pot device proposed for bringing the toe of the gate to rest in its quoin without shock; the unwieldy size of the floating crane required for handling single leaf gates in replacements; the great expenditure of money and time that would be required in removing a badly damaged gate from the lock; the greater ease and speed of operation of mitering gates; the probability that if equipped with safety horns their inferiority to single leaf gates as regards safety would be to a large extent eliminated; and the opinion, favourable to the use of mitering gates, expressed by Mr. Noble, as quoted above. Under the original scheme, it was intended to use two gates at the head of each of the twin locks No. 6 and at the head of lock No. 8. With mitering gates, it was decided, as an additional safety feature, to use two gates at the foot of each of the twin locks No. 6, at the head and foot of lock No. 7, and at the foot of lock No. 8 as well. It was also decided to use an unwatering gate at the head of lock No. 8 so as to enable the upper guard gate to be unwatered without moving it to another location, as was intended under the original scheme.

The estimated total cost of making these changes, including the cost of the necessary alterations to existing concrete work and the cost of the additional gates provided, less the saving due to the smaller number of spare gates required and the saving in the cost of the individual gates resulting from the use of the less expensive mitering type, amounted to approximately $600,000. The increase in the usable length of the locks resulting from the change was 20 feet.

The use of mitering lock gates instead of single leaf gates and the provision of additional gates as outlined above were authorized in May 1920 by the late Mr. W. A. Bowden, then chief engineer of the Department of Railways and Canals.

General Features

Steel was adopted as the material of construction for the service gates and timber for the unwatering gates. The water load on the gates, 82 feet high, is so great that their construction in timber is impracticable. For the gates 44 feet 6 inches and 35 feet 6 inches high, timber could be used, but steel was preferred for the service gates for several reasons. Steel is the more reliable material and satisfactory connections are more readily made with it. Timber sticks of the large size required in order to avoid complicated construction are not readily obtainable, and similar sticks for repairs and replacements will be increasingly difficult to find in the future. The service gates can be readily unwatered as often as necessary for inspection and painting. For the unwatering gates, however, timber was preferred, as they cannot be unwatered in place for painting, and, if made of steel, they would, therefore, be expensive to maintain. The timber unwatering gates, on account of their less important functions and the relatively small number used, are of minor interest in comparison with the steel service gates. The remainder of this paper will therefore be devoted principally to a description of the latter, the timber gates being treated separately and briefly afterward.

Shape of Leaf

Mitering lock gates may be of the " arched " type, in which both sides of the leaves are curved in the plan view so as to keep the line of stress at all points near the centre of gravity of the cross-section, or they may be of the " girder " type, in which the downstream side of the leaf, and usually a considerable portion of the upstream side as well, are straight in the plan view.

Gates of the arched type usually weigh less than the corresponding gates of the girder type by from three to eight per cent, but their cost per pound is higher, so that there is little if any saving in total cost to be gained by their use. An important disadvantage of the arched type is the greater depth of the recesses required for them in the face of the lock walls, which is an inconvenience in the operation of the locks and, in the case of twin locks, increases the thickness and cost of the centre wall between the locks. Also, when arched gates are open and the leaves are in their recesses, their concave downstream sides are exposed and ships entering the lock are more likely to strike them heavily than if they were straight. The girder type was adopted for the Welland ship canal.

Five feet was chosen as the thickness of the gate leaves. A smaller dimension would have permitted the use of shallower recesses in the lock walls, but was considered undesirable for gates as high as 82 feet. The gates 44 feet 6 inches and 35 feet 6 inches high could have been made thinner, but were kept of the same thickness as the high gates for the sake of uniformity.

Framing System

The primary framework of a mitering gate may consist either of a series of horizontal girders, or of a heavy horizontal girder at the top of the leaf with vertical girders spanning the space between it and the sill. The former is the less expensive for gates in which the height of the leaf is somewhat greater than its length and the latter for gates which are low in comparison with their length.

For the high gates of the Welland ship canal locks, which are 82 feet high by 48 feet long, the horizontal system of framing was clearly indicated. The cost of the gates 44 feet 6 inches and 35 feet 6 inches high would be practically the same with either system of framing, and therefore in view of the greater rigidity of the horizontal system, and in order to secure uniformity of construction, the horizontal system was adopted for them as well.

Angle of Sill

It was desired to use timber bearings at the quoin and mitre for the gates 35 feet 6 inches and 44 feet 6 inches high on account of the greater ease with which a proper fit can be obtained with them as compared with metallic bearings. These gates are, however, close to the limiting size with which timber bearings are practicable, and it was therefore necessary to avoid unduly high reactions at the quoin and mitre. For the gates 82 feet high the use of timber bearings is out of the question, but here also, on account of the height of the lock walls, it is desirable to avoid unnecessarily high reactions at the quoin, as they will be quite high in any event because of the high head of water these gates will carry, viz., 78 feet at the flight locks. It was therefore desirable to use a fairly large angle for the sills of all of the gates.

Other advantages attending the use of a large angle of sill are a reduction in the pressure that could be transmitted to the lock wall should a closed gate be forced downstream by a ship; and a reduction in the angle through which the gate leaves must turn in opening or closing. This reduction in the angle of operation reduces the energy required to operate the gate in a given time, notwithstanding the contrary effect of the increased length of the gate leaves, up to a sill angle of approximately 42°, beyond which the energy increases again.

Increasing the angle of sill, however, has also some disadvantages which make too large an angle undesirable. It tends to increase the weight and therefore the cost of the gate for sill angles above 22°. It also increases the total length of the lock for a given usable length. This increases both the cost of the lock and the volume of the lockage prism.

The angle whose tangent is 1:2 was adopted.

Sheathing

Mitering lock gates may be built with sheathing plates upon one or both sides. Gates with single sheathing are plated upon the upstream side in order to give lateral support to the compression flanges of the girders of the framework. When a gate plated upon the upstream side only is closed and subjected to a head of water there will be an unbalanced vertical water pressure on the bottom girder, since its lower side is exposed to pressure from the upper pool while its upper side carries only the pressure of the lower pool. This produces an uplift on the gate which, except for low heads, would be greater than its weight if the breadth of the bottom girder were made equal to the full thickness of the gate. For this reason, single sheathed gates usually have to have their sills undercut. As the uplift exists only when the gate is closed, it does not, of course, reduce the load upon the pintles when the gate is being operated, and if an air chamber were used to provide buoyancy for this purpose the sill would have to be under cut still further.

With double sheathing, however, any desired portion of the gate leaf below the level of the lower pool may be used to form an air chamber, the buoyancy of which will balance a portion of the weight of the leaf and reduce the load on the pintle when the gate is being operated. Then, if the interior of the leaf above the air chamber is put into communication with the upper pool through openings in the upstream sheathing, it will fill with water, as the water level above the gate is raised, and increase the weight of the gate leaf as the water uplift on the bottom girder increases.

Another advantage of the use of double sheathing is that it increases the general strength of the gate leaf and its resistance to twisting and buckling. It also takes the place of the diagonal bracing required on the downstream side of a single sheathed gate leaf and serves as a chord to unite the vertical frames into a continuous vertical girder. Its disadvantages are, that it makes the interior of the gate leaf less easily accessible for inspection, painting, etc., and increases the cost of the gate.

As the weight of each leaf of the gates 82 feet high is close to 500 tons, it is important to give them as much buoyancy as possible in order to reduce the operating weight on the pintle. Furthermore, on account of their great height and relatively narrow thickness, great strength to resist buckling and twisting is essential. Double sheathing was therefore adopted for these gates. Buoyancy and strength to resist buckling and twisting are advantageous for the gates 44 feet 6 inches and 35 feet 6 inches high, although not so necessary as in the case of the gates 82 feet high. However, it was considered that these advantages, together with those of uniformity in construction and the avoidance of the undesirable details which accompany the

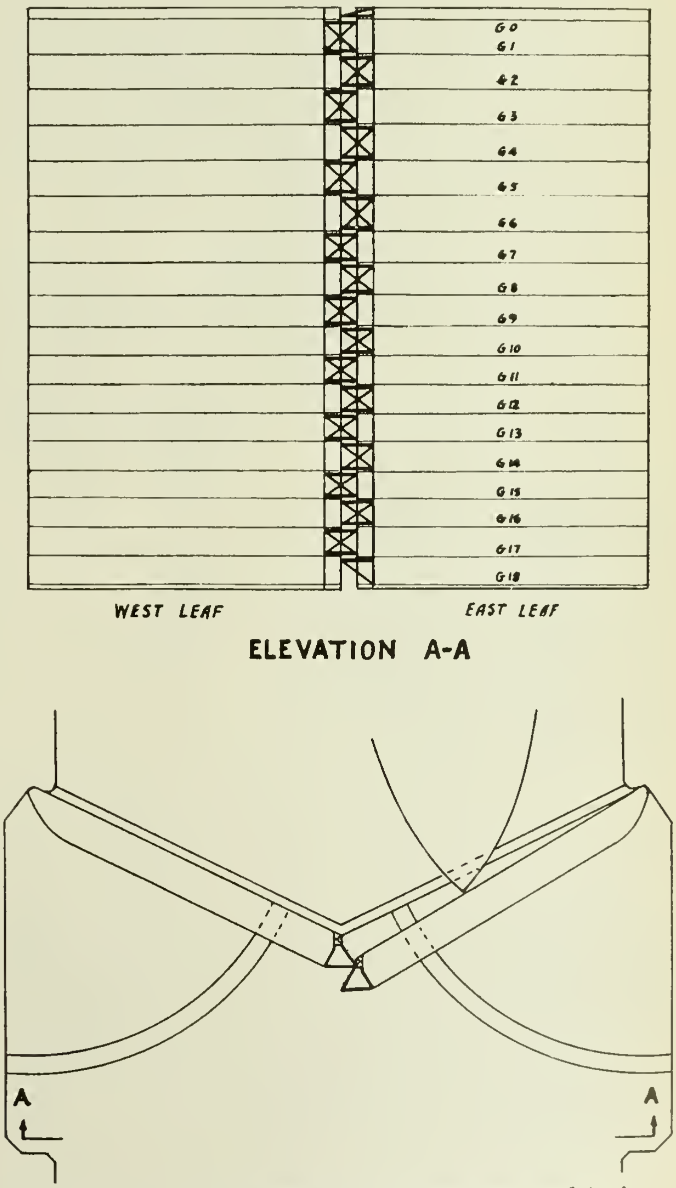


Figure No. 3.—Diagram Showing Arrangement and Action of Safety Horns.

use of an undercut sill, outweighed the disadvantages of increased cost and less easy accessibility and double sheathing was adopted for these gates as well.

Safety Horns

There is nothing new in any of the foregoing features of the lock gates adopted for the Welland ship canal. They involve merely the application of well-known principles to the conditions of the case. In one important feature, however, a radical departure from previous practice has been made. Safety horns have been adopted for all gates except the unwatering gates. So far as the writer knows, this feature has been previously used only on some of the gates of the present Welland canal, as noted above.

Some idea of the value of the horns in preventing accidents may be gained from the history of their use on the present Welland canal. The first set of horns were installed on the upper gates of lock No. 24 in 1911, and the upper gates of seven other locks were equipped with the horns at the beginning of the season of 1914. Safety horns have in no case been used on the lower gate of a lock, as these gates are rarely if ever struck upon their downstream side. Table No. 2 shows the number of ships which passed through the canal in each year from 1914 to 1926 inclusive, the number of locks whose upper gates were equipped with safety horns, and the number of accidents in which lock gates were carried away as a result of being struck by vessels. It will be noted that there has been a marked falling off in the number of accidents since 1922, and, while this is probably due in part to improvement in the equipment of vessels and in the experience of their crews, and possibly to other contributory causes, it is doubtless due in a large measure to the use of the safety horns.

Table No. 2.—Accidents and Traffic on the Present Welland Canal.

Year	Number of Ships passed through the Canal.			Number of Locks with Safety Horns.	Number of Accidents in which Lock Gates were carried away.	
	Up	Down	Total		Total Number	Number in which upper gate was struck by upbound ship.
1914	1734	1779	3513	8	5	4
1915	1394	1388	2782	10	0	0
1916	1249	1360	2609	11	4	3
1917	1352	1529	2881	11	2	2
1918	1335	1579	2914	11	5	5
1919	1348	1656	3004	11	0	0
1920	1402	1500	2902	11	3	2
1921	1859	1848	3707	13	3	3
1922	1911	1888	3799	14	2	1
1923	2065	2037	4102	16	1	0
1924	2397	2364	4761	16	1	1
1925	2560	2548	5108	16	0	0
1926	2381	2343	4724	16	0	0

Figure No. 3 shows the general arrangement of the safety horns as designed for use on the gates of the Welland ship canal, and indicates how they act. The safety horns will permit one leaf of a gate to swing upstream about 4 feet from the mitered position before losing contact with the horns of the other leaf. In the case of the upper gate of a lock carrying an assumed head of 15 feet when struck by a ship, the work done in swinging one leaf against this head, and against the frictional resistance between it and the other leaf, through a distance of 4 feet at the mitre end, would be 1,350 foot tons. This is equivalent to the energy of a ship of 20,000 tons displacement moving at a speed of 2.08 feet per second. To move the lower gate of the lock the same distance, under its full head of 46.5 feet, a 20,000-ton ship would have to have a velocity of 5.6 feet per second. These figures indicate that the safety horns will enable the gates to withstand a blow from a heavy ship moving at considerable speed.

The use of the safety horns increases the cost of the gates by some $360,000 for the entire canal, which is approximately 7.6 per cent of the total cost of the steel gates. The loss resulting from a single accident would probably, however, exceed this figure if we include not only the damage to the canal works but also the damage to the ship and her cargo and demurrage to shipping for the time during which the canal would be closed to traffic.

In addition to their value as a safety measure, the horns also act as an effective mitering device and prevent the leaves from being improperly mitred. The disadvantages attending their use are that they decrease the usable length of the lock chamber by about three feet and slightly increase the resistances to be overcome in operating the gate.

Because of the safety features included in the design of the locks of the Welland ship canal, the danger of the lock gates being struck by ships is comparatively small. The damage that might result from a gate being carried away is, however, so serious that the use of the safety horns was considered advisable.

Toe Wall

Another unusual feature is the curved wall concentric with the pintle centre placed on the bottom of the recess for the gate in the lock floor under each leaf near its mitre end, as shown in figure No. 3. The top of the wall comes about four inches from the bottom of one of the jacking beams of the gate, and is reinforced with a grillage of three curved 12-inch I-beams, so that should the anchorage be broken from any cause, the toe of the leaf will be caught on top of the wall. This will prevent the heel of the leaf from swinging clear of the hollow quoin, except when the leaf is near the open position, and therefore will probably save the leaf from falling to the bottom of the lock. The curved wall also acts as a guide for the wire ropes which are used to operate the gate. By preventing the ropes from leading in straight lines from their anchorages to the gate leaf it rectifies the inequalities of their motion which would otherwise exist. Although this toe wall appears to provide a track for a toe roller which it is common practice in England to use on lock gates, there never was any intention of adopting such a feature, even for the timber gates of the Welland ship canal. Since satisfactory results can be obtained without a toe roller, it is considered to be an unnecessary and objectionable complication.

General Description of Steel Lock Gates

Figure No. 4 shows the general arrangement of one leaf of a gate 82 feet high, and figure No. 5 gives similar information for the gate 35 feet 6 inches high. The gate 44 feet 6 inches high is similar to the gate 35 feet 6 inches high, the increased height being obtained by adding two panels each 4 feet 6 inches high.

Each leaf consists of a series of plate girders placed horizontally one above the other between the vertical quoin and mitre posts of the leaf and connected to each other by vertical diaphragms and frames and the vertical intercostal beams which support the sheathing plates. Each leaf is enclosed on both sides from top to bottom and from end to end with steel sheathing plates riveted to the girders, vertical frames, intercostals and end posts.

In order to reduce the cost of fabrication, special care was taken in working out the design to secure as much duplication as possible both in similar parts of the same leaf and in the corresponding parts of leaves of different heights. Only three different spacings of horizontal girders were used, viz., 5 feet, 4 feet 6 inches and 4 feet, and the 4-foot spacing was used only in the high gates. The use of a closer spacing was avoided in order to keep the interior of the leaf accessible with reasonable ease. Each leaf has five lines of vertical frames spaced at 8 feet 3 inches centre to centre. A large manhole opening is provided through each frame in each panel of the leaf.

The lower part of the interior of each leaf constitutes the air chamber, from which water will at all times be excluded. The upper part, above the air chamber, forms

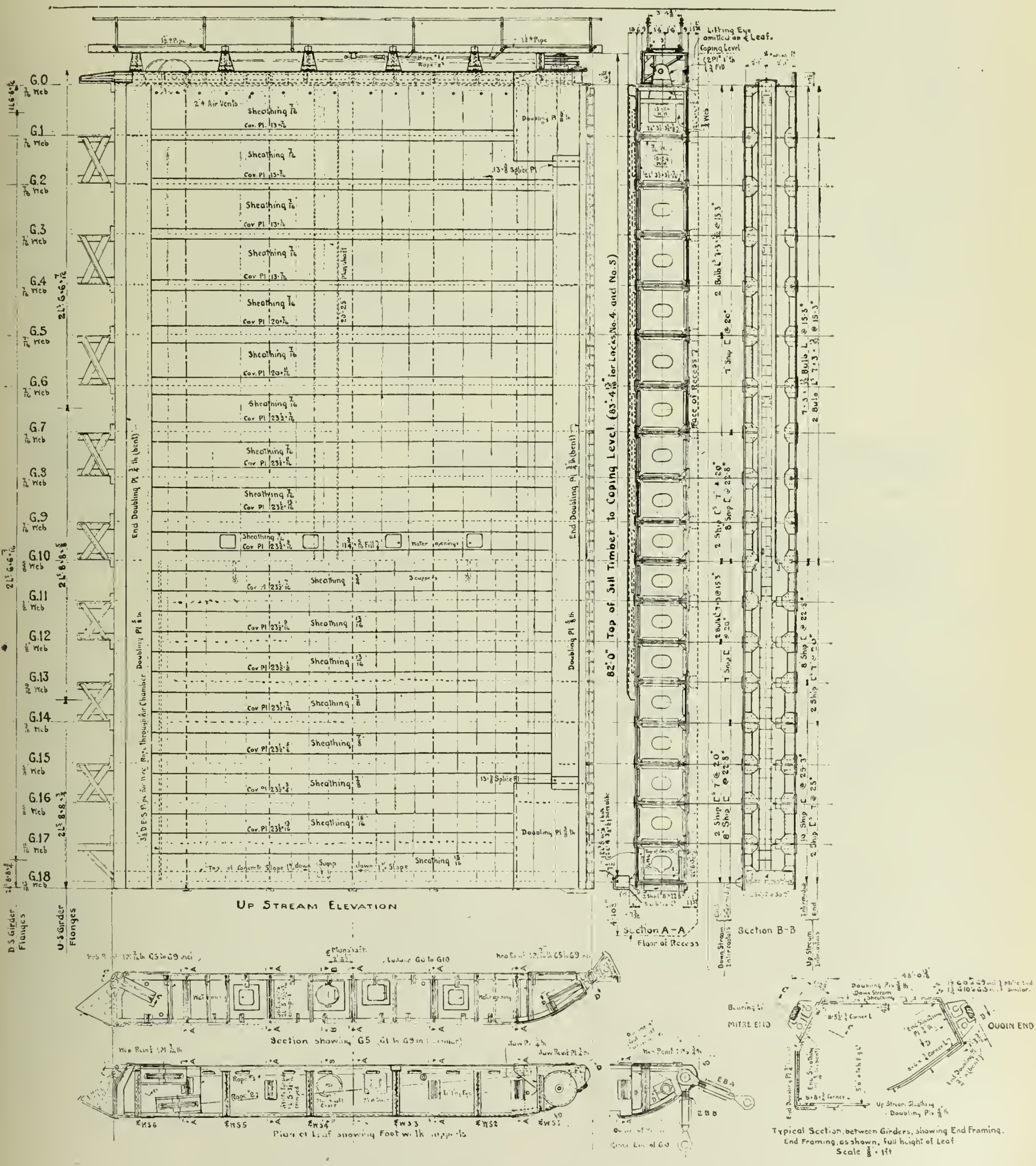


Figure No. 4.—Steel Gate Leaf 82′ High.

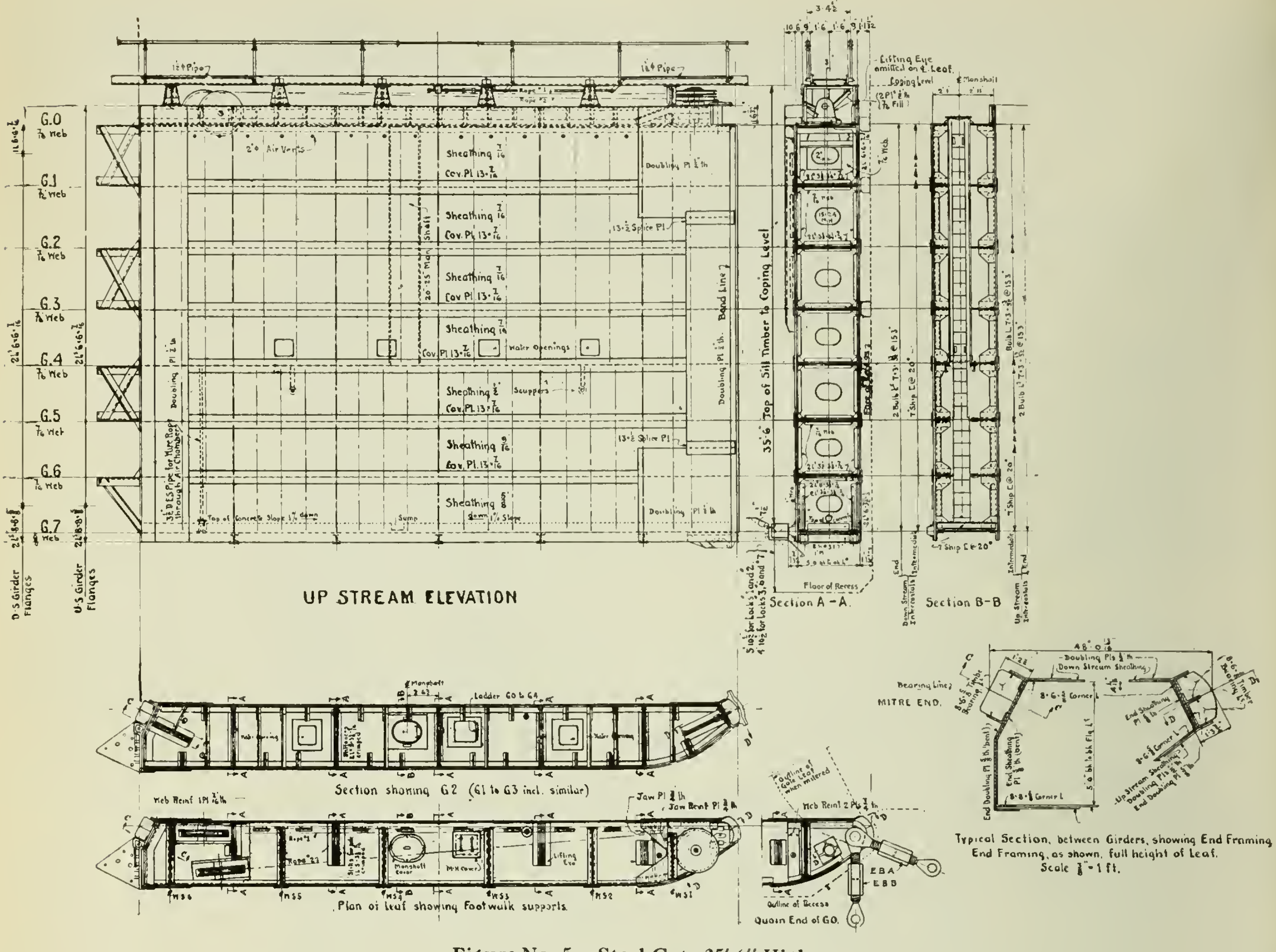


Figure No. 5.—Steel Gate 35′ 6″ High.

the water chamber. Large openings are provided through the upstream sheathing plates, and through the webs of the girders in the water chamber, to permit the free entrance and exit of water so that the water level in this chamber will always be nearly the same as that of the water on the upstream side of the gate. There are vents in the upstream sheathing near the top girder to permit the passage of the displaced air. A manhole is provided in the top girder, in line with one of the water openings in the girders below, and a ladder extends from the top to the bottom of the water chamber at this point to give access to the interior of the chamber for inspection, etc. Access to the air chamber is provided by means of a watertight manshaft extending through the water chamber from the top girder of the leaf to the top of the air chamber. There is a manhole opening in each girder in the air chamber opposite the manshaft, and the ladder in the manshaft is continued down to the bottom of the air chamber. The openings in the top girder for the manhole and manshaft are fitted with watertight covers. To enable the air chamber to be ventilated when the leaf is unwatered for painting, etc., an opening with a removable watertight cover is provided through the downstream sheathing in the bottom panel of the air chamber. The bottom of the air chamber will be covered with a layer of light weight concrete made with burned clay aggregate. The top surface of the concrete will be above the tops of the channel stiffeners of the bottom girder and will be finished to slope from all directions toward a sump formed in the concrete vertically under the manshaft where a small pump can be readily lowered into it for pumping out leakage water.

End Bearings

The end bearings have two functions: (1) to transmit to the lock wall and to the mating leaf the reactions from the water load upon the leaf, and (2) to make a watertight joint at these lines of contact. For the gates 35 feet 6 inches and 44 feet 6 inches high, the end bearings, as shown in figure No. 6, consist of white oak timbers. Each bearing is formed of two timbers, the mitre bearing face being flat and 21½ inches wide. The quoin bearing face is cylindrical of 20½-inch radius and 25¼ inches wide measured on the chord. The hollow quoin bearings consist of iron castings embedded in the concrete of the lock walls and having concave bearing faces smoothly finished to a radius of 20½ inches. For the gates 82 feet high the bearing pressure is so heavy that timber bearings cannot be used. For these gates the bearings, shown in figure No. 7, consist of heavy wrought steel bearing pieces 8 inches wide by 3½ inches thick, supported in recesses in steel castings bolted to the ends of the leaf and bearing, at the quoin end, upon similar steel bearing pieces 12 inches wide by 3¼ inches thick, supported in recesses in the steel quoin castings riveted to the structural steel quoin bearing members, which are embedded in the concrete of the lock wall. The mitre bearing faces are slightly convex of 16 feet radius. The quoin bearing faces on the gate are convex of 18½ inches radius, while on the lock wall they are concave of 20½-inch radius. The bearing faces are accurately finished, and the bearing pieces are adjustable in their recesses in the castings, so that their finished faces can be set to a true straight line from the top to the bottom of the leaf, notwithstanding any slight inaccuracies there may be in the alignment of the castings after erection. . The spaces between the bearing pieces and the castings will be filled with shims planed to the required thickness.

The quoin bearing members, which are embedded in the hollow quoins of the high gates to distribute the gate reactions over the concrete, consist of a pair of structural steel plate girders placed vertically, with their webs, in the plan view, as shown in figure No. 7, lying along the two sides of an isosceles triangle having its apex at the centre of bearing. The forward flanges of the plate girders are close together and are riveted to the vertical line of steel castings which support the bearing pieces. The rear edges of the plate girders are connected by a curved saddle plate which transmits the reaction to the concrete. The object of this design is to distribute the pressure to the concrete as uniformly as possible. The end posts are vertical members composed of plates and angles, extending from top to bottom of the leaf at each end. In order to tie the leaf thoroughly together vertically it was desired to have all parts of the end posts continuous without splices. It was necessary, however, to splice the plates in the end posts of the gates 82 feet high. For these gates, the outer plates of the end posts were designed to be bent to a trough section to enclose the whole end of the leaf, and preliminary inquiries indicated that this would be practicable. The contractor, however, was unable to get these plates bent accurately to the required shapes, and was therefore allowed to fabricate them by electric welding separate flat plates along the bend lines. This procedure was also adopted for the bent plates in the mitre end posts of the gates 35 feet 6 inches and 44 feet 6 inches high.

The end bearing timbers of the low gates, and the steel castings which support the steel bearing pieces of the high gates, are bolted directly to the end posts. The end reactions are transmitted through the end posts to the horizontal girders partly by direct bearing on the finished ends of the

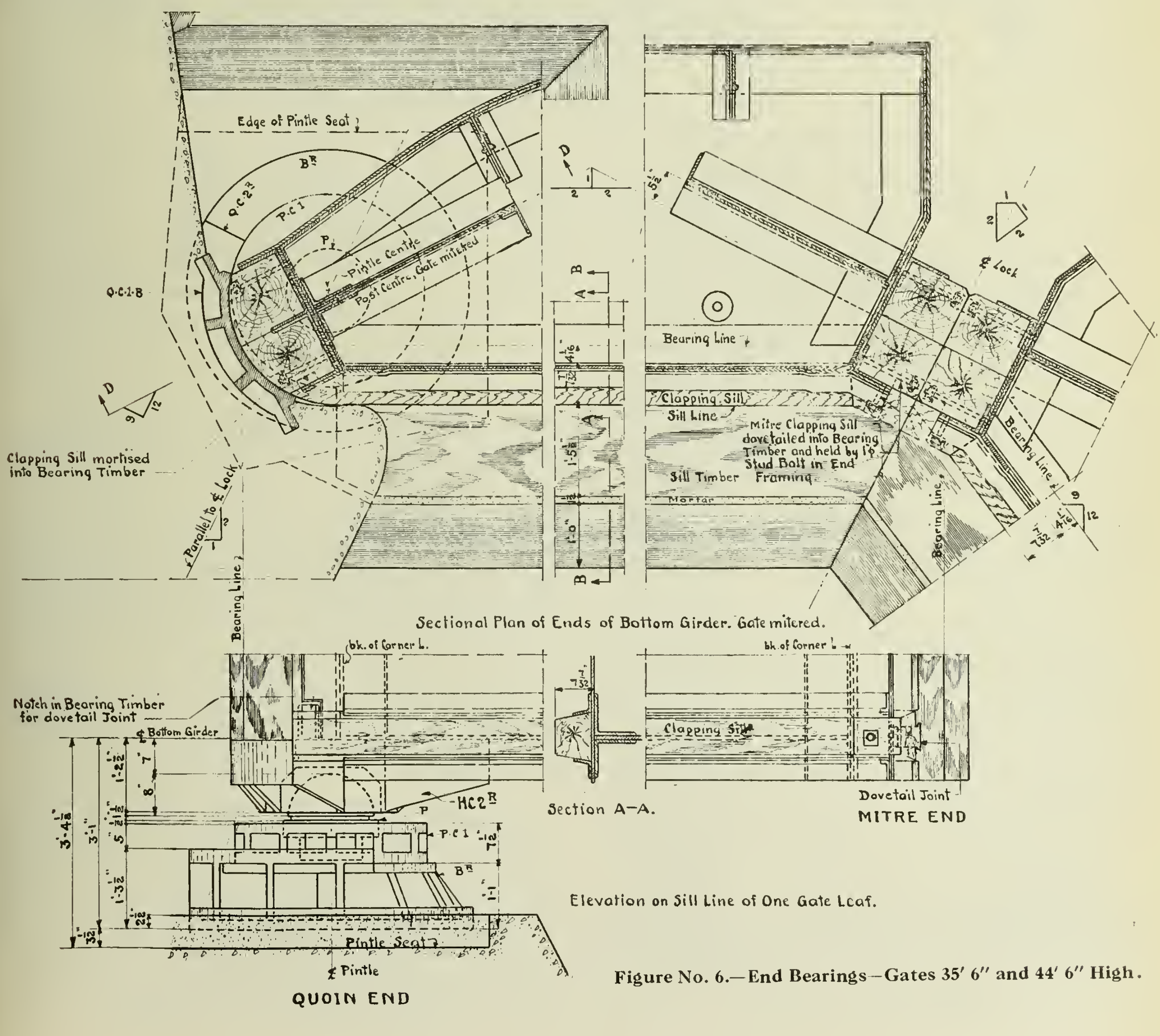


Figure No. 6.—End Bearings—Gates 35′ 6″ and 44′ 6″ High.

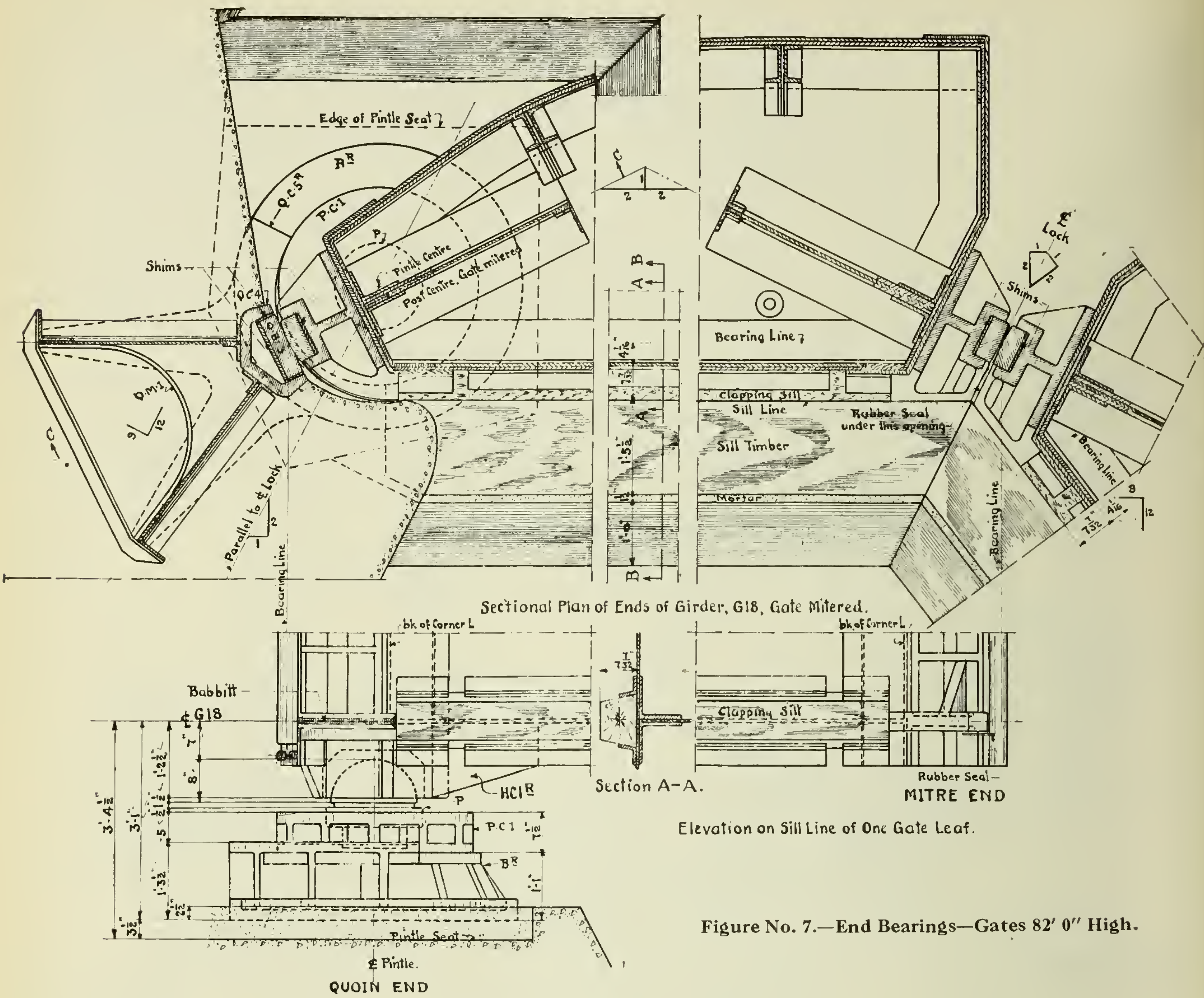


Figure No. 7.—End Bearings—Gates 82′ 0″ High.

girders, partly through the upstream and downstream sheathing, and partly through vertical diaphragms framed between the girders.

Sills

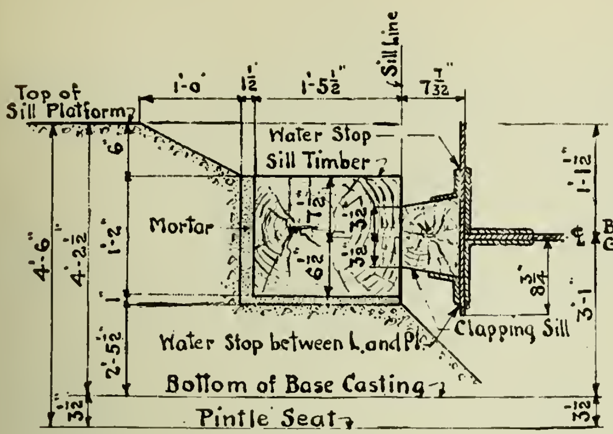
The sills of the gate, like the end bearings, serve to transmit to the lock floor a portion of the water load upon the gate as well as to make a watertight joint along the bottom of the gate. The clapping sills upon the gate leaves, and the fixed sills on the lock floors, are white oak timbers finished to true surfaces along their faces of contact. Figure No. 8 shows the cross-section of the sills. The fixed sill is 14 by 17½ inches and is placed with its short side vertical. The bearing face of the clapping sill is 7 inches wide. The sills for gates of all different heights are the same.

Pintle

A heavy steel heel casting is bolted to the bottom of the leaf at the quoin end. In the bottom of the heel casting, a bronze bushed socket is provided to fit and turn upon the 16-inch diameter hemispherical top of the forged nickel steel pintle mounted in the pintle casting, which is seated upon the base casting embedded in the concrete. Figure No. 9 shows the assembly of the pintle of the gates 82 feet high. The unit bearing pressure on the pintles of these gates is 6,000 pounds per square inch in the dry and 3,000 pounds per square inch under operating conditions in the wet. As the pintles are made the same size for all gates, the bearing pressures in the case of the other gates are less than for the high gates. The pintles are placed 2 inches eccentrically from the centre of the cylindrical bearing faces of the hollow quoins, so that as the gate opens the quoin bearings will swing out of contact, thus reducing the wear upon the bearing surfaces.

Anchorage

The upper hinge pin, 10 inches in diameter, is supported vertically over the pintle in slotted holes in the web of the top girder and in the jaw plate mounted above it. The pin turns in bronze bushings in two anchorage links placed one above the other. The maximum pressure on the bearings will be 4,200 pounds per square inch for the gate 82 feet high in the dry and 2,100 pounds per square inch for this gate under operating conditions in the wet. Figure No. 10 shows the arrangement of the anchorage. The lower anchorage link is at right angles to the centre line of the lock,



Section -B- B.

Figure No. 8.—Cross-Section of Sill.

and the upper one makes an angle of 22° 37′ with the lock centre line. A heavy guide plate is bolted to the top of the pin, and firmly keyed to it by means of a projecting rib formed on the top of the pin which fits a slot cut in the guide plate. The guide plate is free to slide in guides mounted on the top of the jaw plate parallel to the slotted pin hole. This prevents the pin from rotating with reference to the gate, which, experience has shown, there is a strong tendency for it to do when double anchorage links as described above are used, but leaves it free to slide forward when the gate leaf is forced back into the hollow quoin under water load. Each anchorage link has a pin connection to a structural steel anchor embedded in the masonry and the length of each link is made adjustable, by means of a differential turnbuckle, to compensate for any slight errors in the setting of the structural steel anchors. The anchors are generally of the form shown in figure No. 10, but special anchors are required for some special cases.

Fenders

Oak fenders are provided on the downstream side of the leaves to protect them in the open position from contact with ships entering and leaving the locks. When the leaf is in its recess, the surface of the steel work at its downstream side lies approximately 10 inches back from the plane of the face of the lock wall, and the outer surface of the fenders lies about one inch back from the same plane. Each leaf has a horizontal fender 13½ inches wide, placed with its upper edge in line with the web of the top girder and extending over nearly the full length of the leaf. Below the horizontal fender are five lines of vertical fenders 11 inches wide, placed on the lines of the five vertical frames and extending from the horizontal fender to a distance of about 15 feet below the level at which the surface of the water will normally be when the gate is open. At all points where the vertical fenders cross the horizontal girders, they are supported laterally by a tapered oak block at each side, resting against a steel angle bracket riveted to the steelwork of the leaf. To protect the footwalks of the gates 35 feet 6 inches and 44 feet 6 inches high from contact with the overhang of passing ships, these gates are provided with an additional horizontal fender placed above the top girder and supported by structural steel brackets riveted to its web plate. This fender is 13½ inches high by 16 inches wide, and its upper edge is placed 19 inches above the web of the top girder.

When the leaf is in its recess its upstream side is about 12 inches clear of the face of the concrete at the back of the recess, in order to facilitate the entrance of water behind the leaf as it moves out of its recess and reduce the force rquired to operate it. To hold the leaf clear of the concrete

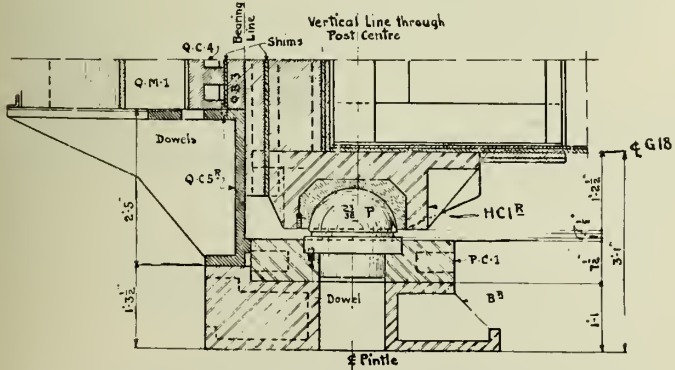


Figure No. 9.—Section Through Pintle.

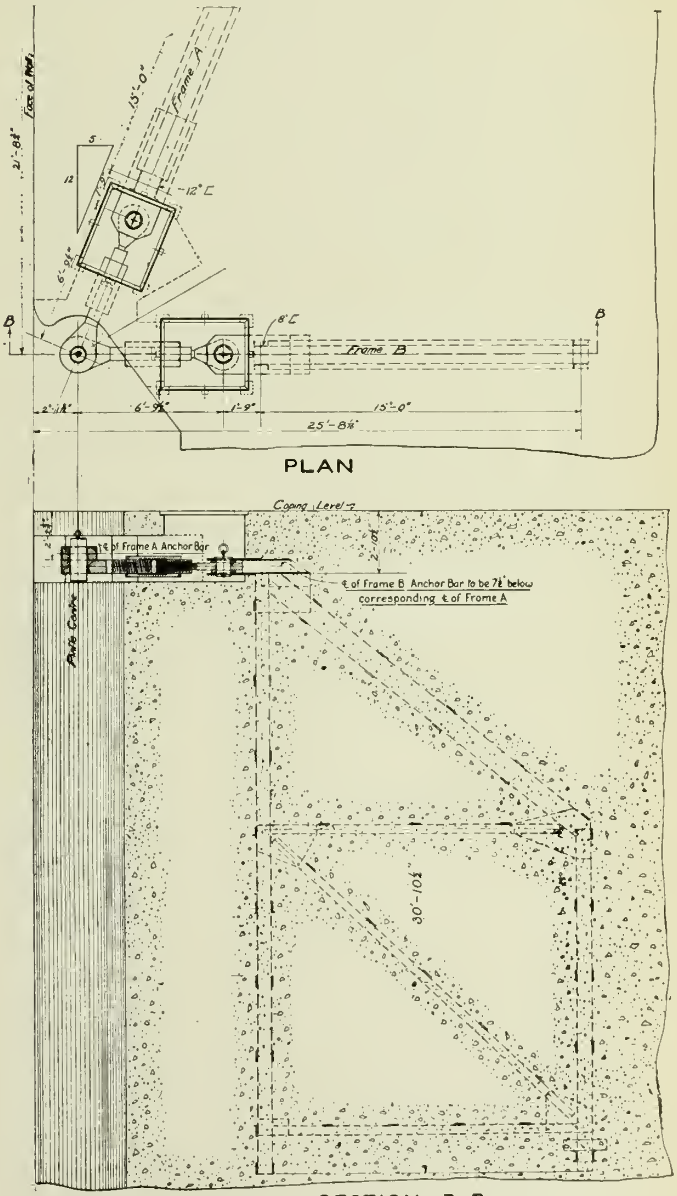


Figure No. 10.—Anchorage.

under pressure from passing ships, horizontal oak timbers 14 inches wide are bolted to the concrete in line with the two upper horizontal girders of the leaf and with the alternate girders below them, down to a level near the lower ends of the vertical fenders on the downstream side of the leaf. The outer faces of these horizontal timbers are finished to fit the surface of the adjacent steelwork of the leaf, the two inner rows of rivets in the girder flanges opposite the timbers being counter-sunk outside, and the corners of the timbers being chamfered to clear the heads of the next two rows of rivets.

Footwalks and Handrailings

The footwalks upon the top of the gates consist of rolled steel checkered plates upon structural steel supports. The walks overlap the coping of the lock walls in order to avoid the necessity of making the quoin end to fit the curved outline of the masonry, as would be required with flush walks. The top of the walk is, however, only 6 inches higher than the top of the lock wall. There is a handrailing at each side of the walk. To prevent the railings from being damaged by contact with the overhang of ships, and to keep them from interfering with the handling of lines along the lock walls, the railings are made collapsible and are designed to fold down automatically to a position below the top of the footwalk stringers whenever the gates are opened. This is done by using a single horizontal handrail and hinging the railing posts to the horizontal handrails at their tops, while at their lower ends they are keyed to tumbler shafts placed transversely under the footwalk, two posts, one at each side of the walk, being keyed to each tumbler shaft. The tumbler shafts are connected to each other by a system of cranks, connecting rods and levers, and this mechanism is connected to one of the anchorage links, so that as the gate is opened the handrailings will be automatically folded down beside the footwalk.

The lower gates of the twin locks Nos. 4 and 5 are 1.4 foot higher than the lower gates of the other locks Nos. 1, 2, 3, 6 and 7, which are all 82 feet high. These gates 83.4 feet high are made the same as the gates 82 feet high in all respects, except that the structural steel supports for the footwalk are 1.4 foot higher, and a vertical shaft in the mechanism connecting the handrailings to the anchorage is 1.4 foot longer. This means that these gates have 1.4 foot less freeboard above normal water level than the other gates. The smaller freeboard is, however, decidedly advantageous for the gates in the lower locks of the flight, which are exposed to the danger of over filling through faulty operation of the valves, as it gives them a greater spilling capacity without flooding the lock coping.

Should a gate be so injured in service as to require it to be sent to the gate yard for repairs, one of the spare gates would be brought from the gate yard and set in the place of the damaged gate in the lock. For this purpose, the department will use a heavy floating crane designed especially for this service, and capable of lifting the heaviest leaf without the aid of the buoyancy of the air chamber. To provide means for attaching the lifting tackle of the crane to the gate leaf, each leaf is furnished with four heavy lifting eyes projecting above the top horizontal girder and placed one at each of the four lines of vertical frames nearest the ends of the leaf. In general, gate leaves will be transported to and from the gate yard floating upon the water. To enable this to be done, removable watertight covers will be provided for all openings into the water chamber. To enable the gate leaf to be jacked up in its recess sufficiently to permit of the inspection of the bearing surface of the pintle, suitable jacking beams are provided upon the bottom of the leaf.

Design

Materials

Mild steel meeting the requirements of the Standard Specifications for Structural Steel for Bridges of the American Society for Testing Materials was adopted for all structural steelwork in the gates.

In order to reduce the number and size of the bolts required for bolting the end bearing castings and safety castings to the leaves, a heat treated alloy steel conforming to the American Society for Testing Materials Standard Specifications for Carbon Steel and Alloy Steel Forgings, class *L*, was specified for these bolts. For the quoin and mitre bearing pieces of the high gates, rolled carbon steel bars conforming to the requirements of class *E* of these specifications were used, but nickel steel forgings, class *H*, were adopted for the pintles and for the pins supporting the sheaves for the operating cables.

Vanadium steel, of 80,000 pounds per square inch ultimate strength, was specified for the heel castings of the gates, but for all other steel castings, including the quoin and mitre bearing castings and the safety castings, medium carbon steel in accordance with the standard specifications of the American Society for Testing Materials was used. Heat treatment of all steel castings was required. Cast iron was used only for a few minor parts.

Phosphor bronze, American Society for Testing Materials, class *A*, was used for the pintle bushings, and class *B* for the upper anchorage pin bushings and for the bushings and journal bearings of the operating rope sheaves.

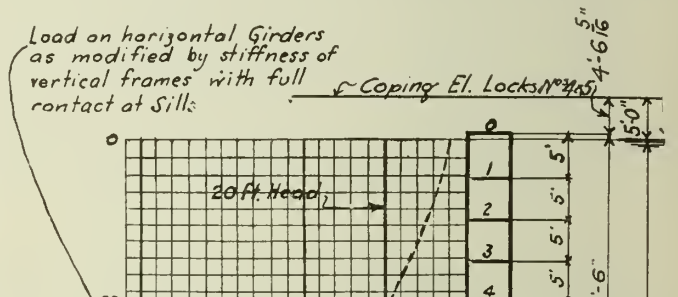


Figure No. 11.—Assumed Load Diagram.

Loads

All gates of the same height are designed to be interchangeable and to be good for the loads which may come upon them in any location in which they could be used.

In order to avoid unduly light construction near the top of the gates, where the theoretical water load decreases toward zero at the assumed level of the upper pool, the water load upon the upper 20 feet of the gate was arbitrarily assumed to be that due to a uniform head of 20 feet. This gives the gates increased strength at the top, where ships are most likely to come into contact with them.

The distribution of the water load to the horizontal girders depends, of course, upon the amount of load transmitted to the sill. As a basis for the design, it was assumed that the extreme conditions in this respect will be (a) no load transmitted to the sill, and (b) full contact at the mitre with no deflection of the bottom girder. Under the latter condition, the vertical stiffness of the leaf will relieve the horizontal girders near the bottom of the leaf of a portion of their load and transmit it, principally to the sill, and partially to other girders higher up the leaf.

In the gates 35 feet 6 inches and 44 feet 6 inches high, the girders whose loads are increased by the vertical stiffness are those near the top of the leaf, and the increase is more than covered by the assumption of a uniform head of 20 feet over the upper part of the leaf. For these gates, therefore, the effect of the vertical stiffness did not govern the design.

In the gates 82 feet high, however, the vertical stiffness, in addition to slightly increasing the loads upon the two upper girders of the leaf where the increase is amply covered by the assumed uniform 20-foot head, also increases the loads upon girders Nos. 7 to 13 inclusive, which are well below the 20-foot zone. For these girders, therefore, the condition of no deflection at the bottom girder governed the design. Figure No. 11 shows the load diagram used for the design of the gates 83.4 feet and 82 feet high.

In order to avoid the lengthy and laborious computations necessary to determine the increase in the girder loads by the elastic theory, the results of the elaborate studies made upon this feature of the design of the gates for the Panama Canal* were used, and applied to the gates of the Welland ship canal by interpolation. As the gates of the two canals are of the same type, have the same angle of sill, and practically the same thickness in proportion to the width of the lock, this procedure was particularly easy of application.

Studies were made of the amount of eccentricity which could be produced in the reactions at the mitre as a result of faulty mitering and deformations of the leaves under load and temperature changes. For the high gates with steel bearings an eccentricity of 3½ inches up or down stream was assumed as a basis for the computation of stresses, and for the gates with timber bearings an eccentricity of 8 inches was taken.

Methods of Design

In the design of the horizontal girders the flange areas were assumed to be concentrated at the backs of the flange angles and to be composed of one-eighth of the web plate, the flange angles, the cover plate and those portions of the sheathing plates which lie between the outside rows of rivets in the cover plate and beyond them to a distance equal to twelve times the thickness of the sheathing plate.

The vertical end bearing diaphragms at the quoin end of the leaf were assumed to carry two-thirds of the total end reaction of the panel in question. But at the mitre end of the leaf, where the upstream sheathing can not receive any load directly from the end bearings, the diaphragms were assumed to carry the total panel reactions.

The intercostals were designed as simple beams to carry their full panel loads without assistance from the sheathing plates. Their end connections, however, were made good for the moments which may come upon them.

For the design of the sheathing plates the Bach formula for flat plates was used in the form:

$$t = 0.402\, b \sqrt{a^2 H \div (a^2+b^2)\, S},$$

in which,

t=required thickness of plate, in inches,
a=effective height of panel, in inches,
b=effective width of panel, in inches,
H=head of water at centre of panel, in feet, and
S=allowable working unit stress, in lbs. per square inch.

No rolled steel plates or shapes of less than 7/16-inch in thickness were used except for fillers.

Working Stresses

For the combined bending and compressive stresses in the horizontal girders and the diaphragms, 14,000 pounds per square inch was used as the allowable working stress. For the bending stresses produced by the unbalanced water pressure on the web plates of the girders at the top and bottom of the air chamber a working stress of 14,000 pounds per square inch was allowed in the web stiffeners, but the working stress in the web plates themselves was restricted to 8,000 pounds per square inch, as these plates when carrying this stress will also be stressed by the loads carried by the girder as a member of the framework of the leaf.

The intercostals at the downstream side of the water chamber and the upstream side of the air chamber, when carrying their maximum bending stress due to water pressure on the sheathing, may also be subjected to stress from the vertical bending of the leaf as a whole, and for them a working stress in bending of 11,000 pounds per square inch was used. For the intercostals at the downstream side of the air chamber a working stress of 16,000 pounds per square inch was allowed, as no stress from the vertical bending of the leaf as a whole can be developed when they are carrying their maximum stress, which occurs when the water level on the downstream side of the leaf is at the level of the upper pool. For the high gates this can of course occur only when they are used as the lower guard gates of locks Nos. 6 and 7. The only water loads which can come upon the intercostals at the upstream side of the water chamber are those due to the small head produced by the lag as the chamber fills and empties, and to the few feet of head to which they will be subjected when the leaf is floating upon the water with the water chamber empty. The smallest sections which it is desirable to use for practical reasons are more than ample for these loads.

The working stresses in the sheathing plates due to bending under water pressure were also modified to provide for stresses from other causes to which the plates may be subjected at the same time. At the downstream side of the water chamber the plates are in tension from the horizontal bending of the leaf as a whole when their local bending is at its maximum, and a working stress of 8,000 pounds per square inch was used. The plates on the downstream side of the air chamber, however, receive their maximum stress in local bending when the gate as a whole carries no load, and for them a working stress of 16,000 pounds per square inch was allowed. The upstream sheathing of the

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*"The Distribution of Stresses in Mitering Lock Gates, with Special Reference to the Gates of the Panama Canal," by Henry Goldmark. Transactions, Am. Soc. C.E., Vol. LXXI, p. 1621.

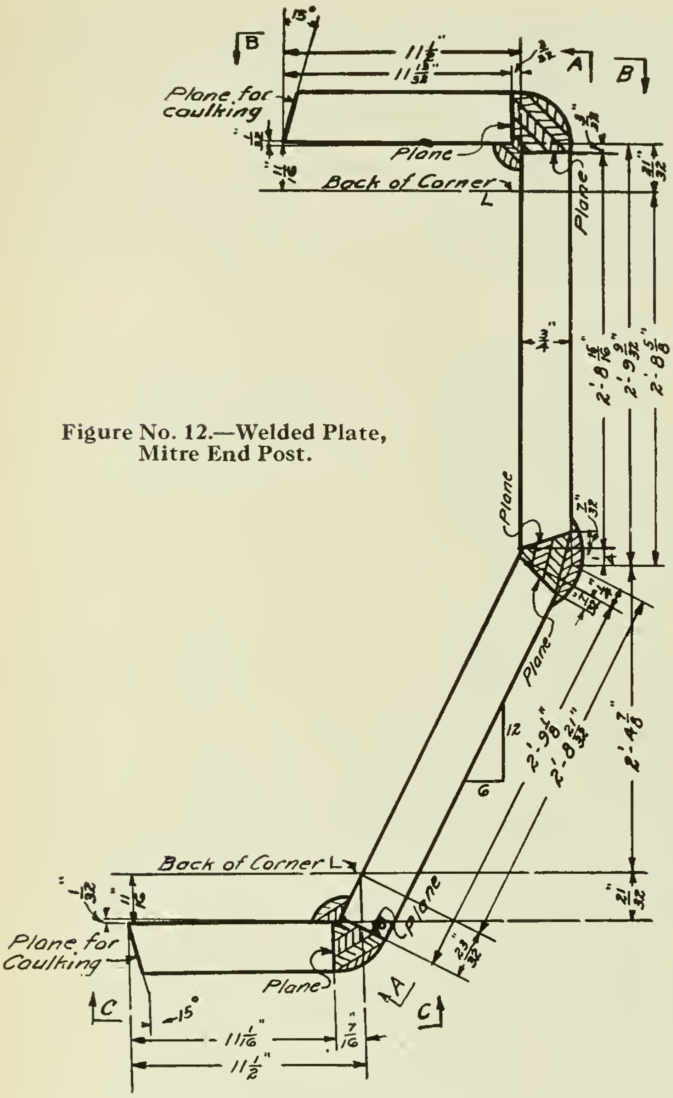


Figure No. 12.—Welded Plate, Mitre End Post.

air chamber will be in compression from the horizontal bending of the leaf as a whole and may also be in compression in the other direction from vertical bending of the leaf, when it carries its maximum stress in local bending. Its working stress was therefore limited to 5,000 pounds per square inch. For the upstream sheathing of the water chamber the adopted minimum thickness of 7/16-inch is ample for any calculable loads.

The allowable working stress in shear on the webs of girders, diaphragms and intercostals was taken as 9,000 pounds per square inch. For shop rivets, working stresses of 11,000 pounds per square inch in shear and 22,000 pounds per square inch in bearing were used, while for field rivets the corresponding stresses were 9,000 and 18,000 pounds per square inch. For rivets in tension a working stress of 8,000 pounds per square inch was allowed. All of the rivets which connect the downstream sheathing of the water chamber to the frame of the gate will be in tension. This is standard practice in double sheathed gates and has been found to be entirely satisfactory.

Fabrication

In general the fabrication of the structural steel work is being done by the methods usually employed in modern shops. Some special features may, however, be noted.

It is, of course, important that all of the horizontal girders of a leaf should be of exactly the same length between the finished surfaces at their ends which bear against the end posts, and that these surfaces should be finished accurately to the proper angle with reference to the centre line of the girder. It is also important that the girders should be of exactly the proper depth back to back of flange angles at their ends which fit between the flanges of the end posts. The girders are therefore assembled with their ends set in cast iron frames or jigs which hold the flange angles to their proper distance apart. Each jig has two reference points 4 feet apart on a line at right angles to the girder centre line. By taking accurate tape measurements from each reference point on one jig to both of the reference points on the other jig they are carefully set in proper position relatively to each other for the assembly of each girder. The jigs when properly set are used as templates, by means of which a group of reference holes are drilled in the outstanding legs of the flange angles at each end of the girder on both the upstream and the downstream side.

The ends of the girders are planed, and the rivet holes for the connection of the end bearing diaphragms are drilled to steel templates having hardened steel nose pieces along the edge to which the ends of the girders are to be planed. These templates are connected by suitable castings to the bottom of a rigid trussed steel frame 48½ feet long, 5 feet wide and 5 feet 4 inches deep, which holds them in the proper relative position. The trussed frame also carries upon its under side castings shaped to fit around the ends of the girder and having holes to match the reference holes drilled in it from the jigs in which it was assembled.

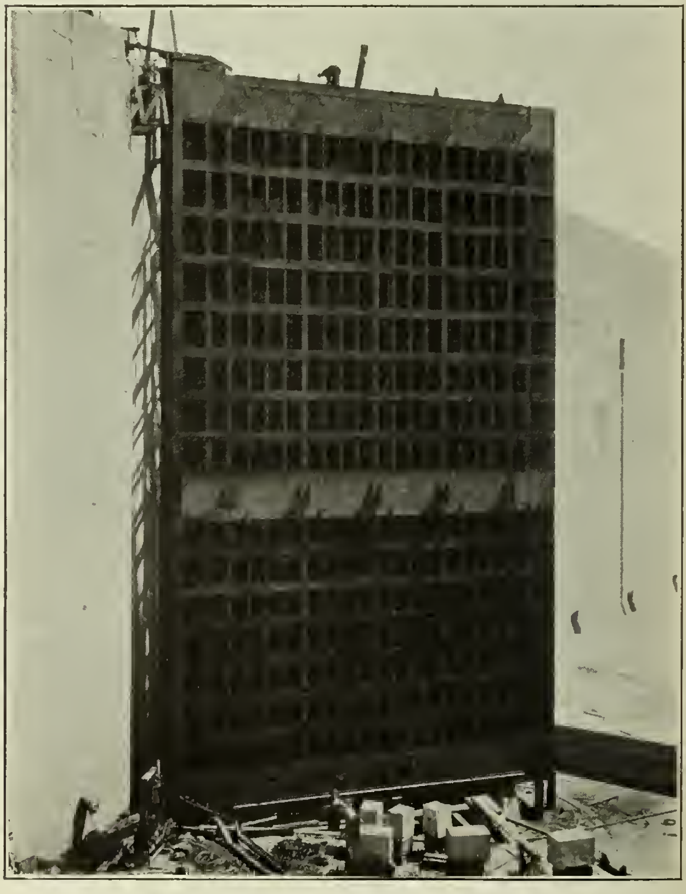


Figure No. 13.—East Leaf, Lower Gate, Lock No. 1.

Therefore when the trussed frame is set upon a girder and adjusted so that the reference holes in its castings match the reference holes in the flanges of the girder, the steel templates must be in proper position with reference to the girder and to each other. The templates are then firmly bolted to the girder for use in planing and drilling the ends after the removal of the carrier frame with its castings.

The most unusual feature of the work in the shop is the fabrication of the bent plates for the end posts by welding separate flat plates together along their edges by means of the electric arc. Figure No. 12 shows typical details of the welded joints in one of the plates for the mitre end post of the gate 82 feet high. The plates are assembled for welding by bolting them to transverse frames of the required outline, spaced about 3 feet centre to centre, and set in accurate alignment with each other upon concrete foundations. Two series of frames are provided, one for the quoin posts and one for the mitre posts. The transverse joints are welded first, and the longitudinal welds are made afterwards, working from one end of the post toward the other. Four courses of welding are used in building up the welds to the required thickness and an additional bead is applied from the inside of the post on some of the joints. The joints are tested by chipping out the weld at two points selected at random. The rivet and bolt holes are drilled after the plates are welded. Owing to the longitudinal contraction due to the welding, the holes required for bolting the plates to the frames do not always remain in their proper location, and some of them have to be welded up and redrilled. The welding of the first end posts progressed slowly, about 270 man-hours being required to weld one quoin post for the 82-foot high gate, and 440 man-hours to weld one mitre post. Considerably better progress is expected in the future.

Some difficulties were found at first in opening out the angles for the end posts. The legs of the angles, instead of remaining flat, tended to curve outward. This was overcome by rounding the outside corner of the angle to a curve concentric with the fillet at the root and by using dies which applied the flaring pressure close to the root of the angle. There was also a tendency for the angle as a whole to curve and twist instead of remaining straight. By going over the angle from end to end several times and opening it out only a small amount each time this tendency was so much diminished that, by carefully straightening the angle whenever a slight twist or curve was produced, satisfactory results were obtained.

Erection

The gates are being erected upright in the locks, each leaf being placed at an angle to the lock wall with the quoin end pointing toward its hollow quoin and at a distance of about 4 feet from it. This is done in order to leave sufficient working space between the steelwork and the lock wall at the upstream side of the leaf and around its quoin end. Figure No. 13 shows the east leaf of the lower gate of lock No. 1 partially erected, and figure No. 14 the west leaf of the lower gate of lock No. 5.

The gate leaves are erected upon temporary concrete pedestals set upon the floor of the lock and so made that they can be removed bodily when the erection of the leaf is completed and used over again for other leaves. The bottom girder is set upon these pedestals and carefully leveled up by wedging so that the accuracy of the erection of the remainder of the leaf can be checked by plumbing. When the erection is completed the leaf will be jacked up and the pedestals removed, their place being taken by roller tracks and treads carrying special screw operated lowering wedges. The leaf will then be set upon the lowering wedges, rolled back into the hollow quoin on the rollers, and lowered on to its pintle by means of the wedges. The upper hinge pin can then be connected to the anchorage, the rollers and wedges removed, and the leaf swung in its final position.

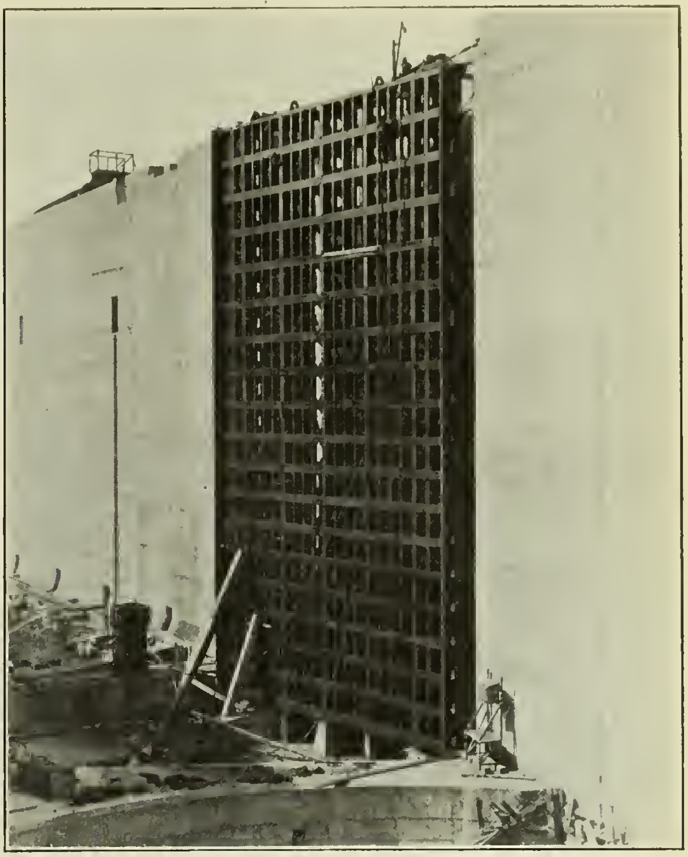


Figure No. 14.—West Leaf, Lower Gate, Lock No. 5.

At most of the locks access by rail can be provided with reasonable ease only to one side of the lock, usually the west side. At these locks, therefore, the east leaf of a gate is being erected before the west leaf, the materials being handled from cars on the west side of the lock into position in the leaf near the east side of the lock chamber by means of a Chicago boom mounted upon the pintle and tied back to the anchorage of the west leaf. When all materials for the east leaf are in place the Chicago boom is taken down and the erection of the west leaf proceeded with, using a locomotive crane operating on the tracks at the west side of the lock for handling the materials. Figure No. 15 shows the Chicago boom in use at lock No. 2.

At the twin locks No. 5, however, rail communication is available to both side walls and to the centre wall as well and the lower gates of these locks are being erected entirely by means of locomotive cranes.

In the erection of the steel bearing plates for the high gates, the alternate plates of a line of bearing plates are first set in place in the recess in the bearing castings and accurately adjusted to their proper positions by means of the bolts and set screws provided for the purpose. The spaces between these bearing plates and the castings are then accurately measured by micrometer calipers at the four corners of each plate. These measurements furnish the information necessary for planing the steel shims, not only for the plates which were set in place but for the intervening plates as well, since all of the plates have been machined accurately to the same thickness. For planing, the shims are bolted to a special adjustable bed plate by means of which they can be finished to any required taper or wind. The alternate bearing plates originally adjusted in place in the bearing castings have, of course, to be removed to enable the line of planed shims to be erected, after which the entire line of bearing plates is finally erected and bolted firmly in place upon the shims.

The biggest single item of the work of erection of the gates is the field riveting. There are over forty thousand field rivets in each leaf 82 feet high, twenty thousand in each leaf 44 feet 6 inches high and sixteen thousand in each leaf 35 feet 6 inches high.

Cost

The cost of one leaf 82 feet high erected in place, including the cost of all materials and labour, but not including the cost of engineering and inspection, or the cost of its operating machinery, is given in table No. 3, the cost of the moving leaf being shown separately from the cost of the pintle, anchorages, reaction bearings and other parts which do not move with the leaf. The cost of one leaf 83.4 feet high is only $69.12 more than the cost of a leaf 82 feet high, the difference being entirely in the cost of the moving leaf.

The cost of the leaves 44 feet 6 inches and 35 feet 6 inches high are given in tables Nos. 4 and 5 respectively in the same manner and covering the same features of the work as given for the leaf 82 feet high in table No. 3.

Table No. 3.—Cost of One Leaf of a Steel Lock Gate 82 Feet High.

Description	Quantity	Unit Cost	Cost
Structural steelwork	789,607 lbs.	$ 0.09	$ 71,064.63
Steel bearing castings	51,835 "	0.17	8,811.95
Steel safety castings	26,460 "	0.17	4,498.20
Vanadium steel heel casting	2,600 "	0.20	520.00
Cast steel sheaves, sheave supports and misc. steel castings	13,973 "	0.18	2,515.14
Idler sheaves and misc. iron castings	348 "	0.10	34.80
Rolled steel bearing plates and their shims	17,017 "	0.23	3,913.91
Forged nickel steel pins, etc.	1,349 "	0.20	269.80
Turned alloy steel bolts	10,204 "	0.15	1,530.60
Bronze bushings and nuts and rubber gaskets	1,176 "	0.50	588.00
Hand railings and their operating mechanism	2,022 "	0.45	909.90
Oak fenders and clapping sill	7 m.f.b.m.	240.00	1,680.00
Concrete in bottom of leaf	11 cu. yds.	30.00	330.00
Painting (incl. maintenance for 3 years)			3,000.00
Total cost of moving leaf			$ 99,666.93
Str. steel anchorage frames	16,375 lbs.	$ 0.091	$ 1,495.52
Str. steel and steel castings in quoin bearing members and base castings	56,636 "	0.112	6,339.61
Steel pintle casting	1,430 "	0.18	257.40
Rolled steel quoin bearing plates and their shims	11,685 "	0.23	2,687.55
Forged steel anchorage links and pins	5,121 "	0.20	1,024.20
Forged nickel steel pintle	716 "	0.20	143.20
Oak fenders on wall	5 m.f.b.m.	240.00	1,200.00
Oak sill	1 m.f.b.m.	353.00	353.00
Total cost of fixed parts			$ 13,500.48
Grand total cost			$113,167.41

Table No. 4.—Cost of One Leaf of a Steel Lock Gate 44 Feet 6 Inches High.

Description	Quantity	Unit Cost	Cost
Structural steelwork	372,863 lbs.	$ 0.09	$33,557.67
Steel safety castings	13,230 "	0.17	2,249.10
Vanadium steel heel casting	2,800 "	0.20	560.00
Cast steel sheaves, sheave supports and misc. steel castings	12,324 "	0.18	2,218.32
Idler sheaves and misc. iron castings	348 "	0.10	34.80
Forged nickel steel pins, etc.	1,349 "	0.20	269.80
Turned alloy steel bolts	1,594 "	0.15	239.10
Bronze bushings and nuts and rubber gaskets	739 "	0.50	369.50
Hand railings and their operating mechanism	2,022 "	0.45	909.90
Oak quoin and mitre posts, fenders and clapping sill	6.5 m.f.b.m.	240.00	1,560.00
Concrete in bottom of leaf	8.5 cu. yds.	30.00	255.00
Painting (incl. maintenance for 3 years)			1,682.00
Total cost of moving leaf			$43,905.19
Str. steel anchorage frames	16,375 lbs.	$ 0.091	$ 1,495.52
Quoin and base castings	18,411 "	0.09	1,645.62
Steel pintle casting	1,430 "	0.18	257.40
Forged steel anchorage links and pins	5,121 "	0.20	1,024.20
Forged nickel steel pintle	716 "	0.20	143.20
Oak fenders on wall	2.5 m.f.b.m.	240.00	600.00
Oak sill	1 m.f.b.m.	353.00	353.00
Total cost of fixed parts			$ 5,518.94
Grand total cost			$49,424.13

Table No. 5.—Cost of One Leaf of a Steel Lock Gate 35 Feet 6 Inches High.

Description	Quantity	Unit Cost	Cost
Structural steelwork	303,781 lbs.	$ 0.09	$27,340.29
Steel safety castings	10,290 "	0.17	1,749.30
Vanadium steel heel casting	2,800 "	0.20	560.00
Cast steel sheaves, sheave supports and misc. steel castings	12,055 "	0.18	2,169.90
Idler sheaves and misc. iron castings	348 "	0.10	34.80
Forged nickel steel pins, etc.	1,349 "	0.20	269.80
Turned alloy steel bolts	1,283 "	0.15	192.45
Bronze bushings and nuts and rubber gaskets	739 "	0.50	369.50
Hand railings and their operating mechanism	2,022 "	0.45	909.90
Oak quoin and mitre posts, fenders and clapping sill	5.3 m.f.b.m.	240.00	1,272.00
Concrete in bottom of leaf	7.5 cu. yds.	30.00	225.00
Painting (incl. maintenance for 3 years)			1,342.00
Total cost of moving leaf			$36,434.94
Str. steel anchorage frames	16,375 lbs.	0.091	$ 1,495.52
Quoin and base castings	15,466 "	0.088	1,362.03
Steel pintle casting	1,430 "	0.18	257.40
Forged steel anchorage links and pins	5,121 "	0.20	1,024.20
Forged nickel steel pintle	716 "	0.20	143.20
Oak fenders on wall	1.8 m.f.b.m.	240.00	432.00
Oak sill	1 m.f.b.m.	353.00	353.00
Total cost of fixed parts			$ 5,067.35
Grand total cost			$41,502.29

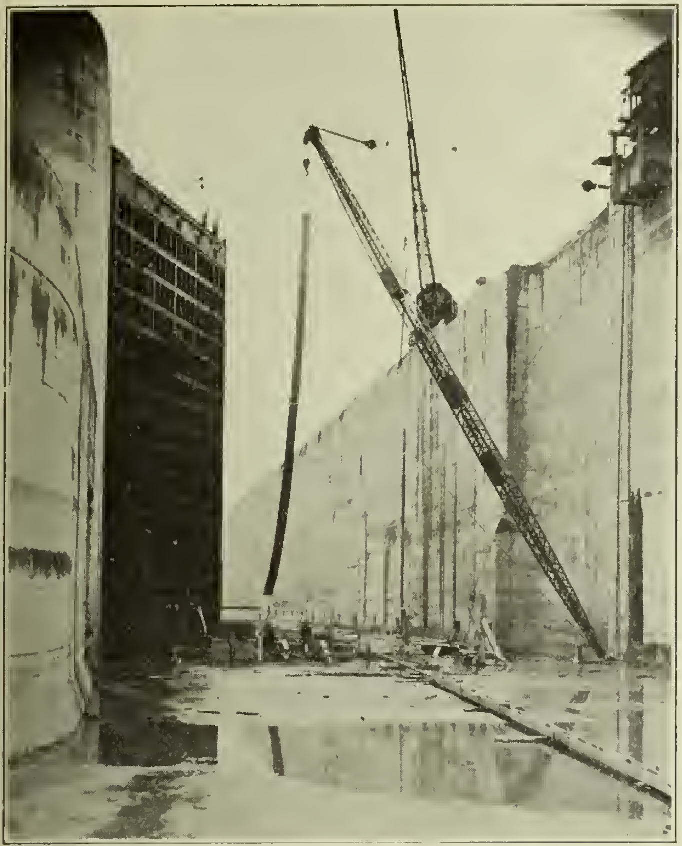


Figure No. 15.—Chicago Boom Erecting East Leaf, Lower Gate, Lock No. 2.

Lock Gate Operating Machinery

The lock gates will be operated by means of steel wire ropes arranged as shown in figure No. 16. There will be two operating ropes for each lock gate leaf, (one for opening it and one for closing it). The former will be attached to a U-bolt built into the masonry of the lock wall at the back of the lock gate recess, and the latter to a similar U-bolt built into the masonry of the lock gate sill near the centre of the lock, both U-bolts being slightly below the level of the bottom of the gate. From these anchorages the ropes will be led horizontally to a pair of sheaves, (one for each rope), mounted upon the bottom of the lock gate leaf near the mitre end. Between the U-bolt anchorages and the gate leaf the ropes will lie against the face of the curved toe wall, shown in figure No. 16, which is concentric with the pintle centre. The sheaves on the bottom of the leaf are set in planes tangential to the face of the toe wall, so that the ropes will lead truly on to the sheaves from the wall in any position of the leaf. Near either end of the travel of the leaf, however, one of the ropes will lose its contact with the circular wall due to the near approach of its sheave to the U-bolt anchor. This will cause the rope to deviate at a slight angle from the plane of the sheave, but the anchors are so located that this angle will in no case exceed 3°. From the sheaves on the bottom of the leaf the operating ropes will be led vertically up through the leaf to two sheaves mounted upon the top girder at the mitre end and thence horizontally underneath the footwalk to a pair of sheaves at the quoin end of the leaf. From these sheaves the ropes will be led horizontally, through a shallow slot formed in the top of the lock wall, to the drums of the lock gate operating machine.

Action of Operating Ropes

When the opening rope No. 1 is placed under tension by the operating machine, the part of the rope between the machine and the sheave near the quoin, and the part between the sheave at the bottom of the leaf and the U-bolt anchorage, exert external forces on the leaf. The former force acts through or close to the pintle centre and produces no appreciable moment tending to rotate the leaf. The latter, however, acts at a radius of about 41 feet from the pintle centre and produces a large moment tending to rotate the leaf toward its open position. Similarly, tension in the closing rope No. 2 produces a large moment tending to rotate the leaf toward its closed position. One advantage of this arrangement of the operating ropes is, that as the leaf moves, the parts of the ropes between the U-bolt anchorages and the sheaves at the bottom of the leaf do not move toward or from the leaf, but these sheaves simply roll along the ropes. There is therefore no tendency for the ropes to be worn by rubbing on the underwater portions of the lock. Another advantage is that, for each leaf, only two sheaves are placed under water.

A third advantage of having the operating ropes arranged as described above is, that the amount to be hauled in on one rope will be very nearly equal to the amount to be paid out on the other rope during the same interval of time over any portion of the travel of the gate leaf. There will, however, be slight variations in the relative travel of the two ropes in different positions of the leaf, due to the movement of the sheaves at the quoin end of the leaf, and to the loss of contact between a rope and the toe wall under the gate leaf, near either end of the travel of the leaf. The amount of these variations are shown by the curves in figure No. 17. Curve No. 1 shows the effect of the movement, away from the operating machine, of the sheaves at the quoin end of the leaf as the leaf moves from the open to the closed position. This movement tends to increase the total length of the two operating ropes. Curve No. 2 shows the compensating effect of the unwrapping of the operating ropes around these sheaves, which tends to decrease the total length of the two ropes. Curve No. 3 shows the combination of these two effects. Curve No. 4 shows the effect of the loss of contact of one rope with the toe wall near either end of the travel of the leaf. This tends to increase the total length of the two ropes as the leaf leaves its open position, and to decrease it again, but by a smaller amount, as the leaf approaches its closed position. Curve No. 5 is the sum of curves Nos. 3 and 4 and shows the combined effect of all the above mentioned variations. This curve shows that the aggregate length of both ropes between the operating machine and the rope anchorages has a minimum and a maximum value which differ from each other by about 8¾ inches and which occur at 15 per cent and 100 per cent respectively of the travel of the leaf from its open to its closed position. The difference between this aggregate length of the ropes at either end of the travel of the leaf is 8 inches and is compensated for by making the drum upon which the opening rope No. 1 is wound slightly larger in diameter than the drum for the closing rope No. 2. The effect of the difference in the diameter of the drums is shown by curve No. 6. Curve No. 7 shows the remaining uncompensated variation which amounts to 3 inches of slack rope at each end of the travel of the leaf. This small amount of slack is taken up by means of spring connections between the drums of the operating machine and their driving gears.

Operating Machine

The operating machine is simply a large double drum winch driven by an electric motor through a train of spur

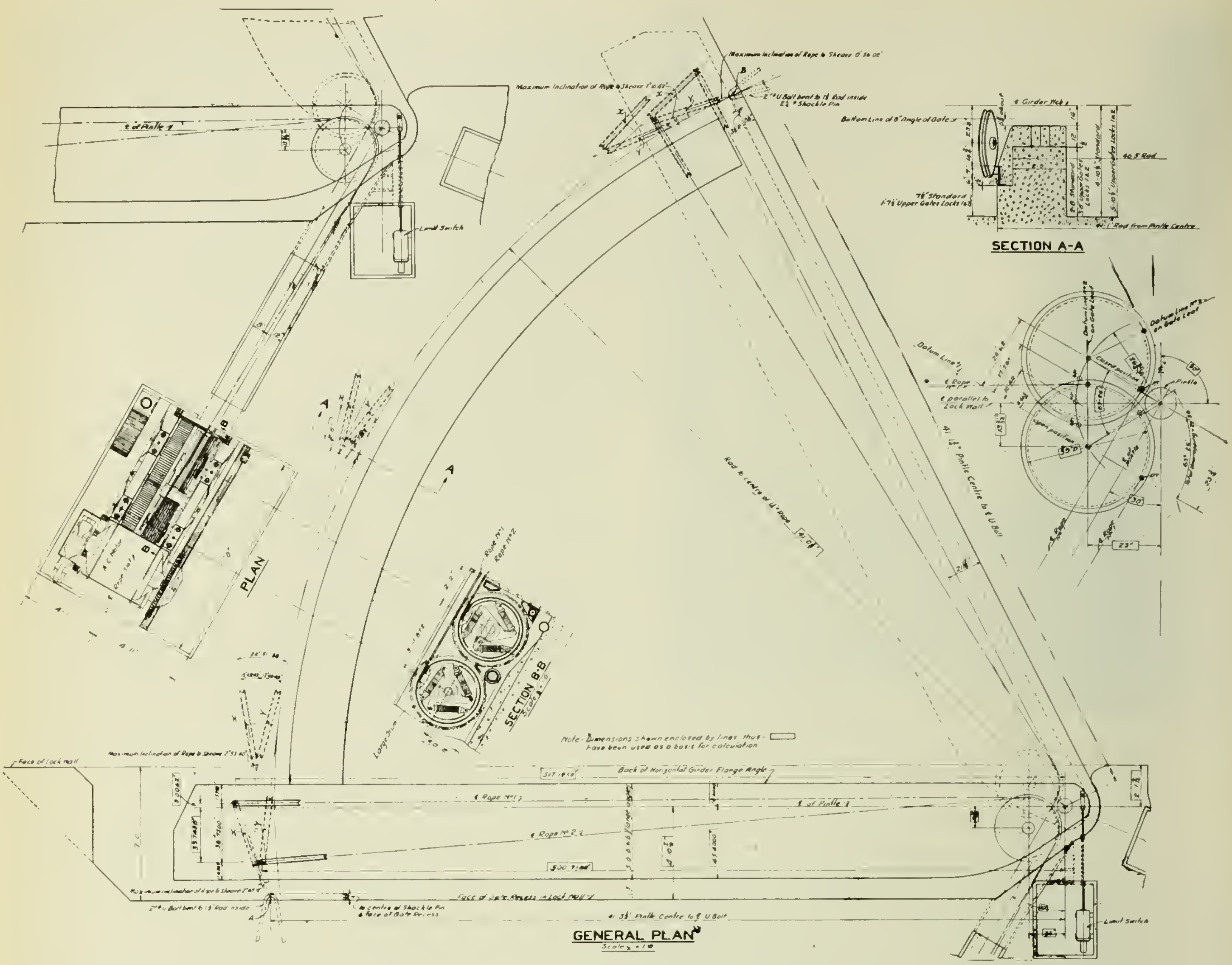


Figure No. 16.—Arrangement of Gate Operating Ropes.

gearing. Figure No. 18 shows the general arrangement of the machine, the motor being omitted in the plan view. A separate drum is used for each of the two operating ropes for the following reasons: (a) to enable provision to be made for the slight variations in the relative travel of the two ropes by making one drum slightly larger than the other, and by permitting slight variations in the relative movements of the drums; (b) to enable both ropes to pay out simultaneously in the event of the gate leaf being carried away by a ship, thus preventing the machine from being subjected to the breaking load of the ropes, and, incidentally (c) to provide a convenient means for taking up slack due to the stretching of the ropes. The two main spur gears which drive the two drums mesh with each other and therefore have a uniform relative motion. The variation in the relative motion of the two drums is provided for by making each drum free to rotate, with reference to its driving gear, under the action of heavy springs acting against the pull of the rope, stops being provided to limit the relative movement of the drum and the gear and to furnish a positive drive for the rope which is operating the gate leaf.

Figure No. 19 shows the drum shaft assembly. There is mounted upon each drum shaft the driving gear, a drive disc, the drum, and a spring spider, arranged in the order named. The drive disc and the spring spider are keyed to the shaft, but the drum and the gear are bronze bushed and made free to rotate upon the shaft. The driving torque is transmitted from the gear to the drum through the drive disc, which is connected to the main gear by means of a single pin in shear passing through holes in the adjacent rims of the two parts. This pin is designed to shear off and release the drum from the gear whenever the tension in the rope exceeds 75,000 pounds. In this way the machine is protected against excessive loads in an accident to the gate. There are six holes for the shear pin in the rim of the gear and 25 in the rim of the drive disc, thus providing for the adjustment of the relative position of the gear and the disc in steps of 0.84 inch at the pitch of the rope. By means of this adjustment any considerable increase in the length of the rope, due to its stretching in service, can readily be taken up. In the rim of the drive disc, on the side adjacent to the drum, a notch is cut, into which projects a heavy steel key dovetailed and bolted into the rim of the drum, the slot being so much larger than the key as to allow the drum to rotate through an angle of 25° be-

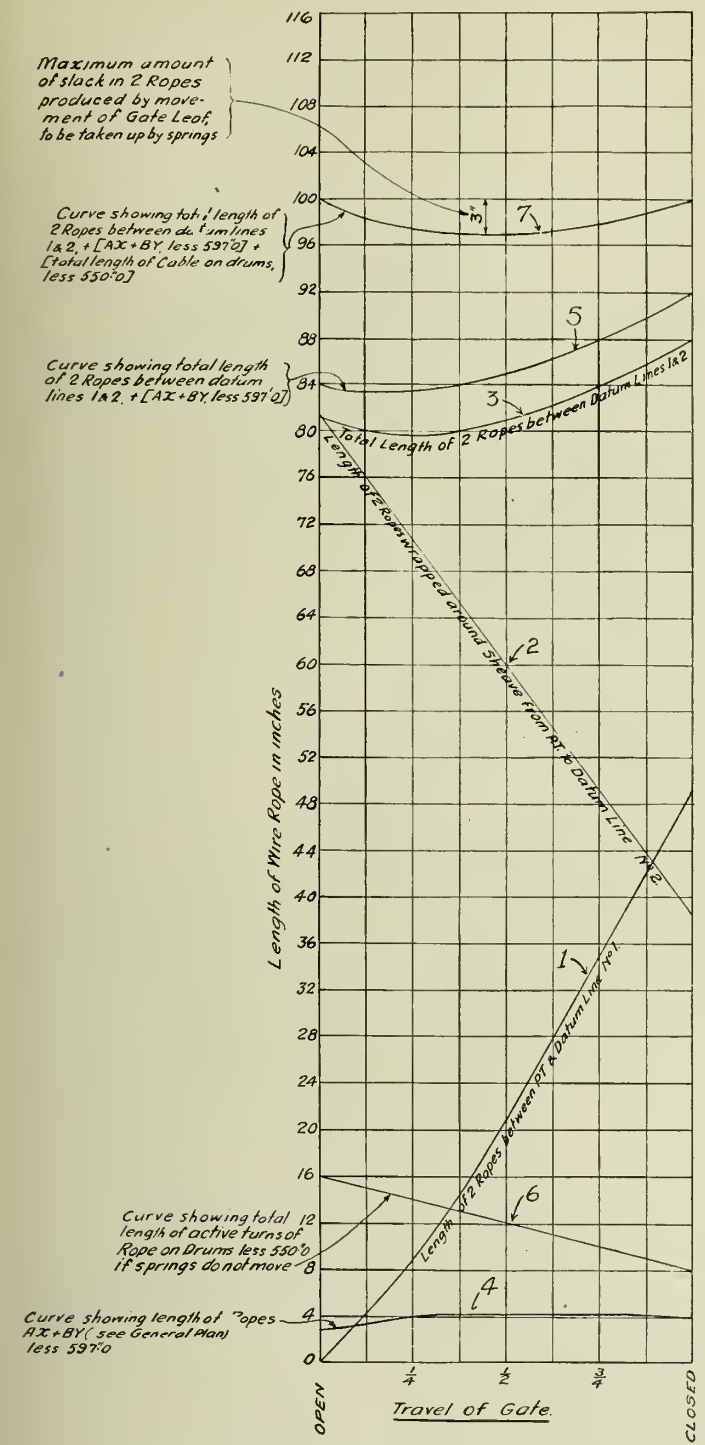


Figure No. 17.—Variations in Rope Travel.

tween the positions of contact of the key with either end of the notch. The other end of the drum overhangs the spring spider and three spiral springs, mounted between the spider and the drum, tend to cause the drum to rotate with reference to the spider in the direction which would wind in the rope. The rope is attached to the drum by means of a clamp bolted to the side of the rim. The clamp anchors the rope securely against a tangential pull, but will allow it to be ripped free from the clamp with comparative ease should the direction of pull have a considerable radial component, as would be the case in the event of all of the rope being unwound as a result of the lock gate being carried away by a ship.

A slip friction is provided in the gear which meshes with the motor pinion. The purpose of this is to prevent any part of the mechanism from being damaged should the gate meet unusually high resistance to its operation due to surges, wave action or the presence of some obstruction in the lock, or should the gate be moved by a head of water, or by contact with a ship when the brake is set.

Under normal conditions the operating machine will open or close the gate in 1½ minute.

The operating ropes are steel armoured wire ropes composed of six strands of nineteen wires each, laid around a hemp centre, each strand being completely covered with an armour of flat steel tape wound around it before being laid up into the rope. The ropes are 1¼ inch in diameter over the armour and have an ultimate strength of 112,000 pounds.

The motor is a 550-volt, three-phase, totally enclosed, wound rotor induction motor with a split frame. Its nominal capacity is 45 h.p. and its synchronous speed, with 60-cycle current, is 600 r.p.m. The motor is equipped with a solenoid brake in order to stop the machine promptly when the gate leaf reaches the end of its travel.

The motor will be operated by remote control from the lock control board, upon which there will be a control handle for each gate leaf. The control handle will have three positions: forward, off and reverse. It will be connected with the motor control panel, located close to the operating machine, by 220-volt control circuits. A control switch is also provided on the control panel to enable the motor to be controlled from that point when desired. The 550-volt power current to the motor will be controlled by magnetic contactors mounted upon the control panel. The motor will be started with resistance in three legs of the secondary circuit, a portion of which will be cut out automatically when the motor has attained the proper speed. The remainder will be left in the circuit to give the motor a slip of about 20 per cent when it is exerting its full load torque. This is done in order to reduce the peak load by causing the gate to move more slowly under heavy load and thus reduce the hydraulic resistances to its motion. The forward and reverse contactors are interlocked so that both cannot be closed at the same time. An inverse time element overload relay and a low voltage protection relay are provided in each of two legs of the circuit which will open all three legs. Upon tripping, either of the relays will reset when the control switch is placed in the off position. The overload relay will be so adjusted that should the gate leaf meet some obstruction in its course which will cause the slip friction to slip, the overload so produced will quickly open the relay and stop the motor.

The motor is automatically stopped and the brake applied, when the gate leaf reaches its open or its closed position, by means of a limit switch operated by direct connection to the heel of the leaf, as indicated in figure No. 16. The limit switch does this by opening the control circuit for the direction in which the gate has been moving, the control circuit for the other direction being opened at the other end of the travel of the leaf.

Timber Gates

The unwatering gates are of solid timber construction, timber being preferred to steel for these gates for the reasons stated previously. The gate at the foot of lock No. 1 is 41 feet high. The three gates at the lower ends of locks Nos. 4 and 8 are 35 feet 6 inches high. The highest timber gate required is that at the head of lock No. 8, which is 44 feet 6 inches high. Figure No. 20 shows the general arrangement of one leaf of the latter gate. The gates 35 feet 6 inches high are of similar construction. The gate 41 feet high for

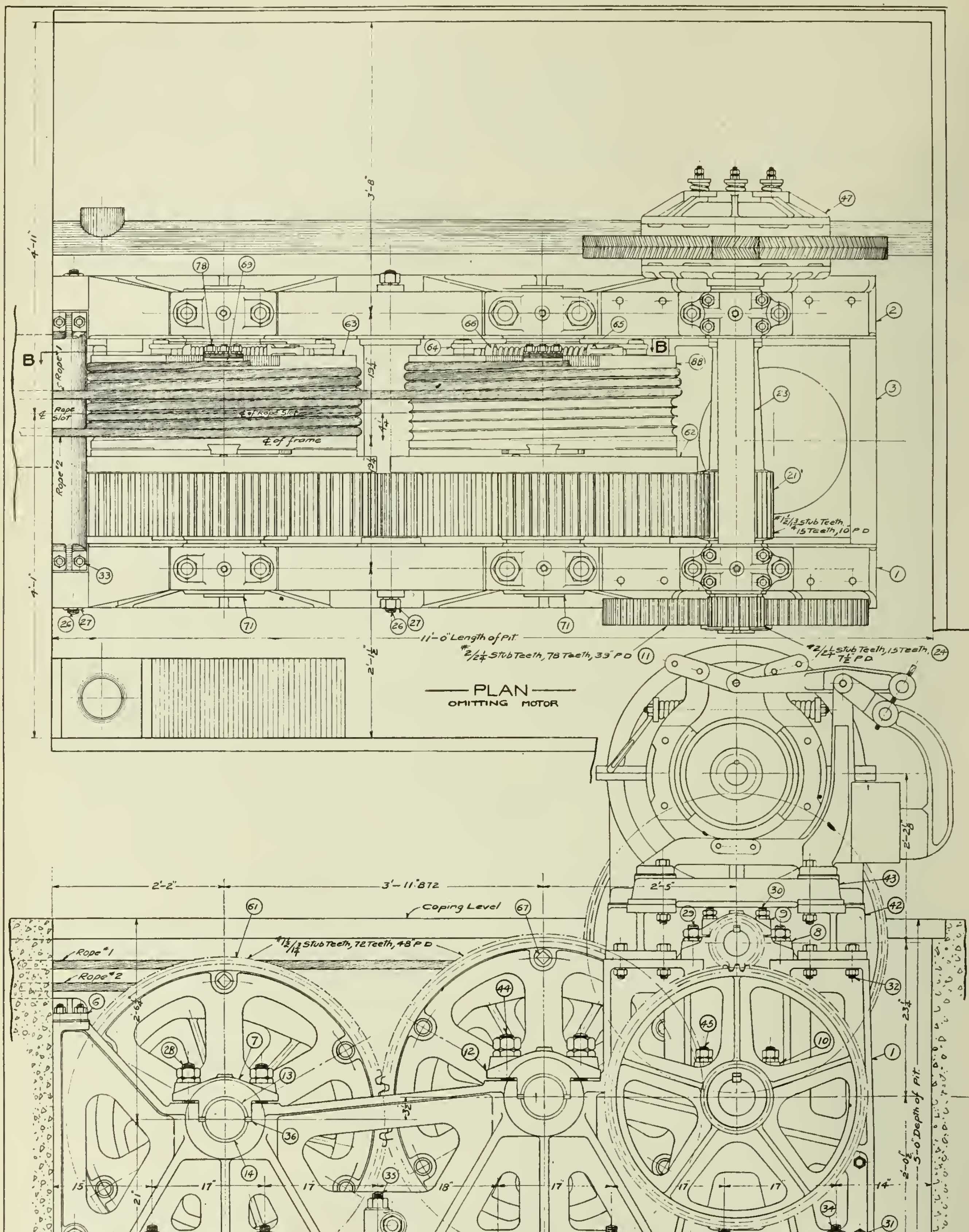


Figure No. 18.—General Arrangement of Gate Operating Machine.

lock No. 1 was built first, and differs from the other gates in a few details which were changed for subsequent gates, as noted hereinafter.

The pintles, anchorages and sills for the timber gates are the same as those for the steel gates. Their bearings in the hollow quoin also are the same as those for the steel gates 35 feet 6 inches and 44 feet 6 inches high, which have timber end bearings. The unwatering gates are not provided with operating machines. They will normally require to be operated only once each year, and this can readily be done by means of lines from the lock capstans. The gates will usually stand open in their recesses, a heavy recess lock being provided near the top of each leaf to anchor it securely to the lock wall and prevent it from being moved by wave action.

Each leaf consists of a series of timber girders of rectangular cross section placed one on top of the other. The downstream sides of all except the bottom girder are in line with each other and form a plane surface. The downstream side of the bottom girder, however, projects 3 inches beyond this surface to meet the fixed sill. The bottom girder of the gate 44 feet 6 inches high is 63 inches deep. The bottom girder of each of the other gates is 60 inches deep. The depth of the top girders of all of the gates is 39 inches. For convenience in construction, the depth of the intermediate girders is not increased uniformly from the top to the bottom of the leaf, but a group of girders all of the same depth is followed by another group of a depth from three to nine inches greater.

Douglas fir was adopted as the material for the girders in order to make it possible to secure sticks of such large dimensions that each girder could be made of one or, at most, two timbers. Girders up to 45 inches in depth are each made from a single stick of timber, but for girders of greater depth two timbers are used. It was somewhat difficult to obtain the considerable number of large timbers required, and some latitude was allowed in the thickness of the timbers furnished, provided that they were of the necessary depth. A few spare sticks were ordered to provide for the possible loss of timbers due to spoiling during fabrication or to the discovery of concealed imperfections. The final detail plans were made after the timbers were received, to suit the thickness of the timbers furnished.

Girders built up of two timbers consist of a large timber running the full length of the girder, reinforced upon its upstream side by a smaller and shorter stick bolted to it to give the required total depth at the centre of the girder, as shown in figure No. 18. The longitudinal shear between the two timbers is carried by steel key castings at the two ends of the shorter timber and by 2½- by 6-inch keys and 4-inch diameter dowels of lignum vitæ. In the gate 41 feet high, these and other keys and dowels are of steel. The quoin ends of the girders are accurately finished to a cylindrical surface of 20½ inches radius to form the quoin bearing of the leaf, and the mitre bearing is formed in a similar manner by finishing the mitre ends of the girders accurately to the required bevel.

The leaf as a whole is firmly bolted together by sixteen long vertical bolts, 2½ inches in diameter, passing through all girders from the top to the bottom of the leaf. There are also four shorter vertical bolts through the upstream timbers of the built-up girders in the lower part of the leaf. The ends of the leaf are stiffened by means of vertical 12-inch steel channel binders placed one at each side of the leaf near each end, and held in place by bolts passing through the leaf. Shear in the horizontal joints between the girders is provided for by means of 4- by 4-inch keys and 4-inch diameter dowels of lignum vitæ. The tendency of the leaf to droop at the toe under its own weight is resisted by two diagonal braces of steel eyebars, one at each side of the leaf, extending from the upper corner at the quoin end to the lower corner at the mitre end. A similar but lighter pair of diagonal eyebar braces is also provided between the upper corner at the mitre end and the lower corner at the quoin end to prevent distortion of the leaf in this direction. The stresses in the eyebars are distributed to the timber at each corner of the leaf by means of a steel cap or shoe, made to fit over the corner, to which the eyebars are connected by means of pins.

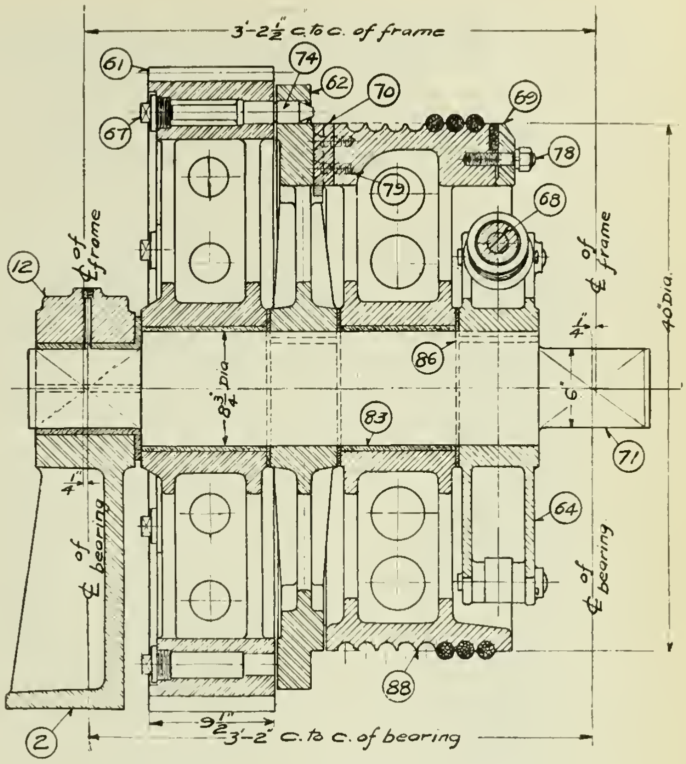


Figure No. 19.--Drum Shaft Assembly.

The shoes at the lower corners of the leaf are of cast steel. The heel casting carries on its under side a bronze lined hemispherical socket to fit the 16-inch diameter pintle. Its rear face is finished to a cylindrical surface of 20½ inches radius to fit the hollow quoin bearing plates. Its downstream surface is flush with the downstream side of the leaf, but has two projecting ribs forming a horizontal dovetail slot into which a short piece of oak clapping sill is fitted. The outer surface of the oak sill is finished flush with the downstream side of the bottom girder and continues the surface of sill contact over that portion of the girder which is cut back to fit inside the heel casting. The sill and mitre bearing surfaces are carried over the mitre shoe casting in a similar manner by means of short pieces of oak fitted into dovetail slots formed on the outside of the mitre shoe castings. The mitre and quoin caps are of riveted structural steel. The mitre bearing, in way of the mitre cap, consists of a strip of oak held in a dovetail slot formed by two vertical angle castings bolted to the cap. In the gate for lock No. 1 the mitre bearing pieces on the mitre shoe and the mitre cap were of cast steel, the bearing faces being finished slightly convex, to a radius of 48 inches. The quoin cap does not cover the quoin bearing surface of the timber girders, but is prevented from sliding forward along the leaf by a heavy rib fitted into a transverse slot cut in the upper surface of the top girder. The quoin cap is provided with heavy horizontal pin plates in which are slotted holes to receive the upper hinge pin of the leaf, which

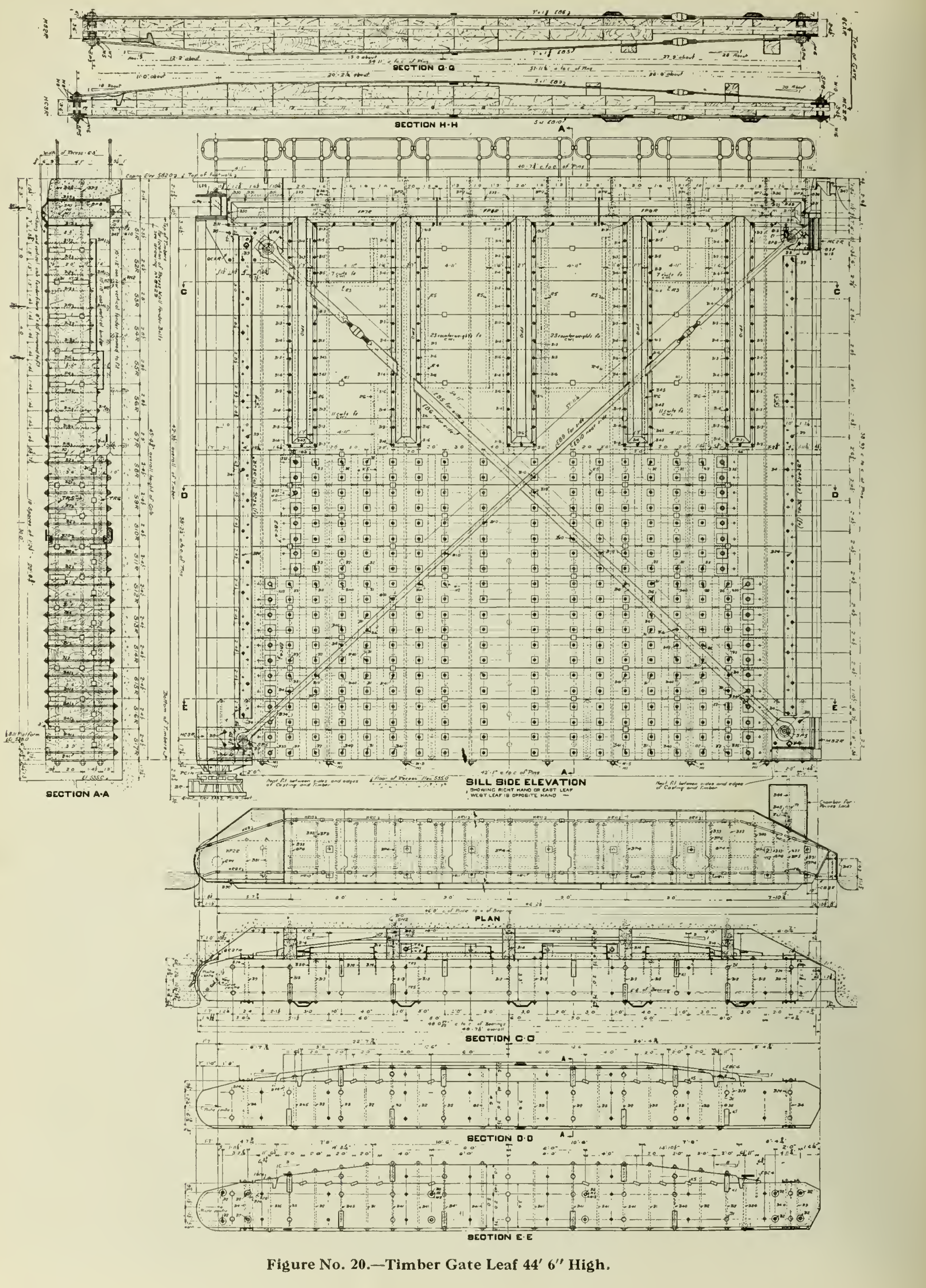


Figure No. 20.—Timber Gate Leaf 44′ 6″ High.

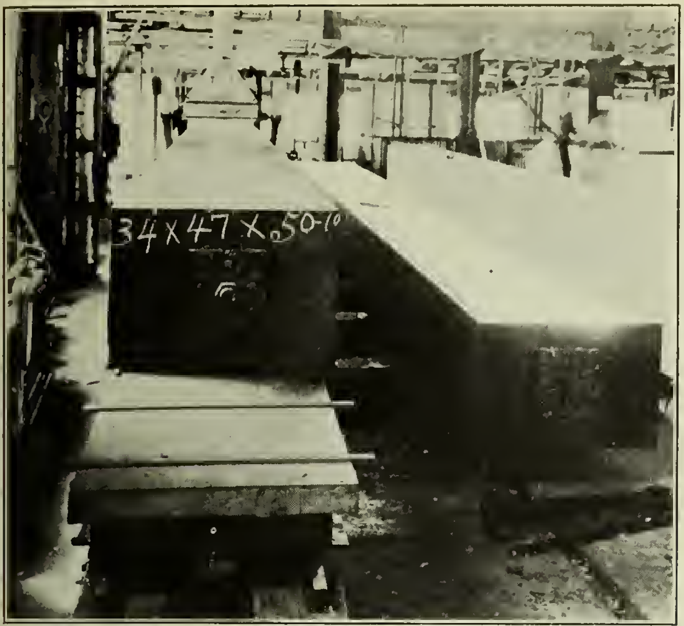


Figure No. 21.—Planning Gate Timbers in Shop.

is of the same diameter as the hinge pins of the steel gates, and is held against rotation but left free to slide in its pin plates in the same manner. The quoin cap extends up to the coping level, where its upper surface consists of a rolled steel checkered plate forming part of the footwalk of the gate. Nickel steel was used for steel parts which will be under water in order to increase their resistance to corrosion.

To prevent the leaf from being lifted off its pintle by the buoyancy of the timber, it is counterweighted with cast iron blocks. The blocks are placed in Z-bar racks bolted to the upstream side of the leaf.

Each leaf of the gate 41 feet high has four horizontal fenders spaced at 4 feet $10\frac{1}{2}$ inches centres on the side of the leaf which is toward the lock when the gate is open. The top and bottom edges of these fenders are beveled at 45° to prevent fenders or other projections on the sides of ships from catching on them and exerting large vertical forces on the leaf. The fenders are covered with $\frac{3}{4}$-inch steel plates bent to the required shape. The other gates are provided with fenders of similar construction, but arranged in a different way. A single horizontal fender near the top of the leaf is used, with five vertical fenders below it, arranged in a manner similar to that described above for the steel gates. Fenders arranged in this way are considered to be less likely to be heavily engaged with projecting fenders on ships. Each timber gate leaf has five vertical oak fenders on its rear face, planed to bear against five corresponding oak timbers bolted to the face of the concrete at the back of the gate recess, so as to transmit pressure from passing ships to the lock walls. The fenders on both sides of the leaves cover roughly the upper half of the leaves only.

As the leaf will usually stand in the open position in

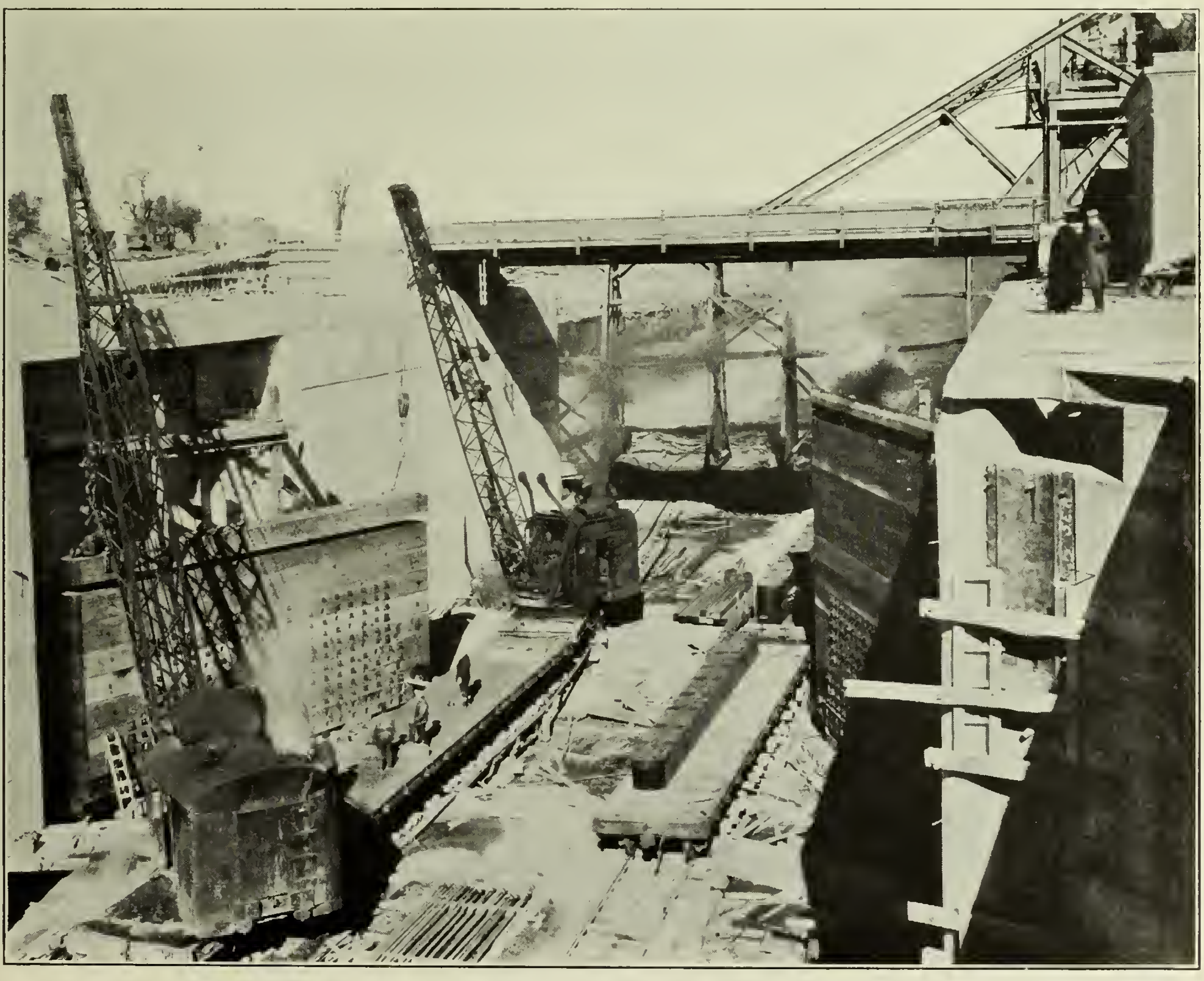


Figure No. 22.—Erecting Lower Unwatering Gate in Lock No. 8.

its recess, the top of the footwalk is made flush with the lock coping and its outline is made to fit the outline of the recess closely, except at the mitre end. Here the footwalk must be kept clear of the mitre bearing face of the leaf and thus leaves a triangular gap between it and the end of the recess. The gap is filled by means of checkered steel plate carried on removable brackets attached to the lock wall. This plate must, of course, be removed before the leaf is moved out of its recess. Removable pipe handrailings, made in short sections for ease of handling, are provided for use at each side of the footwalk when the gate is closed. Sockets are furnished in the top of the footwalk to receive the posts of the handrailings. In order to reduce the total weight of counterweight blocks required, the footwalk is made heavy. In the gate 41 feet high it consists of small reinforced concrete piers standing upon the top of the upper girder of the leaf, which is about 3 feet below the coping level, and carrying reinforced concrete walk slabs. The piers and slabs are made with structural steel connections and frames to provide for bolting the piers to the gate and the slabs to the tops of the piers. In the gates 35 feet 6 inches and 44 feet 6 inches high the footwalks consist of a series of large concrete blocks solidly filling the space between the top girder and the coping level. The footwalks are removable, to give access to the cast steel lifting eyes which are set upon the top girder and connected to the leaf by the long 2½-inch bolts which pass through it from top to bottom.

Fabrication of Timber Gates

A planer of the size required to dress the large timbers of the gate could not be found in stock, and the prices submitted for building one to order seemed prohibitive. The timbers for the first gate were therefore dressed entirely by hand. A planer of the cylinder type and of 24 by 48 inches capacity was afterward secured at second hand and rebuilt to handle timbers 48 by 48 inches and 60 feet long. This planer was used for rough dressing the timbers of the remaining four gates, but hand planing was used for finishing the timbers to their final dimensions. Bolt holes, dowel holes and key seats were accurately laid off by means of templates of the full length of the girders. To facilitate the handling and turning of the large timbers in the shop, a cast steel trunnion was bolted to each end of the timber. When hung on these trunnions from overhead cranes the timber could be easily turned by means of long wrenches fitting the hexagonal ends of the trunnions. Figure No. 21 shows some of the timbers being planed in the shop. The ends of the timbers were finished last, as this entailed the removal of the trunnions. The quoin and mitre bearing faces were finished to within ¼ inch of their final lines in the shop. The final planing of these surfaces was not done until after the leaf was erected.

The leaves were erected in the locks close to their final positions. Each leaf was erected upon a timber skidway upon which, when nearly completed, it was slid back into position over its pintle by means of jacks. It was then jacked up on eight 35-ton jacks, to permit the removal of the skidway, after which the leaf was lowered by the jacks upon its pintle. The concrete footwalk and the counterweight blocks were not placed upon the leaf until after it was set upon its pintle and connected to its anchorage. Figure No. 22 shows one leaf of the lower unwatering gate of lock No. 8 being erected and figure No. 23 shows one leaf of the unwatering gate of lock No. 1 completed with the exception of the footwalk.

The lock gates and their operating machinery were designed by the writer, his principal assistants in the work on the lock gates being M. B. Atkinson, M.E.I.C., and O. W.

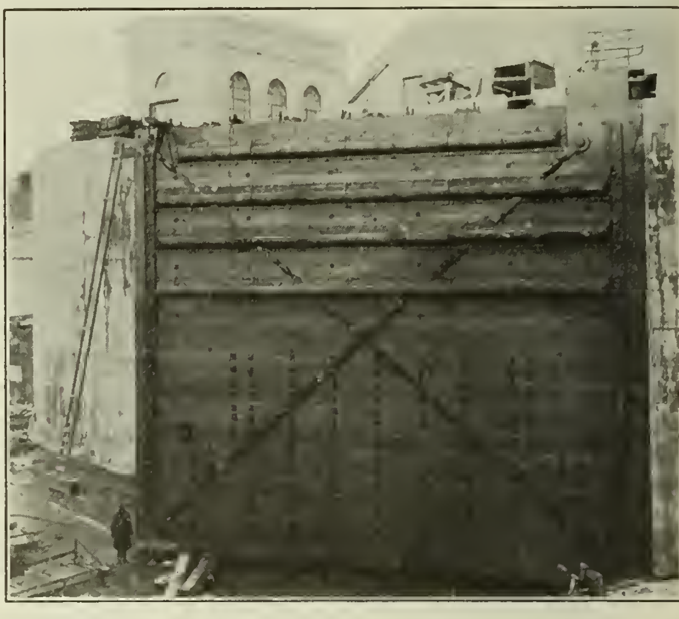


Figure No. 23.—East Leaf, Unwatering Gate Lock No. 1.

Ross, A.M.E.I.C.; on the operating machinery, J. B. McAndrew, A.M.E.I.C., and W. T. Porter, and on the electrical equipment for the operating machinery, L. P. Rundle, to each of whom much credit is due.

Contracts for the lock gate anchorage frames, quoin bearings, base castings and other fixed parts which are built into the masonry of the locks were let from time to time over a period of five years, from 1921 to 1925, to various manufacturing firms as required to suit the progress of the work on the locks.

The contract for the steel gates was let in June 1926 to the Steel Gates Company, Limited, a company formed for the purpose, with E. S. Mattice, M.E.I.C., as manager and chief engineer. Sub-contracts for the shop work were let by the general contractor; to the Hamilton Bridge Works Company, Limited, for the fabrication of nearly all of the structural steelwork; to the Montreal Locomotive Works Company, for the castings and forgings; to McGregor and McIntyre, Toronto, for the footwalks and handrailings, and to the Canadian Power Specialty Company, Limited, St. Catharines, for the manshafts. The gates are being erected by the general contractor, with J. O. Childers as superintendent of erection.

The metalwork for the timber gates and the lignum vitæ dowels and keys were furnished under contract, but the dressing and framing of the timbers in the shop and the erection of all parts of the work were carried out by Welland ship canal forces under the superintendence of Major W. J. Gander.

The contract for the lock gate operating machines for lock No. 1 was let in January 1927 to the Dominion Bridge Company, Limited.

John Rankin, M.E.I.C., was in charge of the inspection for the Welland ship canal of all work in the shop and in the field up to March 1926, when he resigned. He was succeeded by R. R. Stevenson.

Steelwork for the Royal Bank Building in Montreal

Some Features in the Design of the Steelwork for the New Twenty-Three Storey Head Office Building for the Royal Bank of Canada in Montreal

R. M. Robertson, A.M.E.I.C.
Structural Designer, Dominion Bridge Company, Limited.

Paper to be presented at the Annual General Professional Meeting of The Engineering Institute of Canada, at Montreal, Que., February 16th, 1928

The first building of the skyscraper type to be erected in Montreal is the new twenty-three storey head office building for the Royal Bank of Canada, situated in the block bounded by St. James, St. Peter and Notre Dame streets and Dollard lane.

A new by-law affecting the height of buildings within the city limits was passed by the city council on August 18th, 1924. Briefly, the by-law states:—

> "No building more than one ground-floor and eleven storeys in height, from the level of the sidewalk or of the street, or more than one hundred and thirty feet in height, from the level of the sidewalk or of the street to the highest point of the roof, shall be erected within the city limits.
>
> "The provision of this section shall not, however, apply to the erection of buildings, the frontage of which shall not exceed the height therein mentioned, but having central portions exceeding such height, provided that such central portions shall be set back from the frontage at least twenty-three feet, and provided furthermore that the floor area of such buildings, from and including the ground-floor to the roof, shall not exceed the area of a building containing eleven storeys and one ground-floor and erected over the entire lot."

The building occupies a lot of irregular shape, having a frontage on St. James street of 180 feet 8 inches, on St. Peter street of 172 feet 11 inches, on Notre Dame street of 156 feet 11⅝ inches and on Dollard lane of 170 feet 8 inches. Conforming to the by-law, a set-back of approximately 23 feet occurs at the third floor level, 104 feet 7 inches above grade, and a further set-back of fifteen feet takes place at the 19th floor level, 307 feet above grade. The top of the lantern is 393 feet above grade and 415 feet above sub-basement level. Figure No. 1 shows an elevation of the building and indicates the floor levels and set-backs.

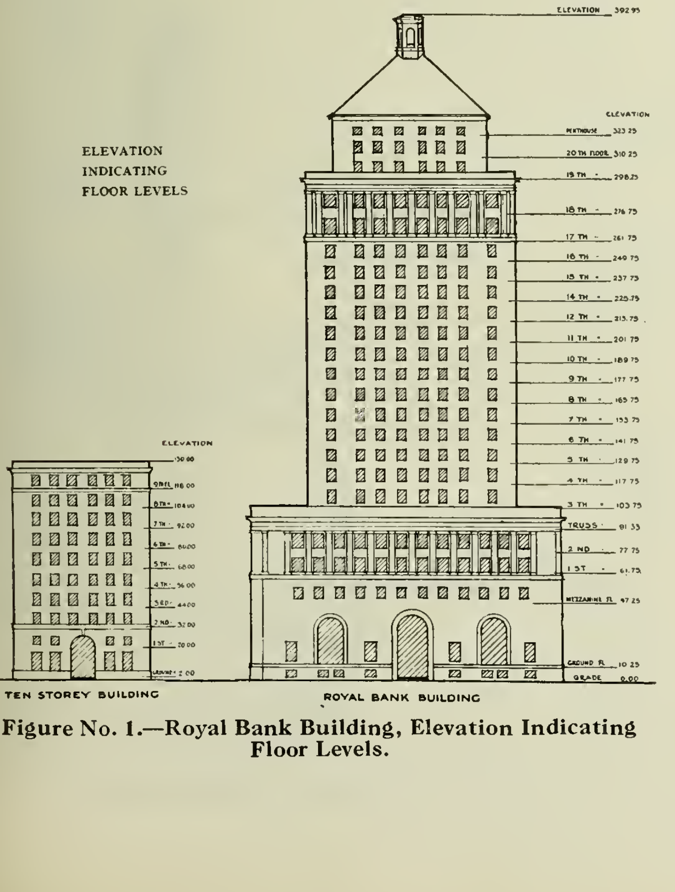


Figure No. 1.—Royal Bank Building, Elevation Indicating Floor Levels.

There are twenty-six floors, including sub-basement, basement and penthouse. Seven floors, the sub-basement, basement, main, mezzanine, first, second and truss are situated in the lower portion of the building. Fifteen typical office floors occupy the portion between the two set-backs, and in the tower above the second set-back there are two office floors in addition to the penthouse.

The lower portion of the building will be occupied exclusively by the bank, and the balance, from the third to the twentieth floor, will be available for rental as general office space.

Safety deposit and security vaults are located on the sub-basement floor in addition to the boilers and other mechanical equipment.

The banking room proper is on the main floor, adjacent to the Notre Dame street side of the building, and occupies an area 49 feet wide, extending from St. Peter street to Dollard lane uninterrupted by any columns. The ceiling over this room is immediately below the first floor and is 46 feet above the main floor level.

A truss floor, introduced between the second and third floors, made it possible to get ample space for trusses, girders and ducts without interfering with architectural requirements. This floor will be used for general storage, also for fans and other ventilating equipment.

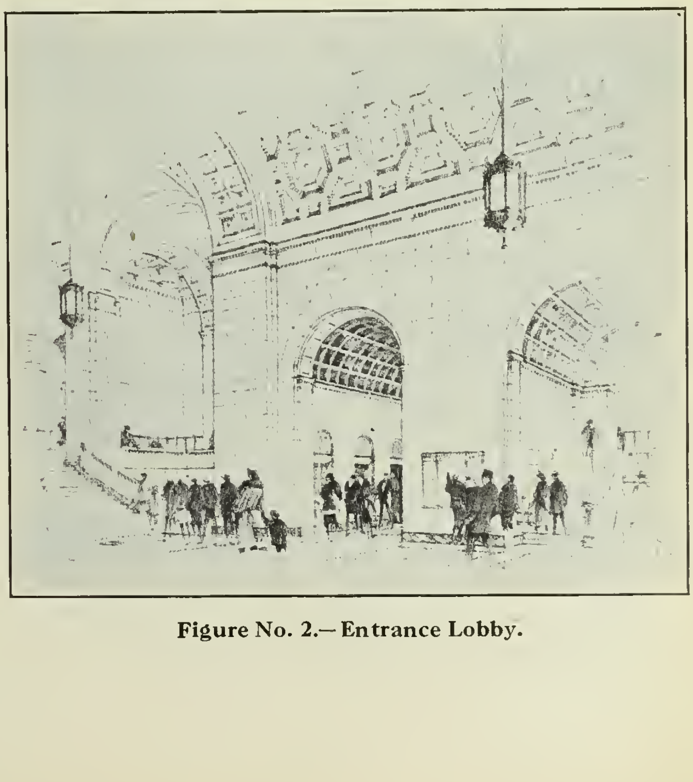


Figure No. 2.—Entrance Lobby.

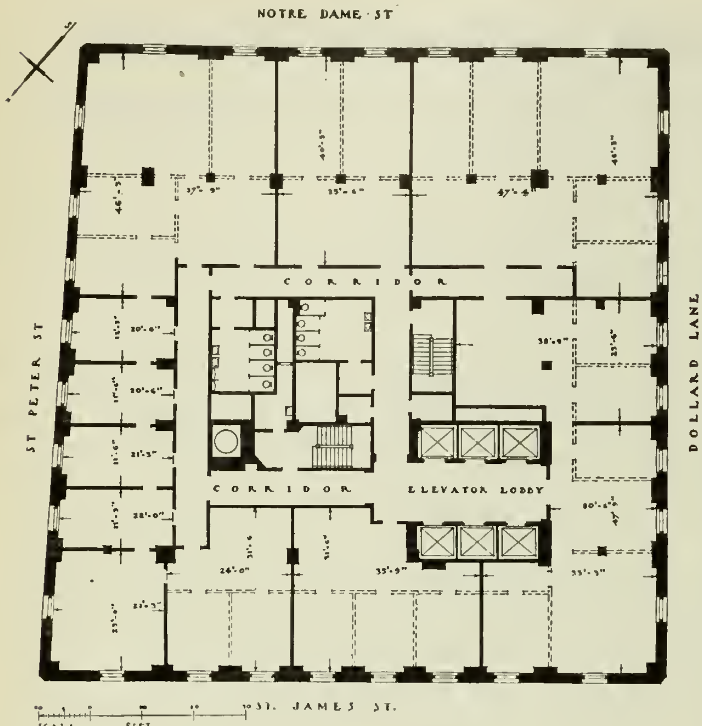


Figure No. 3.—Typical Plan of Floors—Third to Eighteenth.

The main entrance is on the St. James street side of the building and leads to a lobby 20 feet wide, at the end of which is a monumental staircase leading up to the banking room and down on either side to the basement. Elevator halls are located on each side of the entrance lobby, the upper floors being served by six elevators, five passenger and one freight, making their first stop at the fifth floor. The elevator service on the lower floors will be taken care of by two elevators running to the fifth floor and one elevator near the corner of Notre Dame street and Dollard lane running to the second floor. In addition to these, there are two elevators for the use of the bank employees, running to the mezzanine floor, on which is located the cafeteria and employees' rest and locker rooms.

Figure No. 2 shows an architect's picture of the entrance lobby and elevator halls. The main staircase leading to the banking room can be seen at the left, while the stairway shown at the right leads to the general working space on the main floor. This view also shows the general architectural treatment of the main floor, the stone facing on the walls and arches being 80 per cent "Indiana limestone" in varying colours and tones from a warm buff to a cold grey, with 20 per cent "Briarhill sandstone" of warm colour with strong vein markings.

The main structural problem encountered in the design of the steelwork was that of carrying typical floor columns on trusses or girders at the third floor level.

Of the sixty-two columns carried on the foundations, only four, numbers 29, 30, 37 and 38, extend to the roof; six end at the penthouse floor; ten at the nineteenth floor and the remainder at the third floor level. Thirty-one columns are carried on trusses or girders at the third floor level.

Floor Construction

A typical floor plan is shown in figure No. 3. The floor framing, with the exception of girders and trusses at the third floor, consists mainly of I-beams.

Columns are spaced approximately 24 feet centres in each direction on the lower floors and 24 feet by 12 feet in the upper storeys.

A twelve plus two long-span concrete joist construction is used throughout, with the exception of the main and basement floors, on which the floor construction is a four-inch stone concrete slab supported on steel stringers approximately 8 feet centres.

On the typical floors the joists span 24 feet, and are supported on a 10 x 10 H-beam framing to the columns 12 feet apart. Ten-inch I-beams running in the direction parallel to the joist are used as ties between the columns. By the use of these shallow beams it was possible to conceal the steelwork in the floor construction, thus giving large areas of ceiling without any beams projecting below.

The material used for floor fill throughout the building is aerocrete. This substance, which weighs 60 lbs. per cubic foot, is composed of one part cement, four parts very fine sand and seventy-five drams per cubic foot of cement of finely powdered metallic aluminum, the whole when mixed with hot water liberates hydrogen and causes the substance to rise like yeast. It is easily screeded and sets in about the same length of time as ordinary concrete.

"Marble mosaic" will be used as a finish on the main floor, and on all other floors the corridors will be finished with terrazzo and the remaining portions with one inch of cement.

Walls

The walls in the lower portion of the building are eight-inch Queenston limestone backed with eight inches of brick. They are self-supporting up to the first floor, a height of 62 feet above grade. Massive stone pillars, spaced at 12 feet centres, and surmounted by a heavy cornice, form the main architectural treatment between the first and third floor levels.

Above the third floor the walls are four-inch Montreal

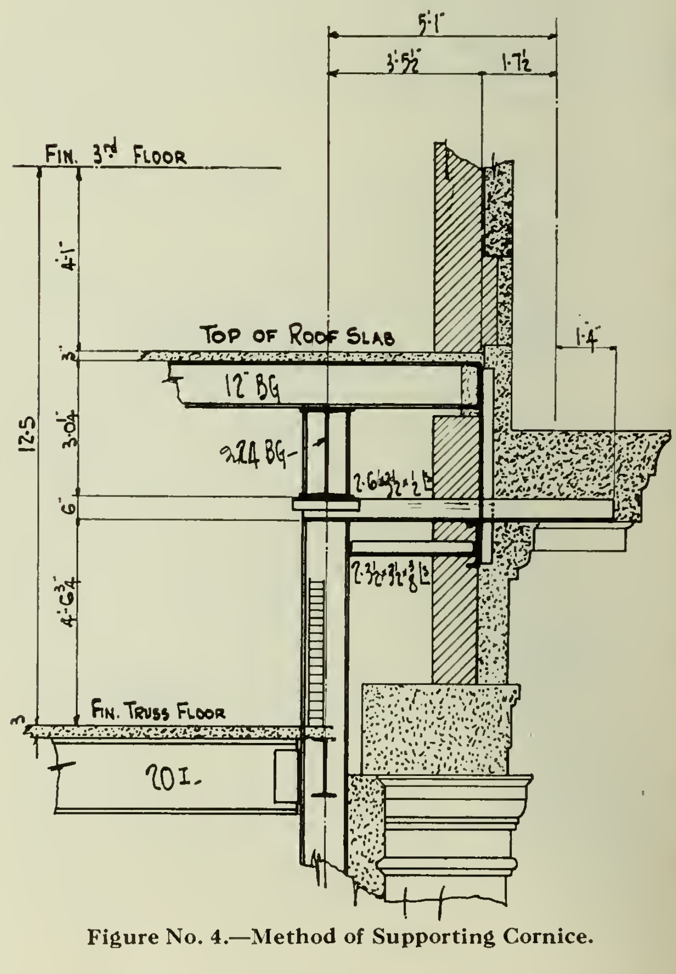


Figure No. 4.—Method of Supporting Cornice.

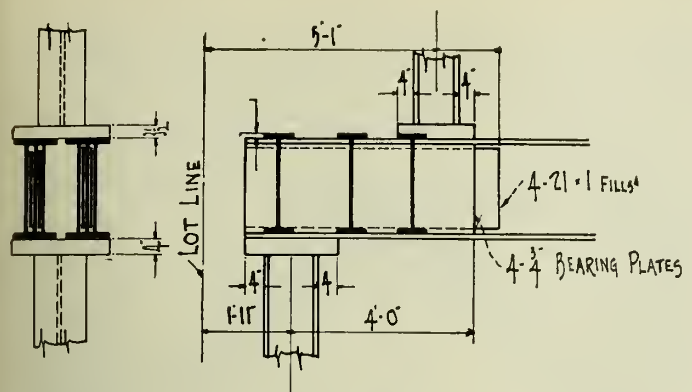


Figure No. 5.—Support for Wall Columns—First Floor.

limestone with eight inches of brick backing, and are supported on spandrel beams at each floor level.

Cornices, similar to the one at the third floor, occur at the nineteenth floor and roof levels. A detail showing the method of supporting the cornice is shown on figure No. 4. Pairs of angles spaced about four feet centres were cantilevered out over the spandrel beams, the angles being arranged so as to come at the stone joints, and in order to provide for adjustment in setting the stone they were fastened to the beams by means of square hook bolts.

The wall columns between the first and third floors had to be set back to clear the stone pillars, these set-back columns being carried on double beams at the first floor level. A detail of the ends of these beams is shown in figure No. 5.

Loading and Unit Stresses

The live loads assumed on the various floors were in accordance with the Montreal Building By-law, as follows:

Basement	100 lbs. per sq. ft.
Main floor	100 " " " "
Mezzanine floor	60 " " " "
First floor	60 " " " "
Second floor	60 " " " "
Truss floor	100 " " " "
Typical office floors	60 " " " "
Roofs	40 " " " "
Elevator and tank supports	Actual loads

In designing the floor beams and girders, partition loads were taken as they actually occurred and not figured as a load per square foot uniformly distributed over the floor area.

The unit stresses used in the design were as follows:

Tension, net section	18,000
Tension on rivets	10,000
Compression, gross section, struts and columns	$\dfrac{18,000}{1+\dfrac{l^2}{18,000r^2}}$
with a maximum of 15,000 lbs., where l is the unsupported length and r the least radius of gyration applicable to this length.	
Bending on extreme fibres,—tension,—net section, if lateral deflection is prevented	18,000
Bending on extreme fibres, compression	$\dfrac{20,000}{1+\dfrac{l^2}{2,000b^2}}$
where l is the unsupported length and b the width of the flange.	
Shear, webs of beams and girders, (gross area), where h, the height between flanges in inches, is not more than 60 times t, the thickness of the web in inches	12,000
Shear on pins and power driven rivets	13,500

	Double Shear	*Single Shear*
Bearing, pins and power driven rivets	30,000	24,000
Bearing, turned bolts in reamed holes	30,000	20,000
Bearing, hand driven rivets and unfinished bolts	20,000	16,000

Main Trusses

Figure No. 6 shows the framing plan at the third floor level. This plan shows the location of the trusses and girders carrying columns over the main banking room, also girders in other portions of this floor carrying upper storey columns.

Five trusses spanning 49 feet, and spaced 23 feet 9 inches apart, were used over the main banking room. Each consisted of two individual trusses with chords and webs of I-section. The two units were designed to be self-supporting under their own portion of the load, but for increased stiffness were connected together by tie plates.

These trusses support three lines of girders 5 feet deep on which the upper storey columns are carried. It was decided to support the girders framing into these trusses by direct bearing in preference to riveted connections, and for this purpose rolled steel slabs were extensively used. The major problem in the design of these trusses was that of eliminating eccentric stresses induced by unequal reactions of the girders framing in on opposite sides of a truss. It will be noted from the plan that the columns carried at this floor are not spaced symmetrically about the trusses, also that the centre line of the girders supporting the outer row of columns is 6 inches off the centre line of the columns below.

The use of slabs materially decreased the number of rivets to be driven in the field, and, furthermore, had the advantage that it was possible by adjusting the centre of bearing of the girders framing in from opposite sides of the truss to locate the centre of gravity of the reactions from these girders directly on the centre line of the truss, thus making each half carry an equal portion of the load.

Figure No. 7 shows a detail of the truss between columns 38 and 50. The stresses and make-up of the members are shown on the diagram and need not be repeated here. This drawing also shows in section the double girder framing in at the centre of the truss and the single girder framing in 6 inches from the right hand end.

A detail of the support on the truss for one of the double girders is shown on figure No. 8. The end reactions from these girders are transferred through bearing stiffeners to a rolled steel slab, which in turn rests on another slab

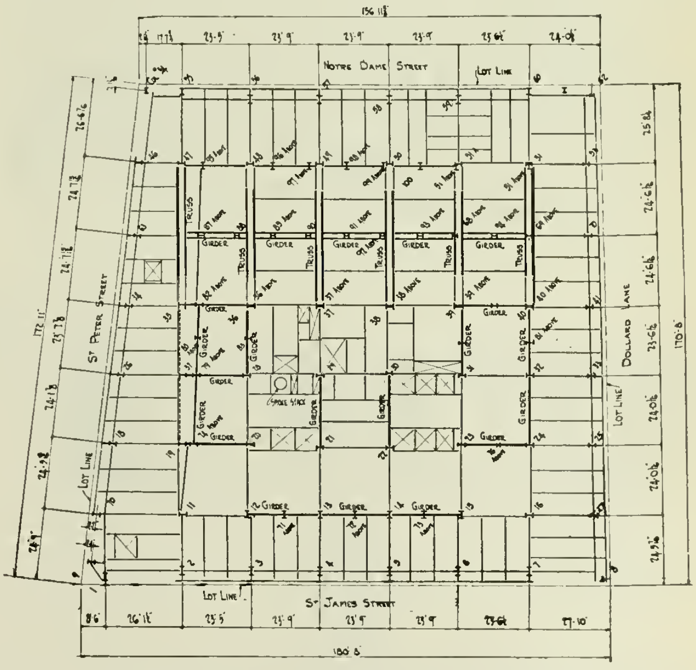


Figure No. 6.—Framing Plan at Third Floor.

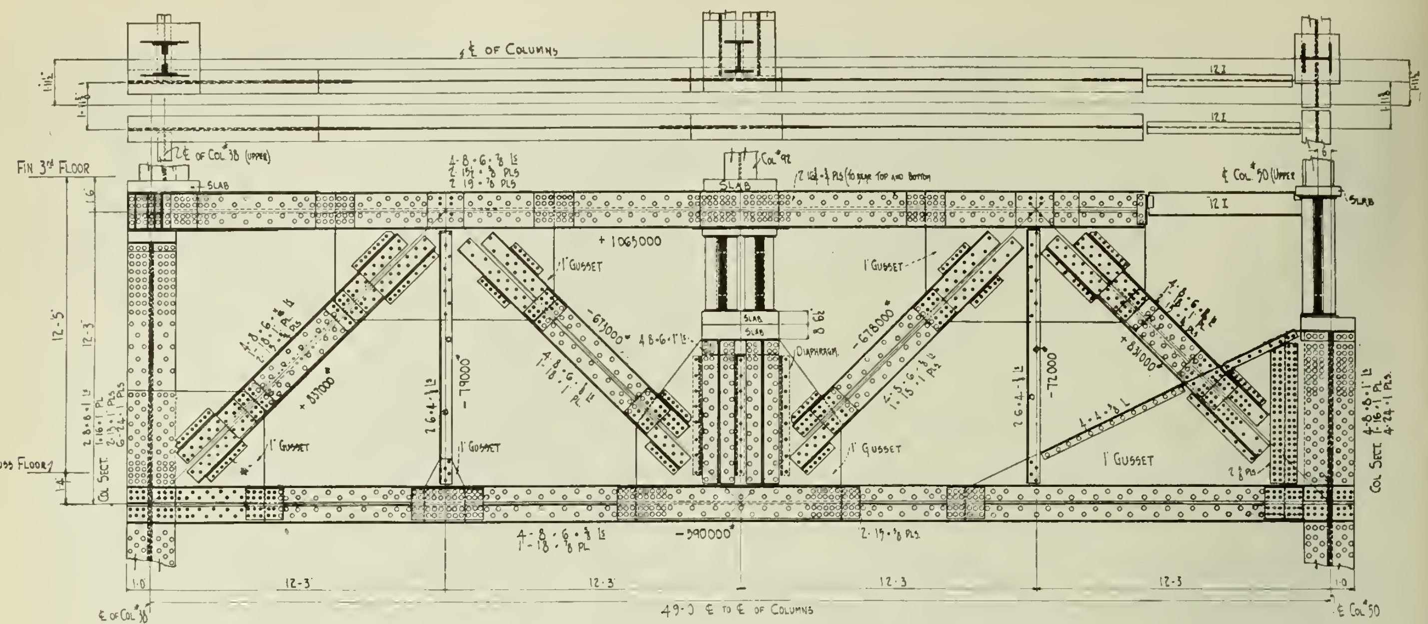


Figure No. 7.—Details of Truss between Columns Thirty-eight and Fifty.
Material and Stresses are for Half of Truss.

supported directly on the gussets of the truss. The bearing area between the two slabs was restricted to a width of 12 inches situated symmetrically about the centre line between the gussets, so as to ensure as far as possible an equal distribution of the load to each half of the truss. It was necessary to cut away the upper portion of the ends of these girders, in order to clear the top chord of the truss; and, to take care of the shear and moment at this point, reinforcing plates and angles were added, as indicated on the sketch.

It will be noted from the detail shown on figure No. 7 that the slab under column 92 rests partly on the girder and partly on the top chord of the truss. This made it necessary to transfer a portion of the load through the chord to the girder below. The web of the chord at this particular point was faced top and bottom, and, in addition, bearing plates riveted to the web were made to bear against the inside of the chord angles, the load then being transferred through a slab to the stiffeners on the lower portion of the girder.

Care had to be taken to ensure an even bearing for the slab under this column, and it was, therefore, necessary to make sure that the depth of the cutaway portion of the girder was exactly equal to the depth of the chord, plus the thickness of the slab underneath it. Actual measurements were taken on the chord and the girder as fabricated before the slab was finally planed.

Another feature in the design of these trusses was the necessity of providing for the eccentric loads from the girders framing in 6 inches from the ends of the truss, as shown in figure No. 7. The eccentricity due to the girder reaction was taken care of by extending the gusset plate to the first panel point and designing the plate to take the bending stress developed, in addition to the stress from the end post and bottom chord. At the other end, where a column rests directly on the truss, the direct load was transferred through bearing plates and the bending stress taken care of by the top chord.

Care had to be taken in fabricating the line of double girders framing between the centre points of the trusses. The load from the columns supported by these girders was transferred to each half by means of a slab, and it was, therefore, necessary to ensure that the tops of these girders were at the same height and perfectly level.

Owing to the build-up of cover plates and also to the fact that flange angles are liable to be slightly off square, it is difficult to obtain a girder exactly square and true. It was, therefore, necessary in this case to plane the portion of the flanges underneath the column slab so as to ensure a perfectly horizontal bearing for the column above.

With the exception of the line of columns described above, all other girders on this floor carrying upper storey columns were of the single web type, generally 60 inches

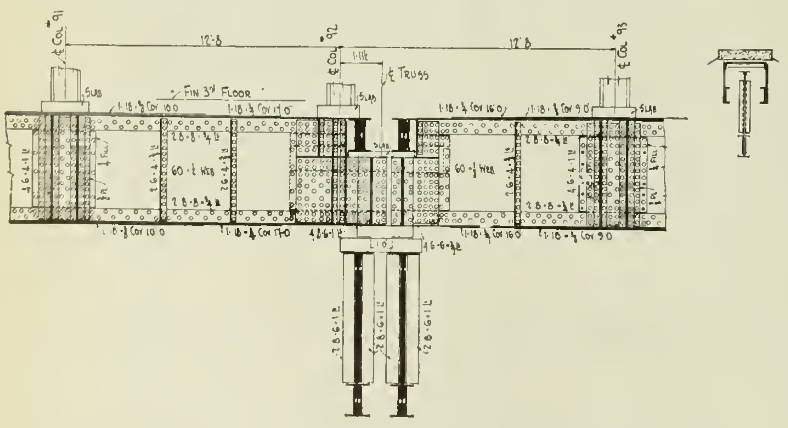


Figure No. 8.—Detail of Support for Girder at Centre of Truss.

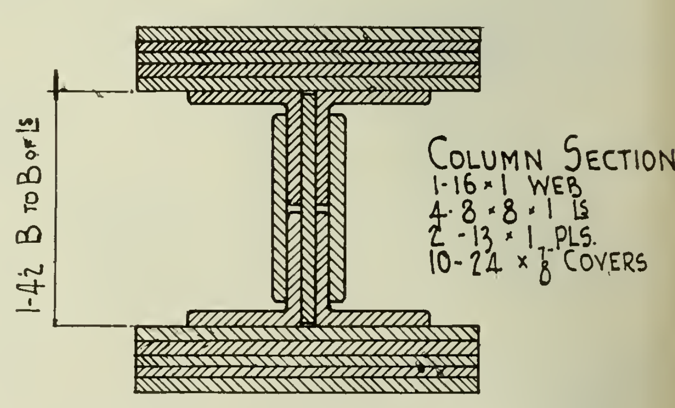


Figure No. 9.—Cross-Section of Heaviest Column.

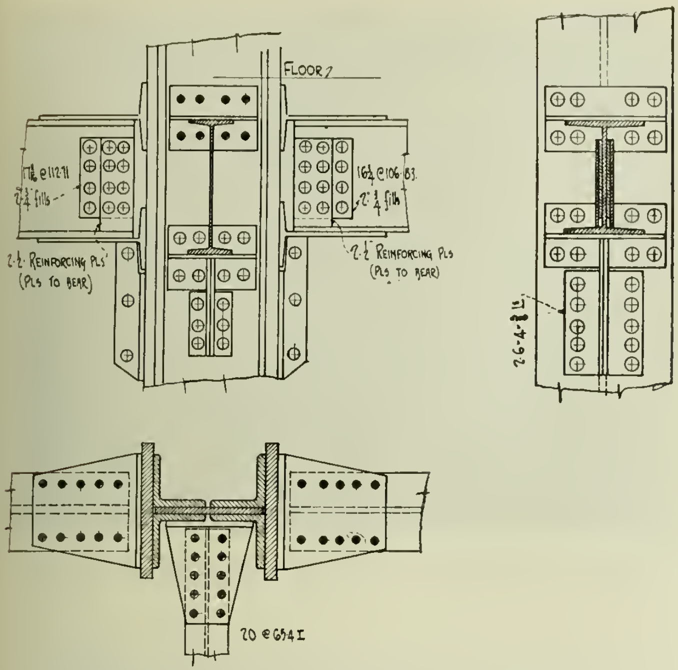


Figure No. 10.—Typical Wind Connection T-type.

deep. The heaviest girder is that between columns 48 and 49, carrying columns 96 and 97. The make-up of this girder was as follows:

One 60" x ⅝" web plate
Four 8" x 8" x 1" angles
One 22" x 1" plate } top
One 18" x 1" " } top
One 18" x ¾" " } top
Two 18" x 1" " } bottom
One 18" x ¾" " } bottom

It was originally intended to hang the portion of the first and second floors over the main banking room from the trusses at the third floor. However, it was found possible to carry this portion of these two floors on a latticed girder placed in the duct space between the first floor and the ceiling over the banking room.

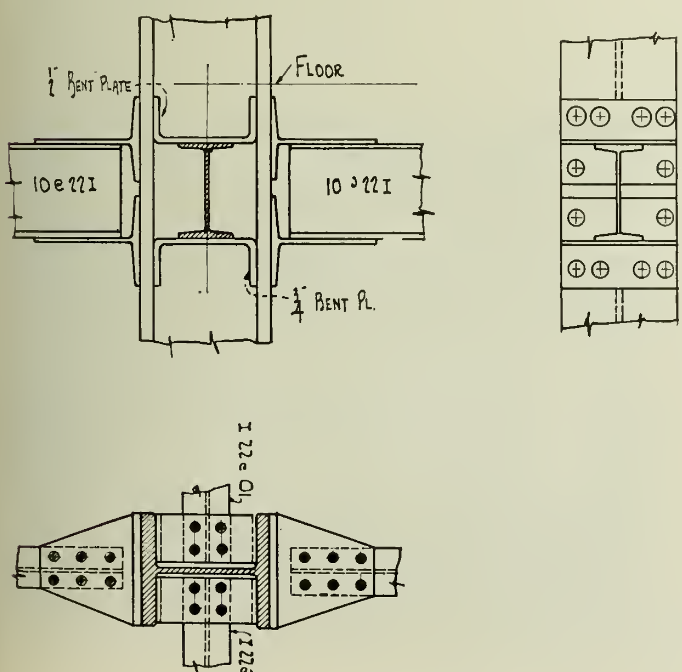


Figure No. 11.—Typical Wind Connection U-type.

The use of this girder greatly facilitated the erection of the main trusses, as it was only necessary to shore the bottom chord of the truss from the second floor instead of assembling each half of the truss on the main floor and hoisting it into place as was originally contemplated.

The large end gusset plates on the truss were shop riveted to the bottom chord, and, instead of being field riveted to the column direct, a field splice was made just clear of the column, in order to reduce the number of long rivets to be driven in the field.

One complete double truss weighed 60 tons, the heaviest piece to be handled being a bottom chord section which weighed 14 tons.

Columns and Slabs

The columns generally in the upper storeys and the wall columns in the lower storeys were rolled Skelton or Bethlehem H-sections. Built-up sections of angles and plates were used for the heavier loads on the lower storeys.

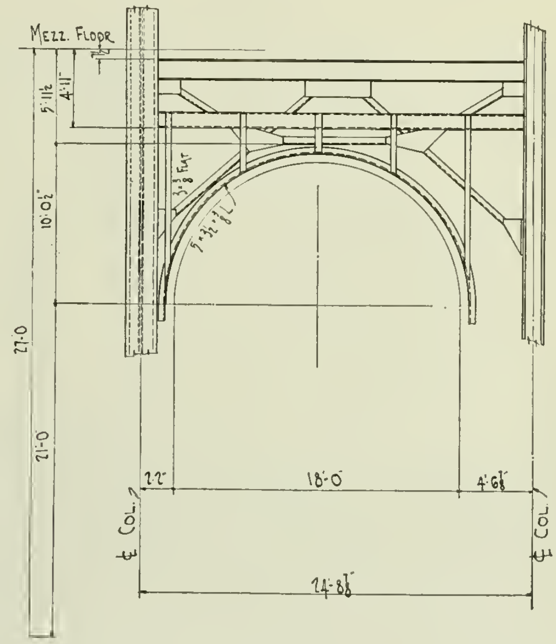


Figure No. 12.—Portal and Support for Interior Stone Arches.

A cross-section of one of the heaviest columns which supported a load of 2,200 tons is shown on figure No. 9. It was made up of:—

Four 8" x 8" x 1" angles
One 16" x 1" web plate
Two 13" x 1" " "
Ten 24" x ⅞" cover plates

Lower storey columns were spliced at the main, mezzanine, second and third floors, the upper storey columns being spliced every third floor.

Rolled steel slabs were used under the columns to distribute the loads to the grillages or footings. The columns were anchored to these slabs by two 1¼-inch diameter studs tapped 2 inches into the slab, the weight of the slab being considered sufficient to hold the column in place during erection.

In certain cases it was impossible to obtain from the mills slabs of sufficient area and thickness to distribute the load over the concrete footings, and in these cases a double layer of slabs was used, the lower slab being split in two, the additional area being obtained by increasing the size of the slab in one direction only.

Wind Stresses

The problem of wind stresses in a building of this type, although not a serious one, had to be given consideration.

The by-law required that the building should be designed to resist a wind pressure equivalent to 30 pounds per square foot on its exposed surface.

It was assumed that the permanent partitions and exterior walls would resist a pressure of 15 pounds per square foot on that portion of the building above the first set-back and 30 pounds per square foot on the portion from the first set-back to grade.

The steelwork was, therefore, designed to resist, in addition to the dead and live loads, a wind pressure of 15 pounds per square foot on the exposed surface of the building from the third floor to the roof.

A fifty per cent increase in the ordinary unit stresses was allowed when considering wind loads combined with dead and live loads. It was thus possible to design the structural frame for dead and live load stresses only and then investigate its capacity for resisting wind loads.

Figure No. 14.—Progress of Steel Erection February 9th, 1927.

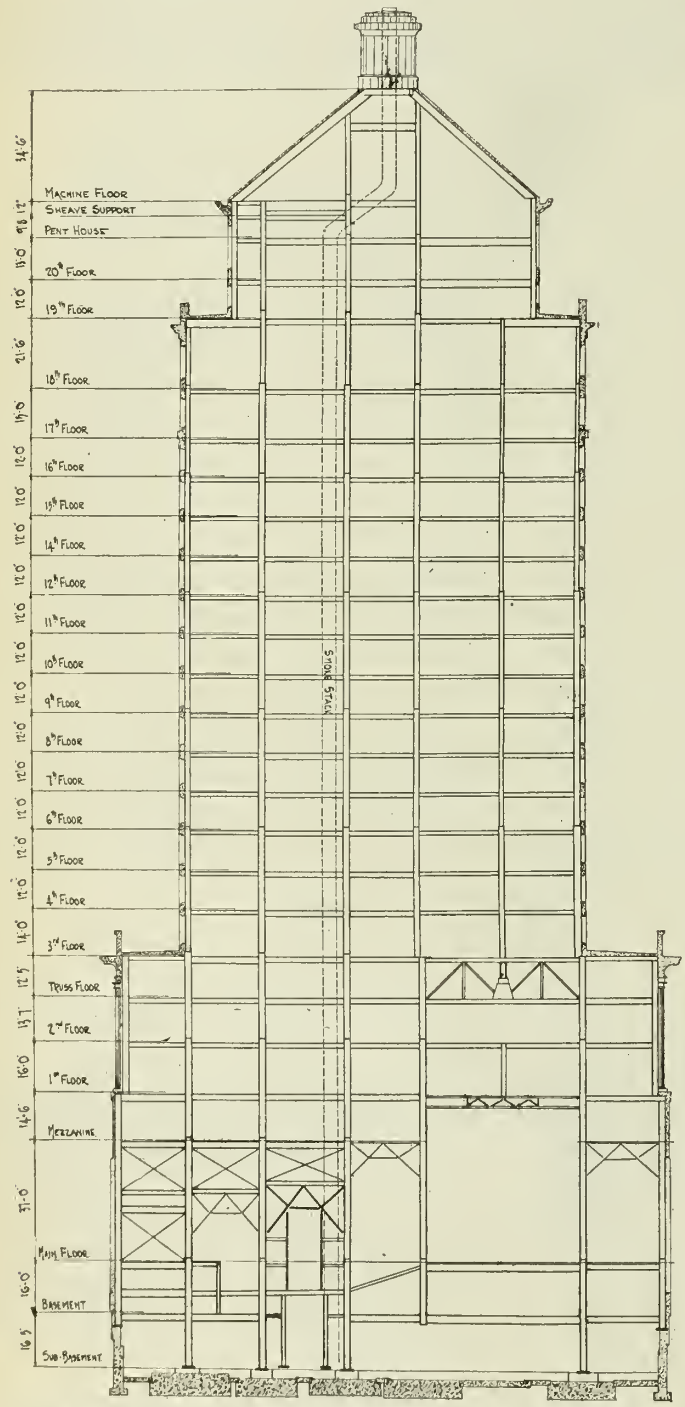


Figure No. 13.—Cross-Section of Completed Building.

Typical wind connections are shown in figures Nos. 10 and 11. The T-type of connection, shown in figure No. 10, was principally used on beams connecting to the flanges of rolled columns, also on beams connecting to both flanges and webs of built-up columns. This type of connection has the advantage of being able to develop a large moment of resistance at the ends of a beam and is easily concealed in the fireproofing of the columns or beams.

For beams framing into the webs of columns with webs up to one inch thick, a T-type of connection would generally overstress the web, therefore, in such cases a U-type of connection, shown on figure No. 11, was used. The advantages of this connection are apparent in that the stress is transferred directly to the flange of the column, thus obviating any necessity for reinforcing the web.

As a general rule, owing to the amount of space occupied by the tees on the flanges, it was impossible to get an adequate web connection capable of resisting the end shear of the beams, and it was, therefore, necessary to place stiffeners under the lower tee in order to transfer the load from the beam to the column. The amount of projection of these stiffeners beyond the flange of the column was limited by architectural requirements, thus confining the actual bearing to a very short distance, so that in certain cases it was necessary to reinforce the web of the beams to take care of excessive web crippling stresses.

The tees used for these connections were cut from 24-inch at 84.5-pound and 18-inch 64.5 pound Bethlehem I's, the U-type connection being made from a ¾-inch plate bent to shape in a die while hot.

As a general rule, the connections were shop riveted to the columns, and, to allow for over-run in the beams, the tees were kept apart ⅜ inch more than the depth of the beam.

A system of portal and X bracing was introduced immediately below the mezzanine floor, the portals being concealed by the stone arches forming the architectural treatment for the ceiling of the main floor. A typical detail of a portal at this point is shown on figure No. 12. This figure also shows the method of supporting the face stones of the arches by means of bent angles suspended from the structural frame above.

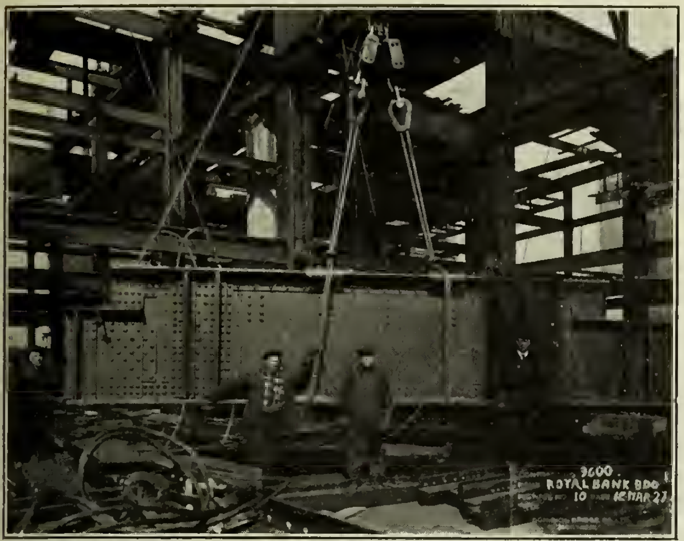


Figure No. 15.—Progress of Steel Erection, March 12th, 1927.

The following assumptions were made for the purpose of investigating wind stresses:—

(1) That the floor slab would distribute the horizontal shear to all the columns passing through that floor.

(2) That the wind shear at any storey would be resisted by all the columns in that particular storey, and that the amount of shear resisted by any one column would be governed by the shear that could be transmitted by either,—

  (a) The column.

  (b) The beams connecting to that column in any one direction.

  (c) The connection of these beams to the column.

(3) Points of contraflexure were assumed at mid-storey heights for columns.

(4) Intersection points of beams and columns were assumed as fixed.

The actual method used in designing wind connections was to apply a certain type of connection to any one floor,

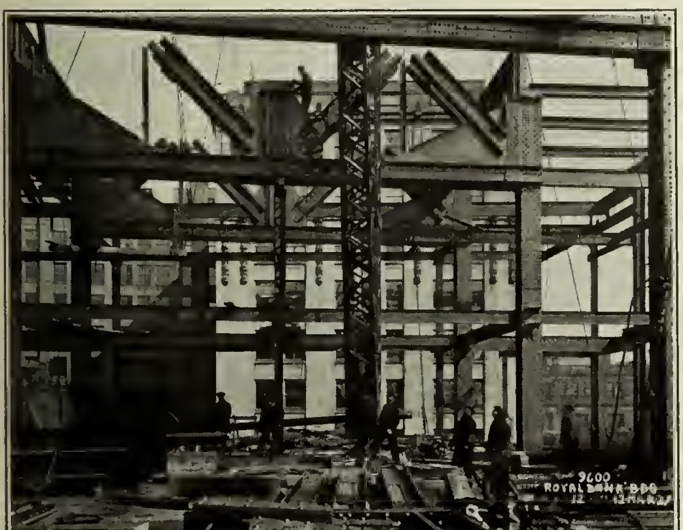


Figure No. 16.—Progress of Steel Erection, March 12th, 1927.

this type being used on all beams, regardless of their size. The use of a minimum number of different types of connections on any one floor greatly facilitated the detailing of beams and columns.

Each column was then investigated in accordance with the foregoing assumptions in order to find how much wind shear it was capable of resisting. The shears thus found were summed up for all the columns at that floor and equated to the actual wind shear required to be resisted.

Fireproofing

Concrete, terra cotta, aerocrete and brick were used as fireproofing for the structural steel. The use of these materials gave a total weight for the building lighter than any other fireproof construction possible.

The floor beams, chords of trusses and top flanges of girders are haunched with 2 inches of concrete, the remainder of the girders and webs of trusses being fireproofed with terra cotta.

Figure No. 17.—Progress of Steel Erection, March 12th, 1927.

For all the exterior wall columns a 4-inch brick covering is used, and for the interior columns the fireproofing is aerocrete and terra cotta.

Tanks, etc.

House tanks of 10,000 gallons and 7,500 gallons capacity are located at the penthouse and eleventh floor respectively. There is also a balance tank of 1,000 gallons capacity on the truss floor and a suction tank of 10,000 gallons capacity in the sub-basement.

It may be mentioned here that the tanks are rectangular in shape and entirely of welded construction, the various pieces being welded together at the site, using the latest type of portable welder.

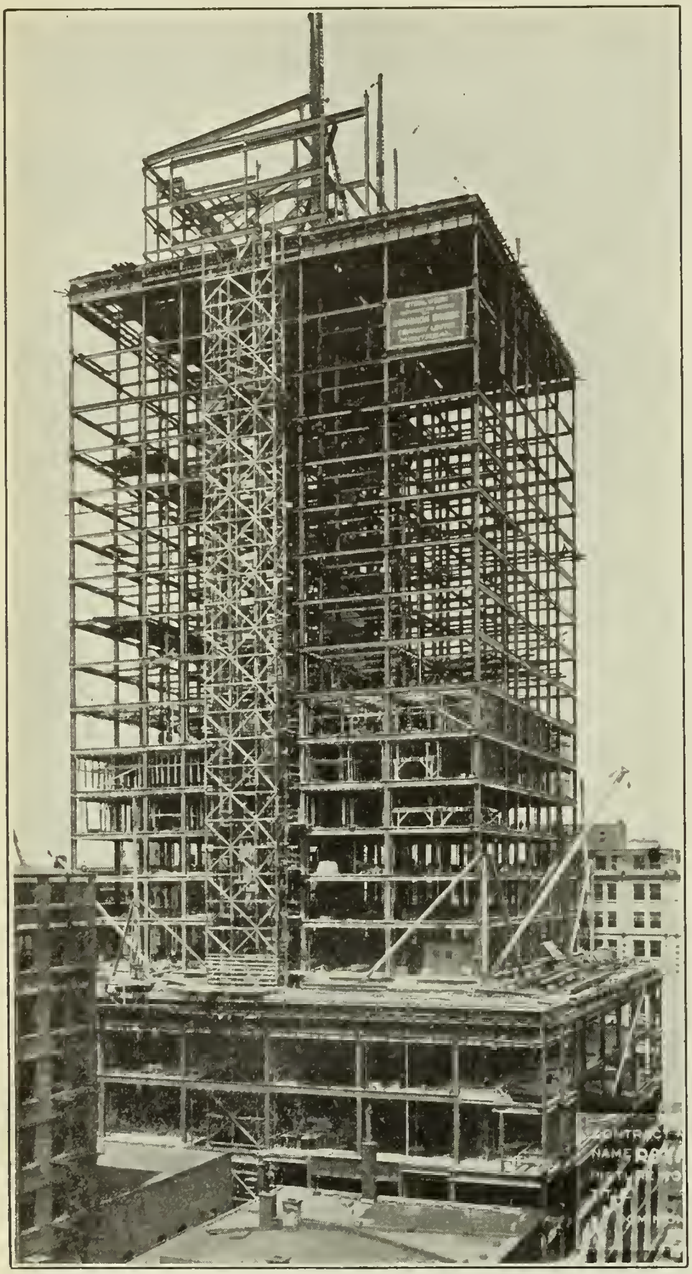


Figure No. 18.—Progress of Steel Erection, May 26th, 1927.

The position of the shaft for the 52-inch diameter smoke stack is indicated on the third floor plan, figure No. 6. This stack continues in this position from the basement to the penthouse floor, at which point it offsets to the centre of the building, as indicated on the section, figure No. 13.

The stack is supported every second floor, ⅜-inch plate being used for the lower portion up to the mezzanine floor, also for the top twenty feet, the remainder of the stack being 5/16 inch thick.

The stack was erected concurrently with the rest of the steelwork and was used by various contractors as an outlet for smoke from their hoisting engines.

A three-ton underhung travelling hand crane is provided in the penthouse for lifting the elevator machines.

Transportation of Materials

All of the steelwork for this building was transported by trucks from the shops of the Dominion Bridge Company at Lachine to the site, a distance of eight miles. Six 5-ton trucks with trailers were used for this purpose, the maximum tonnage transported in one day being 300 tons.

The unloading of the material for this building from two of Montreal's busiest downtown thoroughfares did not in any way interfere with ordinary traffic.

Erection

Two 20-ton guy derricks, each with a 95-foot mast and an 80-foot boom, and two 12-ton derricks, each with a 90-foot mast and an 80-foot boom, were used for the erection of the steelwork up to the first set-back. From this point up to the nineteenth floor the two 12-ton guy derricks were used, while for the portion above the nineteenth floor only one 12-ton derrick was required.

All the material for the portion above the third floor was unloaded and hoisted to that floor by two 12-ton stiff leg derricks, located one on the St. James street side and one on the Notre Dame street side of the building.

The floors immediately above the riveting gangs were completely planked over, and it is a significant fact that the 6,000 tons of steel work in this building were erected without any fatal accident.

Erection of the steelwork was started on January 15th, 1927, and completed by June 13th, 1927. The fact that the building was erected in the winter did not in any way delay the progress of the work.

The progress of the erection is indicated in figures Nos. 14, 15, 16, 17 and 18. Figure No. 14 shows the steelwork immediately above the main floor, with some of the portal and X-bracing in place. Figures Nos. 15, 16 and 17 show some of the trusses and girders in place; the shoring necessary for supporting the bottom chord of the trusses can be seen in the centre of figure No. 16.

Figure No. 18 shows the erection of steelwork nearing completion. On this picture can be seen one of the four main hip rafters supporting the roof. These rafters were 64 feet long and were made of 30-inch 190-pound Bethlehem girder beams with two 12 by ⅜ inch cover plates.

Architects and Engineers

The architects for this building were Messrs. York and Sawyer, of New York, and Mr. S. G. Davenport, of Montreal, consulting architect.

Consulting engineers for the foundations were Messrs. Moran, Maurice and Proctor, of New York. Messrs. Purdy and Henderson, consulting engineers, were responsible for the design of the concrete floors and co-operated with the Dominion Bridge Company, who were responsible for the design of the steelwork.

The thanks of the author are due to the following gentlemen: Mr. J. R. Colean, of Messrs. York and Sawyer; Mr. H. V. Spurr, of Messrs. Purdy and Henderson, and Mr. O. A. Barwick, of the Royal Bank staff, who gave material assistance in supplying data for this paper.

The Foundations for the New Building of the Royal Bank of Canada, Montreal

General Discussion of the Features of Design and the Methods Adopted for the Foundations of this Building

C. S. Proctor,
Consulting Engineer, New York City.

Paper to be presented at the Annual General Professional Meeting of The Engineering Institute of Canada, at Montreal, Que., February 15th, 1928

The monumental character of the new Royal Bank of Canada Building at Montreal, now rapidly nearing completion, makes it appropriate at this time that it should be a topic of general interest. This building, by its size and importance, is a fitting memorial to the progress and advancement of the banking industry and the architectural profession. The architectural treatment of such a building, including elaborate stone façades and interior ornamentation, must be protected from cracks or settlements which would detract from its beauty. This protection of necessity draws our attention to the material upon which the building is founded.

Early investigations to determine the character of the subsoil were carried on by means of dry sample core borings taken at various points on the lot, and also by a centrally located test pit. The data resulting from these experiments developed the fact that bed rock, located approximately 80 feet below St. James street, is overlaid with alluvial deposits of sand, varying from fine to coarse, together with sand and gravel admixtures including varying proportions of clay and boulders. Ground water was encountered at approximately 25 feet below St. James street in the open test pit, and this level remained practically constant during the period of observation. In order to ascertain the flow of water through the materials of the site, it was decided to install pumps in the test pit and observe the lowering of the water level at this point. The use of 6-inch tandem pulsometers day and night demonstrated that the supply of water to the site was of such quantity that it would be impossible to lower the water sufficiently to reach bed rock in the open.

Choice of Type of Substructure Design

With the wide choice of suitable methods for foundation work, economics played a large part in the final decision as to the best type of substructure design. If only from a standpoint of insurance, a natural first choice for a structure of this character would be a foundation upon rock, provided that it could be obtained at a reasonable cost over other types. To reach bed rock in the open was impossible because of the presence of large quantities of water.

Since any deep excavation could be made only by the use of compressed air, a study which provided for a pneumatic caisson cofferdam around the entire plot with cellars carried to rock level, was made. This design was discarded for economic reasons, since the space thus provided was not commensurate with the cost. The cost of independent pneumatic piers to rock was proportionately high.

The next consideration was a study using simple spread footings, not extending materially below ground water level, and this appeared to provide a very economic and adequate foundation, provided certain weaknesses, which will be discussed later, could be overcome.

The next step in the investigation was a study based upon the use of piles, but the character of the subsoil materials precluded the use of any type of pile except piles driven by the use of a jet. This was highly undesirable, due to probable disturbance of adjacent building foundations as a result of the agitation of sand particles which would permit readjustments of position with a resultant settlement.

The use of bearing piles driven to bed rock could not be considered, owing to the presence of the extensive boulder deposits, clearly indicated by the borings and the test pit, which would have made it impossible to reach bed rock support with any type of bearing pile. It was further developed in the course of studies that any type of friction pile would offer no greater resistance against differential settlement between adjacent columns than would spread footings, and would be considerably more expensive.

The result of these investigations indicated that only two general types of foundations could be properly considered; namely, the pneumatic pier to rock, or the spread foundation; the latter of which was by far the most economical. If a way could be found to insure its stability on all occasions, it was the reasonable choice.

Foundation Materials

For the purpose of arbitrary classification, foundation materials may be divided into two classes: non-yielding materials and yielding materials. In general, the usual characteristic of the non-yielding material is that it has sufficient internal strength so it will not move laterally under a vertical load within the limits of its strength. Generally speaking, the vertical contraction under load, in non-yielding materials, is extremely small. On the other hand, yielding materials do not possess these properties, though most of them possess an internal resistance, against lateral movement, which, however, is small in comparison with that developed in the solid or non-yielding material. Nearly all of our foundation materials lie between the two widely separated extremes of the solid and the fluid.

In granular materials there is necessarily a certain amount of void space between the various particles. The size of the particles, their grading, and their shapes afford a rather crude means of classification of such materials. In nature the larger sizes are represented by boulders or broken stone, depending upon their shape, and as the size becomes smaller we have coarse gravel, coarse sand, fine sand, silt, clay, and other fine materials. These appear either separately or in combination; either dry or water-bearing, and sometimes with varying admixtures of vegetable matter or humus.

From experiments we may draw the following conclusions:—Settlement in granular material is brought about either by lack of lateral support or by consolidation. Also that consolidation may be brought about in a material of high void content by loading, by vibration, and by readjustment of position due to flowing water. Another conclusion which may be drawn is that granular material such as sand and gravel deposited under water usually has a rather low void content as compared with the dry, loose material such as exists in sand dunes and the like. It is well to note that we have been dealing purely with the larger grained material of fairly regular shape and have not touched upon the properties of fine materials of small, irregular shaped particles usually encountered in the clays, since at this particular site such material only existed in very small quantities and its presence could have but small influence on the problem at hand.

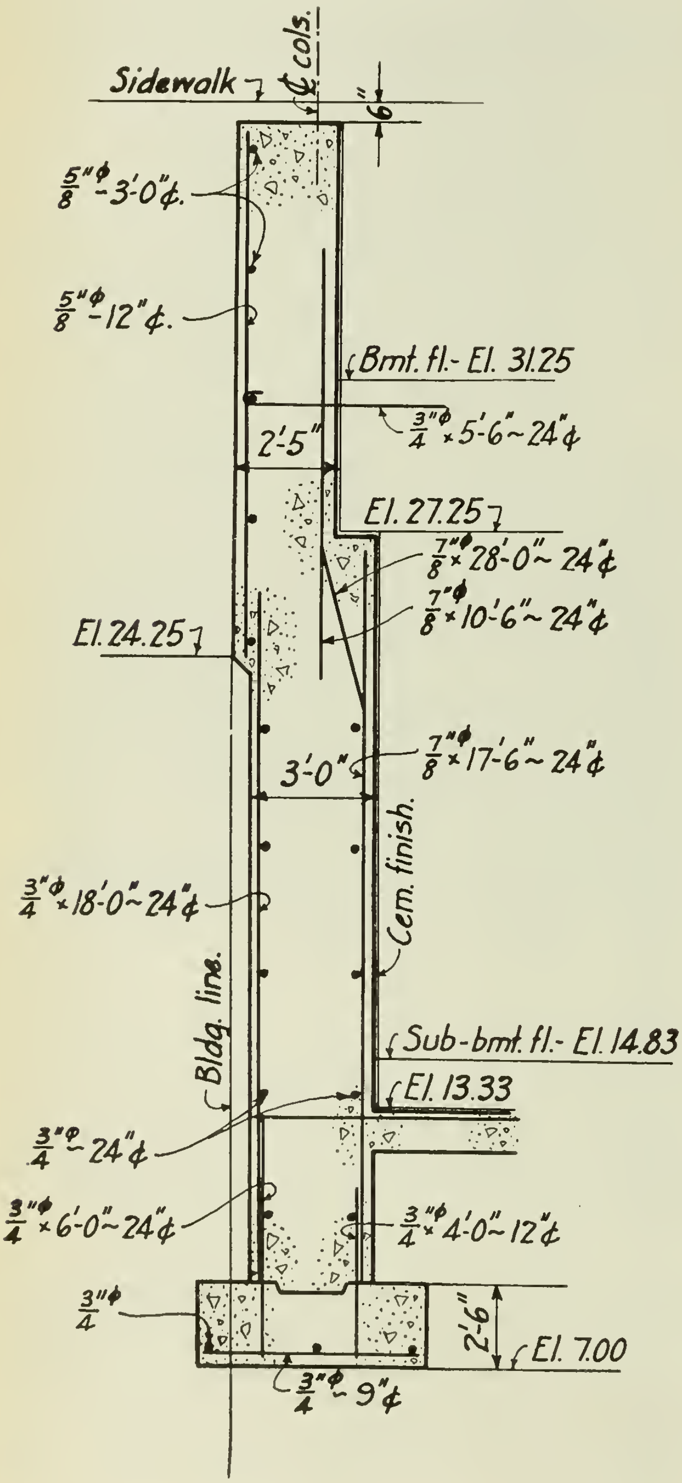


Figure No. 1.—Typical Wall Section in Sub-basement.

TYPES OF FOUNDATION SETTLEMENT IN YIELDING MATERIAL

In the yielding type of foundation material we may divide settlements into three classes, uniform, rotational and local. In order to discuss the various types, let us consider a building foundation in the form of a mat, resting upon what we may term a foundation plane. In the uniform type of settlement the foundation plane is subjected to a uniform subsidence. This type is not harmful to the superstructure, since there is no difference of settlement present, and if the settlement is comparatively small no harm will result to the structure or annoyance to its occupants.

The rotational type of settlement is usually a result of one of three causes. First; If the foundation bed overlying solid material is uniform in thickness but the centre of gravity of the applied loading does not coincide with the centre of gravity of the foundation mat, a high pressure will naturally result upon one side, causing a subsidence in that locality. Second; if the foundation bed lies upon an inclined rock surface it is quite natural that it, at that point where the foundation plane is nearest to the rock, will have the minimum settlement, while at that point where the rock is further removed from the foundation plane the greatest settlement will naturally occur. Third; the same effect is produced if the material under one portion of the foundation has been disturbed by neighbouring deeper excavation or pumping operations, of if the material is of different supporting value under different parts of the foundations.

The third type, local settlement, is perhaps the most disturbing of all forms, and may be due to numerous causes. Local settlements can take place in granular materials even where the foundation bed is of uniform character throughout; that is, the foundation bed may be overloaded, resulting in a consolidation or a lateral movement of the materials. But, unfortunately, we are very ap to encounter so-called spotty conditions, such as small quicksand pockets or pockets of peat, which are purely local and which may have large void contents usually occupied by water, which under compression is rapidly squeezed out, allowing settlement to take place. In the case of isolated spread footings this will cause a difference in settlement between two adjacent footings. Excavation below the level of a spread foundation destroys the lateral support and allows the material to flow into the open excavation. This usually results in a tipping or tilting of the particular footing, which condition is frequently aggravated by water flowing through the subsoil and carrying with it additional material into the open exacavation. It is this local type of settlement, generally speaking, which gives us the greatest difficulty, because of the so-called difference in settlement or variation from the general foundation plane. To eleminate absolutely settlement on a yielding material is practically impossible, so that the best we can hope to do is to minimize and otherwise control the extent and action of such a settlement.

To limit uniform settlement successfully is purely a question of limiting the amount of load which can be placed upon the soil. Numerous tables and building codes indicate certain allowable pressures based upon local experience which show a general agreement for the various classifications, although there are extreme examples as in New Orleans, where the local building code limits the maximum load to 1,400 pounds per square foot. In this case the entire city is located on an alluvial delta formation which consists of a clay with a high water filled void content.

In the case of the rotational type of settlement, the foundation engineer must always know the position of the rock with reference to the horizontal, and must take special precautions where this is inclined, so that settlement of a rotating nature does not occur. If the rock surface, however, is at a considerable depth from the foundation mat, in comparison with the maximum length of the building, the importance of the angle of the rock to the horizontal becomes of lesser magnitude, due to the distribution of the foundation loads through the foundation material as the depth increases; hence the possibility of rotational action taking place grows more remote. On the other hand, if the foundation material has a very high degree of compressibility, the greater becomes the importance of the location of the centre of gravity with reference to the applied load, and it is therefore necessary to co-operate with the architects in securing a building with its centre of gravity located as nearly as possible at the centre of the foundation area.

In order to prevent localized settlement, the first consideration of the engineer is to see that the load on individual footings is such as to produce uniform settlement. It is therefore necessary to proportion the individual footings so that the pressure under individual footings shall be correct under average loading conditions. In so proportioning the area of footings, small differences in settlement actually take place during construction, but the action of the foundation material is subject to the time effect which has the beneficial result of diminishing these, so that when our completed structure is occupied the settlement is virtually uniform throughout the footings. It is quite essential, however, that no footing when subjected to the total of dead and design live load has a pressure in excess of the allowable value for the particular material. Proper proportioning of footings as outlined usually will prevent the tendency to "hogging" or "sagging," the first being the result of heavy exterior wall construction, while the latter is more common in buildings with heavy central towers, such as are commonly seen in the so-called "set-back" type of building. It is to be noted that hogging or sagging are not in themselves very serious defects, since the differences between adjacent columns are usually small, but the undesirable effects are principally experienced in the exterior walls of the buildings, where they show in the form of cracks. In the interior of any building which is of highly ornamental character, partition walls may crack with objectionable results. A purely local settlement is generally the result of the loss of bearing under some portion of an individual footing. To make up for this difference it is frequently desirable to place two columns upon one footing, so that this loss may be equalized, and also to prevent rotation of the individual footing. A further advantage, secured by having a tie between individual footings, is that a loss of material is generally accompanied by a lateral movement, hence by restraining the footing from lateral movement a great deal of the vertical settlement is prevented.

Governing Features of the Design

In the design of the spread type of foundation for the Royal Bank of Canada, in order to control the magnitude of uniform settlement, it was decided that a soil pressure of 4 tons per square foot, exclusive of the footing weight, should be allowed. Footings were then carefully proportioned on the basis of the actual dead load plus a probable actual live load of 20 pounds per square foot of floor area. The question of rotational settlement did not require special treatment, due to the great depth at which rock was encountered and its generally horizontal plane. In order to provide against severe local settlement and tilting action, the footings for the interior columns were designed to support no less than two columns, while in one place six columns rested on the same footing. The exterior columns rested upon a heavy foundation wall designed to distribute the load under either hogging or sagging action, and this wall was placed upon a single continuous footing. The basement floor slab was thickened and strengthened above normal requirements, and designed as a stiffening and tying diaphragm to act with the footings so as to approximate the effect of a continuous mat over the entire area. Each footing and the entire outside wall footing had its steel reinforcement extended out into the basement floor slab, so that additional bearing area might be developed; so that any tendency towards lateral movement in any footing or footings would be restrained; and so as to compensate for any loss of bearing area or local reduction of soil bearing value resulting from soil disturbance caused by pumping operations, either those necessary for the installation of these foundations, or those involved in adjoining future deep cellar excavations.

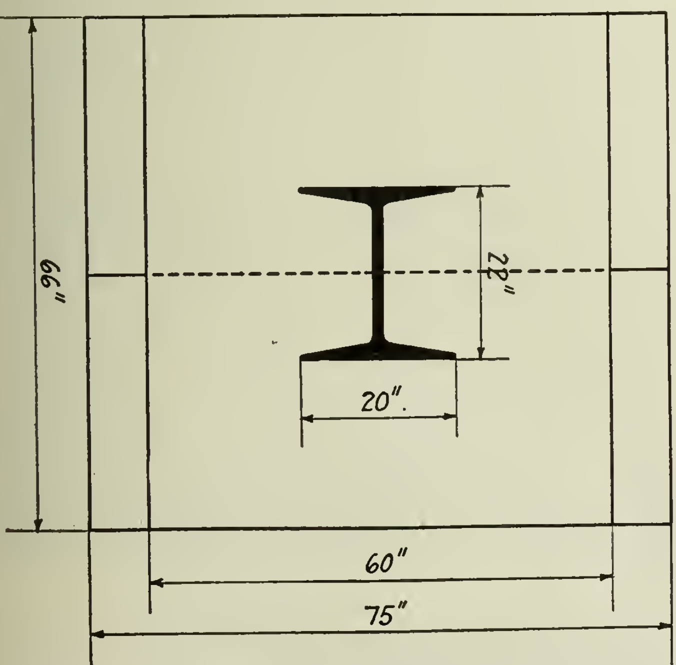
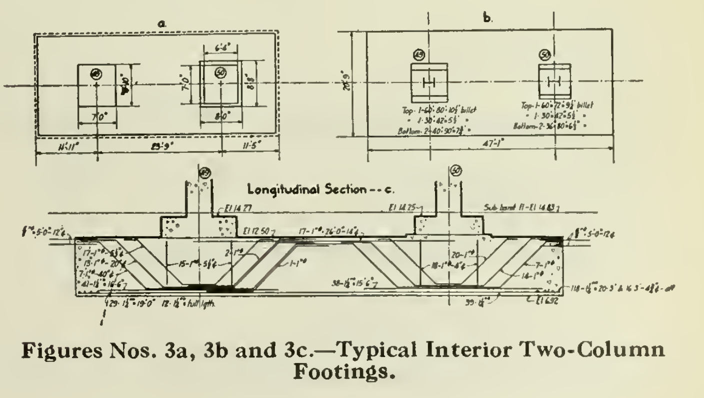
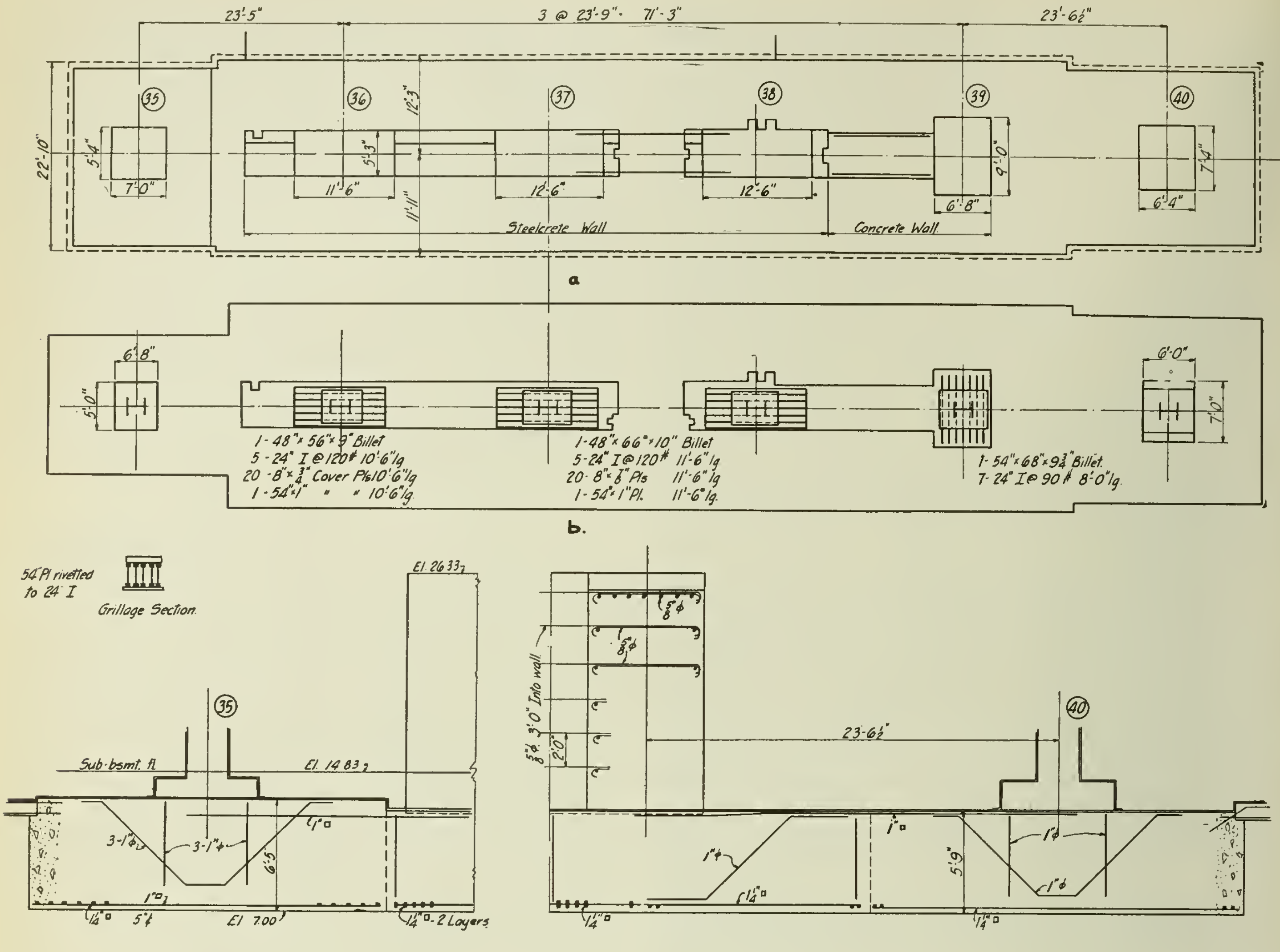
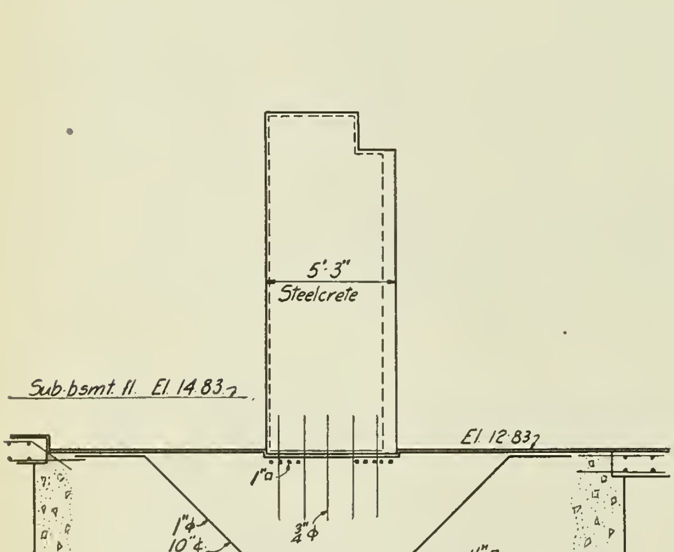


Figure No. 2.—Arrangement of Billet Supports for Column.



Figures Nos. 3a, 3b and 3c.—Typical Interior Two-Column Footings.





Figures Nos. 4a, 4b, 4c and 4d.—Special Design for Support of Six Columns on One Footing.

Design to Provide Maximum Cellar Space

It was desirable that the foundation design should provide the maximum of cellar space, and at the same time it was essential that the maximum depth of excavation below normal ground water level should be such that the unwatering processes would not cause the disturbance and loosening of soil materials which would result from "boiling" or the upward flow of water. This consideration limited the depth of underside of foundations, so that it was felt that with the use of sump filter beds to prevent the flow of fine materials and by careful pumping operations, the ground water level could be lowered without subsoil disturbance, but the design provided insurance against unavoidable soil disturbances which might develop locally regardless of the care in pumping operations, or from an accident to the pumping equipment. It is therefore believed that this design will insure against local settlement, and if a tendency to local settlement or tilting should occur, the loads will be thoroughly distributed throughout the general foundation system. Any other type of settlement which might develop must be of essentially uniform nature within controllable limits.

The requirement for maximum cellar space, combined with the difficulty of lowering the water level at the site, led to several novel developments. Steel billets or slabs were used to distribute the load of interior columns, but the mills

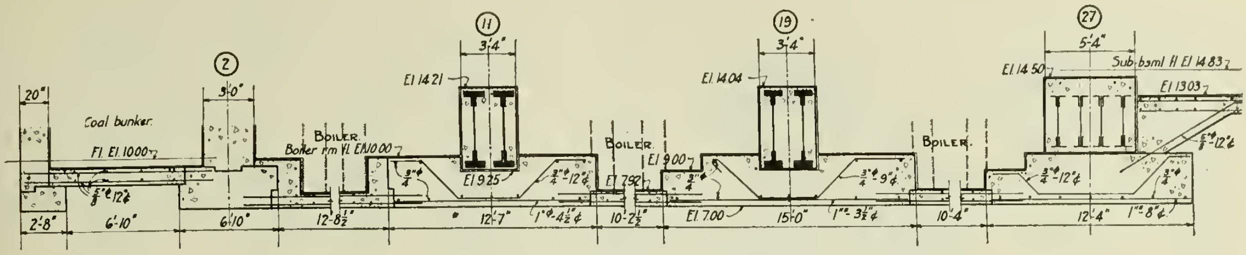


Figure No. 5.—Section showing Foundation in Boiler Room.

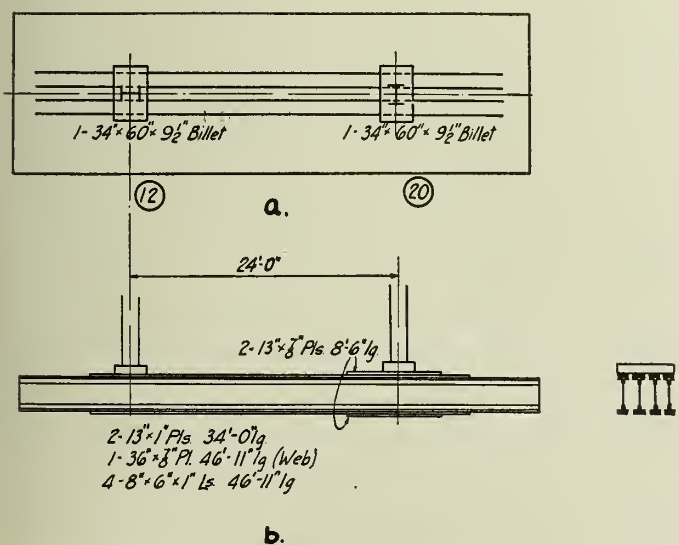
supplying these could do so only within certain size limitations. To overcome this handicap, a thick narrow billet was used to distribute the load upon two wider and thinner slabs placed transversely to the first. This solution, while not as economical as the single large slab, proved quite satisfactory. In general, the column footings were entirely of reinforced concrete about 6 feet in thickness, and continuous under two columns. In the boiler room, where headroom and working space were at a premium, since nearly 5 feet of additional space were required, it was found desirable to use steel girders resting on thin concrete cantilever spread footings, and the girders were placed in the division walls where possible. At the boiler pits, in order to secure even greater clearance, the bottoms of the floor slabs for the boiler pits were placed at the same level as the footings, thus providing additional space for insulation and other protection under the ash pits. The steel girders supporting the columns adjacent to the boilers were run parallel to the boiler settings, so as to not interfere with equipment, pipes, and other necessary floor space requirements. At one place the proximity of an elevator to one of the columns caused considerable difficulty, until a design was evolved consisting of two cantilever spread footings placed on either side of the pit and composed of shallow I-beams, which in turn supported deep steel girders carrying the column; thus the necessary pit depth and clearance were maintained without a loss of bearing area or decrease in the pit requirements. At another point a question involving two elevator pits was more easily overcome, since the pits were so located that a combined footing could be placed between them by properly increasing the spread of this footing. The clearances were much larger in this instance, but the pits had a further requirement of greater depth in order to install oil bumpers. It was finally decided that this difficulty could be best overcome by driving short lengths of steel pipe of considerable size to a depth several feet below the plunger pit bottom. These pipes were then cleaned out and concreted to the elevation of the necessary pit bottom and left in readiness to receive the plunger casing. It is interesting to note that all these provisions were made within the narrow confines of approximately 8 feet from the finished basement floor to the underside of the foundation, and are intended to provide fully the inherent stability essential to the structure, and at the same time take the economic advantage of the use of spread footings.

Principal Features of the Design

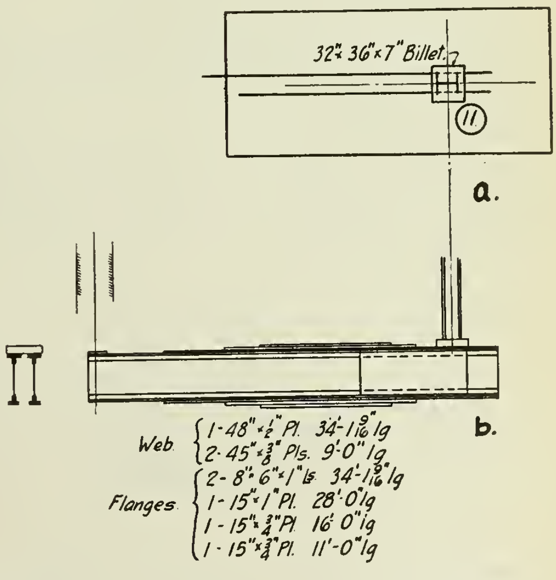
In order to illustrate the use of principles developed above a description of a few of the most interesting features of the design will be given.

The first problem, namely, that of determining the bearing areas and proportioning them so that the settlement of the structure should be uniform, was solved by means of the Moran method* of load distribution. This method is applied as follows: From the assumed total column loads, (dead plus live and wind), the mean loads, (dead plus 50 per cent of live and wind), are determined. The ratio of the mean load to the assumed total load is computed for each column and the lowest such ratio for any column is adopted as controlling the design. The mean unit load is then determined by multiplying the allowable unit bearing stress, (in this case 8,000 pounds per square foot), by the adopted ratio. The bearing area for each column is then found by

* See Kidder's Architects' and Builders' Handbook, 17th Edition, Page 152.



Figures Nos. 6a and 6b.—Footing in Boiler Room Supporting Two Columns.



Figures Nos. 7a and 7b.—Column on Cantilever in Boiler Room.

Col. No.	Assumed Loads			Mean Loads		Ratio = T. Mean Ld. / Ass. T. Ld.	Mean unit load = 8000×0.9167 = 7334	Area = T. Mean Ld. / 7334 Sq. ft.	Bearing Stress Lbs. per sq. ft.	Area = Ass. T. Ld. / 8000 Sq. ft.
	Dead	Live and Wind	Total	50% of L. & W. Lds.	Total Mean Ld.					
	K	K	K	K	K					
1	414.6	34.0	448.6	17.0	431.6	0.965		59.0	7603	56.1
10	654.4	89.4	743.8	44.7	699.1	0.941		95.4	7797	92.9
20	2455.0	291.3	2746.3	145.7	2600.6	0.946		355.0	7736	343.3
30	2954.4	451.6	3406.0	225.8	3180.2	0.933		434.5	7838	425.8
36	3344.2	667.8	4012.0	333.9	3678.1	*0.9167		*501.5	*8000	*501.5
37	3654.8	725.2	4380.0	362.6	4017.4	0.9172		548.5	7985	547.5
40	3134.4	414.7	3549.1	207.4	3341.7	0.942		456.0	7780	443.6
50	2993.0	508.0	3501.0	254.0	3247.0	0.926		443.5	7894	437.6
60	512.5	62.8	575.3	31.4	543.9	0.944		74.1	7764	71.9

dividing the mean load by the mean unit load. From an analysis of the tabulation following, it will be found that the bearing stress under the column whose ratio was used as controlling is the allowable unit stress and is higher than for any other column.

The following table gives the above described values for a few columns selected at random:

It is interesting to note the difference in the bearing areas as found by the common method of assumed total load divided by the allowable bearing stress and those found by the Moran method.

The exterior wall, (see figure No. 1), was so designed as to distribute the load to the footings uniformly. In order to accomplish this and also to give the maximum cellar volume, in addition to providing sufficient width so that the billets would not be excessively long and narrow, a 3-foot wall thickness was adopted. For architectural reasons all exterior column flanges were parallel with the walls. Due to the stiffness of the billet under the column section, the billet thickness was computed by the bending moment taken at a point one-quarter of the flange width from the column centre. The billets were placed approximately 4 feet below the basement floor level. The subgrade of the wall was approximately 20 feet below the billet bearing level, so that the wall could be assumed to distribute the column load to the footing uniformly. The footing widths were varied as required by the bearing areas.

After making a preliminary design of the billets for the interior columns, it was found that the steel fabricators could not supply billets of the required size and thickness. Therefore, it was necessary to adopt a double tier billet design; the lower tier of which was to be made up of two billets; the bearing between the two tiers to be milled so as to insure a uniform load distribution.

The billets were designed to have their long axis parallel with the transverse, or short, dimension of the concrete mats. The bearing areas of the billets on the concrete were established by trial.

The size and thickness of the top and bottom billets were determined with a view to using economical dimensions while keeping within such sizes as the steel fabricators could supply. The top billet was then designed for its controlling bending moment, which was taken either at the edge of the column flange or at one quarter of the flange width from the column centre. The long axes of the bottom billets were perpendicular to the long axis of the top billet. In determining the thickness of the bottom billets centre bending moments were used. While the difference in the deflections of the top billet is not to be neglected, the use of centre bending moments may be justified by the fact that the greater stiffness of the billets at the column section will tend to compensate for the section of the billet having a maximum deflection.

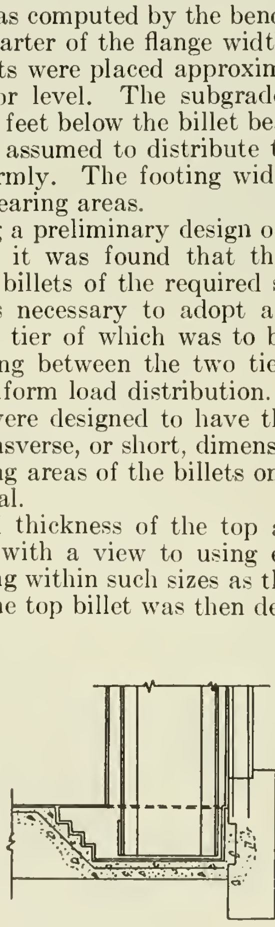


Figure No. 8.—Details of Pockets for Cantilever Girders.

As an example of this design, we will take as typical column No. 29, (see figure No. 2).

Column Load = 3,218,000 lbs.
Bearing area = 3,218,000 ÷ 650 = 4,940 sq. in. or 66 × 75 inches = 4,950 sq. in.

$$\text{Bottom billet:—}t=\sqrt{\frac{3{,}218{,}000\left(\frac{75-60}{4}\right)3}{66\times 18{,}000}} = 5\tfrac{1}{2}\text{ inches.}$$

$$\text{Top billet:—Bearing stress} = \frac{3{,}218{,}000}{60\times 66} = 812\text{ lbs. per sq. in.}$$

$$L = \frac{60-10}{2} = 25\text{ inches.}$$

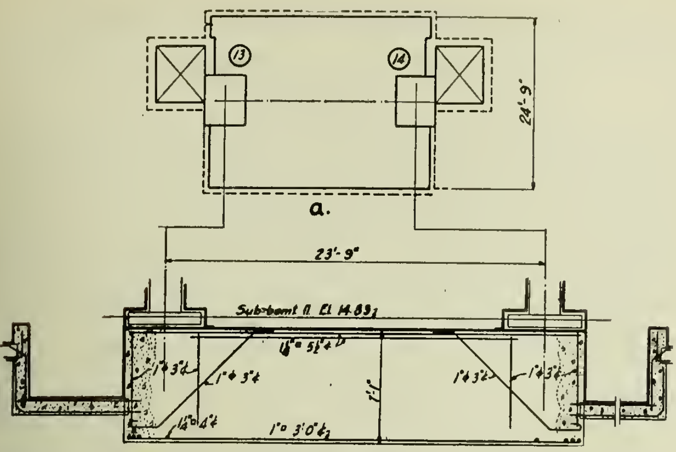
$$t = \sqrt{\frac{812\times 25^2\times 6}{18{,}000\times 2}} = 9\tfrac{1}{4}\text{ inches.}$$

Note:— 60 inches was the greatest width of billet that the fabricator could deliver.

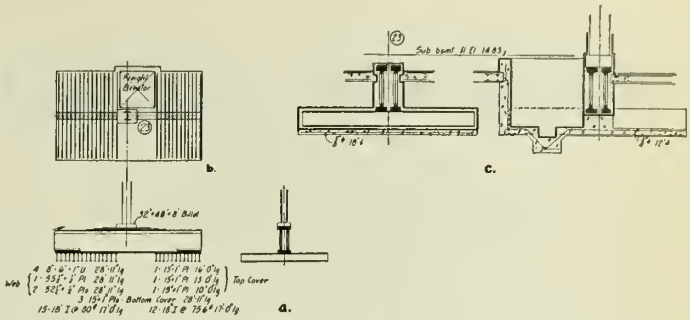
Billets to be used:—Top, one – 60 × 66 × 9¼ inches.
Bottom, two – 33 × 75 × 5½ inches.

The typical interior two-column footings were constructed of double tier billets and a heavy concrete slab, (see figures Nos. 3*a*, 3*b* and 3*c*).

The centre of gravity of the bearing area was made to coincide with the centre of gravity of the loads. In establishing the dimensions of the bearing area, not only had the necessary area, as computed by the Moran method, to be provided, but it was also necessary to consider the limitations of the available space as controlled by adjacent elevator pits, etc. The footing was then designed as a beam on two supports with overhanging ends. The effective width of the beam was assumed as equal to the billet width plus not more than twice the thickness of the footing, and the footing was reinforced longitudinally. In addition to this longitudinal reinforcement, the footing was also reinforced for punching shear, diagonal tension and centre transverse bending moments. As the depth between the sub-basement floor and the established maximum footing subgrade was one of the controlling features of the design, it was found that in many cases the required thickness could not be obtained to satisfy the punching shear requirement. Where this stress exceeded the usual allowable 120 pounds per square inch, as it did in many cases by 40 to 50 pounds per square inch, rods were placed at 45 degrees to the vertical to compensate for the excess punching shear. Diagonal



Figures Nos. 9a and 9b.—Concrete Slab and Billet Foundation at Elevator Pit.



Figures Nos. 10a, 10b and 10c.—Foundation with Elevator Pit showing Divided Bearing Area with Steel Mat Construction.

tension reinforcement was only used when the shear stress exceeded the allowable amount on the footing cross-section taken at the base of a 45 degree slope drawn from the edge of the billet.

In the special case where six columns were supported on one footing, (see figures Nos. 4*a*, 4*b*, 4*c* and 4*d*), the dimensions were established from the required bearing areas and centre of gravity of the loads. The four interior columns have grillages rather than billets and bear on a wall 5 feet 3 inches reinforced with "Steelcrete," so that this wall acts not only as one side of the security vault but also as a girder to distribute the load to the footing. The footing under the wall was designed as a cantilever, and at the doorway through the vault wall it was reinforced so as to act as a beam across this opening. The two columns in this row beyond the wall length were supported directly on the footing, which was designed in the same way as that outlined above for the typical footing, except that a beam was developed spanning from the isolated column to the vault wall.

Owing to the limitations of space in the boiler room, between the boilers and below the finished floor level, the footings there were constructed of concrete mats and steel girders, (see figure No. 5). The mats were designed as cantilevers and reinforced accordingly. In the case of a footing supporting two columns, the steel girders were designed as simply supported with overhanging ends, as was the case for columns Nos. 12, 20, 27 and 28, (see figures Nos. 6*a* and 6*b*). In the case of columns Nos. 11 and 19, between the boilers, the steel girders were designed as cantilevers, (see figures Nos. 5, 7*a* and 7*b*), which were to distribute the column load to the eccentrically placed bearing area. The reaction against uplift from these cantilevers was provided for by the walls and wall columns. Pockets were built in the wall to receive these girders, the upper faces of which consisted of steps having horizontal and vertical planes, (see figure No. 8). The cantilever girders had a bearing plate across the top flanges in order to distribute the load into the wall at the allowable unit bearing stress.

A rather unusual condition had to be provided for in the case of column No. 23, which was immediately adjacent to an elevator pit. It was impossible to combine this column with an adjacent column on one footing as its load was considerably greater than that of its neighbours and as the proximity of the elevator pit did not allow a sufficient area beyond the column centre to develop the economical bearing area. In the case of the footing under columns Nos. 13 and 14, (see figures Nos. 9*a* and 9*b*), the elevator pits were at a sufficient distance from the column centres, and their loads were practically the same, so that the concrete slab and billet type of footing could be adopted.

The finished pit floor level of the elevator next to column No. 23 was 9 inches above the maximum allowable footing subgrade. Obviously, with only 9 inches of depth adjacent to the column, the bearing area had to be developed beyond the pit limits, and this necessitated the division of the bearing area. These areas were proportional to the loads they were to receive. The load was brought on to these bearing areas by two narrow and deep girders, (see figure No. 10*a*), which again were rendered necessary by the clearance requirements of the elevator. The remaining depth from the bottom of the girders to the established subgrade was insufficient to provide for a concrete slab

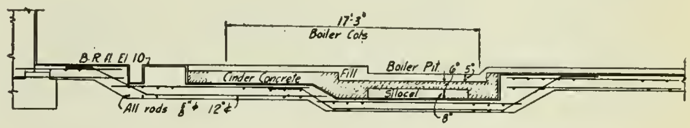


Figure No. 11.—Method of Insulation under Boilers.

capable of transferring the load from the girder to the bearing area. Steel mats of 18-inch I-beams were therefore used, distributing the load to a thin reinforced concrete mat. The construction employed is illustrated in figures Nos. 10*a*, 10*b* and 10*c*.

Figure No. 11 shows the method used to insulate and protect the cement waterproofing and concrete slab against the excessive temperatures under the boilers.

All walls and footings, as will be noted in the various illustrations, irrespective of their types, were tied together with a 12-inch floor slab, which had continuous top and bottom reinforcement between the footings and walls. The purpose of this heavy slab was three-fold, first, to resist the tendency of a possible pull; secondly, to support the floor loads between the footing should the fill tend to settle; and thirdly, to resist the uplift resulting from ground water head.

The foregoing gives a general idea of the basis of the design, and some of the problems which presented themselves in the course of the development of the means required for the safe and economical support of the building.

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Annual General and General Professional Meeting

WINDSOR HOTEL, MONTREAL, QUE.

February 14th, 15th and 16th, 1928

Details of the programme appeared on page 40 of the January issue of The Journal. Complete programmes, with a return post card to be used in making reservations, and a card explaining the arrangements regarding reduced railway rates, have been mailed to all members of The Institute. Members are urged to make their reservations as early as possible, using the special card for this purpose.

A special Committee under the convenership of Mrs. F. P. Shearwood has made extensive plans for the entertainment of the ladies attending the meeting and visiting ladies are assured of a warm welcome and an enjoyable sojourn in Montreal.

The St. Lawrence Waterway Project*

Notes on the Appendices to the Report of the Joint Board of Engineers

The text of the main report of the Joint Board was made public several months ago, and in The Engineering Journal for March, 1927, there appeared an editorial commenting on the conclusions reached. Since that date engineers have looked forward to the publication of the complete report with the promised appendices containing the technical data on which the main report is based. The completed document was issued recently, and the extent of the investigations of the Board can now be realized even more fully than was possible when the main report was published. The main report covers fifty-five pages, and the seven appendices, bound with it, cover 400 pages, including many plates in explanation of the text. In addition there is a separate folder containing eighty-eight plates referring to the appendices. Obviously such a work cannot be reviewed in a short article, but the following outline of its contents has been prepared so that our members may form some idea of the nature of the information published. It is doubtful whether there has ever been issued in connection with a project of national importance, such an amount of technical data. In its completeness and manner of presentation the report indicates the thoroughness of the inquiry. Members of the engineering profession will find in the report and appendices the detailed history of the St. Lawrence river, a record of work done in the past few years, a complete exposition of the views of the Board as to the power and navigational possibilities of this great waterway, and estimates of the cost of the works contemplated.

In the covering letter issued with the appendices, the Board points out that alternatives are presented to the schemes described in the main report, and invites attention to the Crysler-island two-stage project as presented by the Canadian Section for the International Rapids Section of the river. (Appendix C.)

The following is a brief account of the contents of the various appendices:

APPENDIX A—FIELD INVESTIGATIONS—PP. 57 TO 72

This appendix outlines the work undertaken by the Canadian and United States Sections of the Board, which included (a) boring operations and surveys, (b) preparation of stage relation diagrams for the St. Lawrence, above and below Montreal; study of the effect of outlet changes at critical points in the Great Lakes system; lake regulation, (c) layout of power houses, equipment data, etc., (d) plans and estimates for bridges, (e) methods employed in compilation of data and preparation of designs and estimates.

The personnel of the staff is enumerated. A synopsis of the results of the boring tests made to determine the nature of foundations at the proposed power-house sites forms the greater part of the appendix, and brief reference is made to the surveys, valuations and properties affected, investigation of ice jams and packs, experiments on strength of ice, discharge measurements, etc.—subjects providing material for the various other Appendices.

APPENDIX B—LAKE LEVELS AND OUTFLOWS—PP. 73 TO 238

This appendix presents the data on which are based the conclusions in Part II of the main report, relating to the Great Lakes. It discusses, (a) the extent to which levels of the Great Lakes are affected by diversion of water, (b) feasible measures for raising levels to correct the effects

*By Prof. E. Brown, M.E.I.C.

of authorized diversions, and reduce the cost of improving lake channels, (c) the extent to which the outflows can be improved by manipulation of lake levels, (d) cost of deepening the channels through and between the lakes.

After giving a description of the Great Lakes area, storage capacity, supply, annual fluctuation of levels, extreme ranges of monthly mean lake levels, etc., there follows a discussion of diversions and outlets as affecting levels; improvement of levels and outflows; supplies to the lakes; permissible high levels; programme of regulation to secure maximum benefit to levels; compensating works; effect of control of lake levels on cost of inter-lake channels, and the vitally important question of the regulation of lake Ontario. The general discussion outlined covers forty-nine pages, in which are given the formulae used for outflows, backwaters, etc. About ninety-four pages of tabulated data on supply and regulation, and twenty-two plates giving hydrographic data for the river and lakes, form the balance of the appendix. The effect of the programme of regulation is summarized as follows:—Proper regulation would maintain the flow during the summer and fall months sufficiently to preserve completely the low water levels of Montreal Harbour resulting from the unregulated flow. The regulated flows during the first half of April would not exceed in amount or frequency the unregulated flow. The maximum regulated flow for May would not exceed that which has occurred in nature. The conclusion reached is that " the regulation of lake Ontario in such manner as to injure no interest, and at the same time to effect some improvement of lake levels and outflow, is therefore wholly practicable."

Appendix C—Detailed Plans and Estimates for the Improvement of the St. Lawrence—pp. 239 to 392a

This appendix deals in detail with the various schemes considered by the Board, and defines at the outset a scale of unit costs used for estimating purposes. The general character of the various sections of the river is outlined, along with the standards adopted for navigation channels, bridges and locks. The questions of power house design and of power units, which would be of larger dimensions than have yet been built, involved extended study, and from tentative designs, based on current practice, quantity curves were prepared. Power house equipment estimates were based on direct quotations and actual cost of recent developments. All the above general data with standard designs for dykes are given in plates. The various sections of the river are then considered in detail. Thus in the International Section, mile 67-115, the report covers, (a) description of section, (b) present navigation conditions and power developments, (c) plans for improvement, including,—

(1) Full single-stage schemes with the Long Sault reach at maximum level and a free navigation channel at Galops rapids.

(2) Two-stage schemes with upper dam and powerhouses either at Ogden island or Crysler island, and lower dam and power house at Barnhart island.

(3) Partial single-stage schemes with lock and control dam at Galops rapids, and the Long Sault reach held at nearly maximum level with a long free spillway.

Various methods of dealing with these alternative projects are separately considered and illustrated by river charts and drawings, and navigation improvements are discussed. The necessary works in the Soulanges and lake St. Francis Sections of the river are described, and the Lachine Section is dealt with in the same complete manner as the International Section. Considerable space is devoted to economic considerations, different rates of absorption of power being assumed in estimating the overall costs of the various projects. Approximately one hundred and ten pages are devoted to tabulated estimates of cost of the projects outlined, details quantities and unit prices being given in all cases. Thus for the dam and power house at Barnhart island the cost estimates are under the following general headings, (a) dam, except unwatering, (b) power house substructures, (c) unwatering and power house, (d) abutments to power house, (e) trailrace excavation, (f) rail connections to power house, (g) superstructure and machinery.

As showing the nature of information contained in the plates referring to this appendix, the following may be selected:—

Relation between quantity of concrete in power houses and height from draft tube floor to coping.
Relation between cost of generators, turbines, exciters and governors.
Relation between head and cost of turbines and governors.
Relation between head, cubic feet per second unit, and throat diameter.
Relation between head, speed, and throat diameter.
River charts showing location of proposed works.
Results of backwater calculations.

Each project is similarly dealt with in detail, and the complete cost estimates are worked out in every case.

In the main report the American Section of the Board recommended a single-stage development, while the Canadian Section suggested a two-stage development for the International Rapids Section of the river. In the latter scheme it was proposed to locate the upper dam and power house at Ogden island, above Morrisburg. An alternative proposal, to which the Board now directs attention, is to locate the upper dam at Crysler island, below Morrisburg, where boring operations during recent months have shown satisfactory foundation conditions to exist. It is stated that this project will cost about four million dollars more than the Ogden island scheme, but promises better financial returns. The project is estimated to furnish 300,000 h.p. more than the Ogden island scheme in the initial development. The operating head would be 34 feet until such time as the level in the lower reach is raised by the building of the lower plant at Barnhart island. The normal head would then be 24 feet in summer and 18.5 feet in winter. It is estimated that the Crysler island scheme would produce 10,000 h.p. more than the Ogden island scheme during the winter.

Appendix D—River Levels and Discharges at and Below Montreal—pp. 393-405

This appendix contains the basic data and computations considered by the Board in reaching the conclusions set forth in the main Report and in Appendix B with regard to, (1) the manner in which regulation of outflow from lake Ontario changes water levels in Montreal harbour, (2) the extent to which diversions from the Great Lakes system, and from the St. Lawrence river above Montreal, lower the water levels at and below Montreal. There are eight pages of tabulated records of river flow, and five pages of discussion, in which is included a table showing the effect of a diversion of 8,500 cubic feet per second (Chicago diversion) on the river levels, at and below Montreal. The effect at Montreal is a lowering by 0.37 feet, diminishing to 0.03 feet at Quebec. Other influences affecting levels are discussed, and estimates quoted for the cost of compensating works, including the dredging of the harbour and river channels, and corresponding lowering of the foundations of docks and wharves in the harbour.

Appendix E—Ice Formation on the St. Lawrence and Other Rivers—pp. 406-422.

When the preparation of plans for the improvement of the St. Lawrence was first undertaken, comparatively little was known about the ice conditions of the river. During the past ten years systematic study has been made of ice covers, packs and gorges, and the information obtained is contained in this appendix. The subject is discussed under the following general headings:—(1) ice pressure, (2) ice formation in rapid water, (3) effect on power improvement, (4) factors affecting ice covers, (5) limiting velocities for advance of ice packs, (6) rates of ice production, (7) river slopes through ice covered sections.

Extended observations have been made of the formation of ice covers; movement of ice bridges; velocities at which frazil is carried under ice cover and deposited to form hanging dams, etc. Measurements were made of actual contents of hanging dams in different locations, and these, when related to the water surface exposed, indicate a production of from 8 to 15 cubic feet of ice per square foot of exposure. Variations depend on the location, and degree of coldness of the water. Cross-sections have been measured and metered in winter and summer, and studies made of the minute differences of temperature on which so many phenomena of ice formation depend. Eight pages of tabulated data are given, showing river slopes for open water, under ice cover and through ice packs; average air temperature; amounts of frazil or slush formed, etc. Among other conclusions it is stated that ice pressure against dams may reach twenty-two thousand pounds per linear foot; that smooth ice covers may be expected to form in rivers with velocities up to 1.25 feet per second in zero weather, provided there is no high wind preventing such action, and that ice covers may pack upstream up to a velocity of 2.25 feet per second without danger of ice going under the cover. A formula is also given for the amount of frazil formed from a given water surface exposed to cooling action, and values of the roughness co-efficients which can be used in open channel calculations to determine winter slopes under ice covers are quoted.

Appendix F—Experiments on Strength of Ice—pp. 423 to 453

This appendix contains the results of tests carried out by the Board at the cold storage warehouse of the Harbour Commissioners of Montreal, where rooms at steady temperatures ranging from 0°F. to 32°F. were available. The main purpose of the tests was to determine the behaviour of ice at different temperatures when compressed normally to the crystals, as may occur under natural conditions above dams, power houses, bridges, etc. A supply of river ice from the LaPrairie basin, off Verdun, was cut and stored at the warehouse for use in the tests. The testing machines and necessary equipment were loaned from McGill University. During the preliminary work, which included the devising of the means of using mirror extensometers capable of recording strains of $\frac{1}{200{,}000}$, it was found that the rate of loading was a very important factor, and a scheme of loading was developed in which definite load increments were applied at regular intervals to the test specimens, which were approximately 5-inch cubes. The rates of yielding and general behaviour were noted. The series of tests included: —

(a) Compression tests at about 30°F., 16°F. and 3°F. with load increments of about ten pounds per square inch, applied at regular intervals ranging from five seconds to three hundred and twenty seconds.

(b) Crushing strength of ice at the above temperatures under loads applied gradually and suddenly.

(c) Observations on the continuous yielding of ice in compression at 30°F. under loads as low as twenty pounds per square inch, and the yielding in compression at 14°F. under sustained loads of different intensities from one hundred pounds per square inch to four hundred pounds per square inch.

(d) Bending tests at 30°F. and 14°F. at four different rates of loading.

(e) Miscellaneous tests.

Temperature and rate of loading were found to be the important factors. As an example, the results of crushing tests in which the five-inch cubes were loaded at the rate of one thousand pounds in two seconds, were as follows:—

Temp. Deg. F.	Crushing Strength—lbs. per sq. in
28	300
14	693
3	811

This appendix states that for other loading rates different figures would be obtained, and points out that conclusions based on statements of crushing strength alone, apart from rate of loading, are valueless.

As showing the effect of sustained loads of different intensities the following figures may be quoted for tests at temperatures 14°F. to 16°F. Deformations were measured on a length of two inches. For a sustained load of one hundred and three pounds per square inch the total deformation was 0.0016 inch in three hours and thirty minutes; for a sustained load of 300 pounds per square inch the total deformation was 0.021 inch in about eight minutes.

The ice frequently "flowed" during the tests, the "flow" being dependent on the rate of loading and temperature. Sometimes a block, originally 5 inches by 5 inches, would flow beyond the edges of the loading plate measuring 6 inches by 6 inches, and a block originally 5 inches high was frequently and rapidly reduced to 3½ inches height under sustained high load at the end of a test.

In general the rate of yielding under similar conditions was reduced as the temperature was lowered. The modulus of elasticity decreases as load intensity increases under all conditions, and as the length of the loading time interval increases. The modulus of rupture also increases as the temperature is lowered, and does not vary much with the loading rate.

The appendix includes about ten pages of tabulated records of tests, and eight plates showing the apparatus used and results obtained.

Appendix G—Construction Programme—pp. 454 to 459

This is a brief statement dealing with the work to be done in each of the five sections of the river: Thousand Islands, International Rapids, Lake St. Francis, Soulanges and Lachine. It is pointed out that the nature and magnitude of the work will call for the acquisition of a large amount of new plant, which will have relatively small value after the completion of construction. The value of such plant has, therefore, been absorbed into the cost of the work, and this, with interest accumulations during the construction period, indicates that maximum economy will be secured by planning for a construction period of about seven years for the heaviest work. Three pages of tabulated data show the items of work to be undertaken in each section, and the year in which it is suggested that they be carried out.

The above notes are necessarily inadequate and have been prepared solely with the object of stating broadly the contents of the appendices, so that members may realize what an immense amount of valuable information has now been placed at the disposal of the engineering profession. It is understood that a limited number of copies of the complete report, with appendices and plates, are available for interested persons and can be obtained from the secretary of the National Advisory Committee, St. Lawrence Waterway, Ottawa, for five dollars per copy.

Meeting of Council

Meeting of January 18th, 1928

A meeting of Council was held at Headquarters at eight o'clock p.m. on Wednesday, January 18th, 1928, President A. R. Decary, M.E.I.C., in the chair, and eleven other members of Council being present.

Attention was drawn to a communication from the Moncton Branch regarding the proposed amendments to Section 76 of the By-laws, and after considerable discussion the Secretary was directed to address a communication to the Moncton Branch explaining Council's meaning in connection with the proposed amendment as follows: that the amendment at present proposed is intended to provide that future proposed amendments to the By-laws may be modified during discussion at the Annual Meeting and that both the original amendments and the amendments as modified shall be placed on the letter ballot to be voted upon by the corporate membership at large.

The Financial Statement for the year 1927 was presented and received.

Discussion took place with regard to the method of dealing with members resignations when received at Headquarters, as a result of which the following procedure was prescribed for the Secretary's guidance: upon receipt of the resignation of a member in good standing, the name of the member is to be removed from the mailing list so that he incurs no further financial liability to the Institute, the branch concerned is to be notified immediately, and if no action is taken by that branch within sixty days, at the end of that period the resignation is to be brought to the attention of Council for acceptance.

Various arrangements in connection with the forthcoming Annual Meeting were considered.

A resolution passed by the Winnipeg Branch at its meeting on October 6th, 1927, dealing with the enactment of legislation that would stimulate and facilitate research in Canada was submitted and approved.

A list of reports received from a number of the Institute's Committees was submitted and noted.

The resignation of Professor Peter Gillespie, M.E.I.C., from the Chairmanship of the Committee on Biographies was noted with regret.

Professor C. M. McKergow, M.E.I.C., was unanimously renominated as a representative of the Institute on the Main Committee of the Canadian Engineering Standards Association.

A list of reports received from branches was submitted and noted.

The recommendations of the Finance Committee in connection with seven special cases were approved.

Two reinstatements were effected.

Fourteen resignations were accepted.

The following elections and transfers were effected:

ELECTIONS

Associate Members	7
Affiliates	2
Students	16

TRANSFERS

Associate Member to Member	3
Student to Associate Member	3
Student to Junior	4

Twenty-nine applications for admission and transfer were scrutinized and classified for the ballot returnable February 10th, 1928.

The Council rose at eleven o'clock p.m.

The Canadian Electrical Code

The Canadian Engineering Standards Association is performing a valuable service to industry and to the Canadian public, in preparing and publishing standards for engineering materials and structures. The most recent of these and one of the most important is the Canadian Electrical Code. This publication is a compilation of rules respecting electrical equipment, designed to minimize the fire and life hazards attendant upon the use of electricity. It is expected that it will replace the many diverse rules now in existence throughout Canada.

Evolution of Local Rules

These rules were modelled upon the "National Electrical Code" of the United States, a document sponsored by the Fire Underwriters of that country and dealing originally with fire hazards. Within its limits The National Electrical Code has set the standards for electrical work in the United States for many years, and as electrical practice in Canada has from the beginning followed American practice, it has been used by many inspection departments in this country. In the course of its evolution it has been enlarged in scope to include also the life hazard, but before this was done the demand for rules covering the life hazard had resulted in a "National Electrical Safety Code," published by the Bureau of Standards, which has been largely used by inspection authorities to supplement the National Electrical Code. Since electrical inspection is as a rule in the hands of municipal authorities, it was natural that the ideas of local inspectors should be embodied in rules superimposed upon the codes adopted, and the result of this is the existence of a multiplicity of rules covering the fire and life hazard in varying degrees, and in many cases not consistent one with another.

The Situation in Canada

The situation in Canada at the time the code work was undertaken was roughly as follows:

In British Columbia provincial legislation placed in the hands of the Workmen's Compensation Board the administration of rules which were binding over the whole province. In Ontario, the Hydro-Electric Power Commission, empowered by the provincial government, had prepared and was administering rules which were also binding over the whole province. In Quebec province-wide rules applying to public buildings were administered by the Department of Labour. In the rest of Canada inspection was carried on either by municipal authorities, (where required by local by-law), or by the Fire Underwriters.

These various rules were not in agreement in many important features and it was becoming apparent that the existence of so many different rules was undesirable. The manufacturers found it necessary to carry in stock several types of equipment for the same type of service because of local requirements. This increased the cost of such equipment and was thus not in the public interest. This situation also increased the difficulties of inspection authorities in their contacts with the public and the manufacturers.

There thus arose a demand among inspectors and manufacturers for rules which could be adopted universally throughout the country. The Canadian Engineering Standards Association, after ascertaining that the appearance of rules would be welcomed by the industry at large, undertook the task.

The Preparation of the Code

It was decided to separate the work into three parts, the first to contain rules for electrical installations in, on or over buildings using potentials up to 5,000 volts. The second part was to contain specifications for the construction and test of electrical equipment, and the third, rules for overhead electric lines.

The difficulties in the way were serious. Perhaps the greatest obstacle to overcome was geographical. It was realized that the holding of many meetings, at which all parts of the country could be represented, was impossible, and after considerable thought the work was organized by appointing a Main Code Committee representative of all sections of the country and all interests. It was also decided that an effort should be made to appoint a committee in each province for the purpose of obtaining as complete an expression as possible of local opinion. Committees were appointed in five provinces. The work of preparing the code was entrusted to two engineers who were instructed to submit a complete draft for Part 1 of the Rules, making use of the National Electrical Code, the National Electrical Safety Code, the rules of the Hydro-Electric Power Commission of Ontario and other rules in use in Canada.

The first draft submitted by the compilers was studied and criticized by the provincial committees, and while it was in the main acceptable, opinion was not unanimous. During the discussion which followed an extensive revision of the National Electrical Code was undertaken in the United States and it was considered advisable to prepare a second draft embodying certain features of this revision. At a meeting held in Winnipeg in June 1927, this draft was considered by representatives of seven provinces and, with minor revisions, adopted. It was published in September 1927 as publication C22-1927 of the Canadian Engineering Standards Association.

Adoption by Inspection Authorities

The interest which the appearance of the Code has aroused, and the action of local and provincial authorities in adopting it, is ample justification of the decision of the Canadian Engineering Standards Association to undertake its preparation, and is very gratifying to those who expended so much time and energy in its preparation. Within a short time after its publication it had been officially adopted by the Department of Telephones and the City of Saskatoon in Saskatchewan, and by the Hydro-Electric Power Commission in Ontario. Its adoption by all those represented at the Winnipeg meeting will follow shortly, in accordance with the agreement entered into at that meeting. A further result of the Winnipeg meeting was the appointment of committees in two provinces not previously represented, so that all provinces except New Brunswick and Prince Edward Island are now represented by Code committees. The existence of these committees is very necessary to assist in future revisions of the Code.

Contents of the Code

The main features of the Code are, the attention given to the fire hazard, and the form and arrangement. It is believed that in these respects it is in advance of most existing codes in America at least. A special effort was made to obtain logical arrangement and clarity of expression. All rules dealing with any particular subject are grouped together; this will, it is hoped, assist those using the Code in avoiding error and confusion. It is also believed that the rules are so worded as to minimize the possibility of ambiguity.

The scope of the Code, as mentioned above, includes "all electrical work and equipment operating at potentials up to 5,000 volts, which is installed in, on, or over any building, structure or premise." In this connection it should be mentioned that most of the rules are meant to apply to private residences, public buildings and industrial establishments. They were not primarily intended to apply to power houses, transformer stations, etc., in which the equipment has been designed and installed under engineering supervision and which is under the continuous superintendence of competent operators.

Provision is made for seventy sections, of which twenty-four are used in this draft.

All definitions of terms used in a restricted sense are grouped in one section, and all terms so defined are printed throughout the rules in bold face type.

An important section is that on wiring methods. This recognizes seven methods of wiring, specifying the conditions under which each is acceptable or required.

The section on grounding specifies what shall be grounded and indicates acceptable methods of grounding. Other important sections deal with conductors, protective and control equipment, outlet boxes and cabinets, hazardous locations, garages, motion picture studios, radio installations, signs, theatres, small isolated plants, high potential installations. The concluding section contains recommendations for maintenance and operation.

Approval Testing

An important rule in the Code requires that all equipment, (which by definition includes materials and fittings), shall be aproved, hence the definition of "approved" is of interest:

> "Approved: When used with reference to any particular electrical equipment, means that such equipment has been submitted for examination and test to Underwriters' Laboratories of Chicago, or the Laboratory of the Hydro-Electric Power Commission of Ontario, or a recognized Canadian Government Laboratory, and that a formal written report thereon has been obtained, to the effect that such equipment is suitable for sale and use."

The establishment of an approval laboratory under the National Research Council has been discussed, but pending such action the matter of approval should be adequately taken care of by the requirement just quoted. The Underwriters' Laboratories has been carrying on approval testing in the United States and Canada for many years. The Hydro-Electric Power Commission of Ontario established an approval laboratory about ten years ago and its findings have the force of law in Ontario. They have also been accepted in other provinces of the Dominion. The standards of these two laboratories are in substantial agreement.

Future Work

It is intended to issue a revision of the Code in September 1928, after which periodical revisions will be made as necessity may dictate.

The Main and Provincial Committees will continue to function and to make suggestions for changes, which experience in the use of the Code will no doubt promote.

The preparation of Part II (specifications) and Part III (rules for overhead lines) has not yet been undertaken.

The preparation of the Canadian Electrical Code is probably the most important work which the Canadian Engineering Standards Association has undertaken, because of its immediate consequences and its potential influence upon the future of the industry. The production of a standard which is acceptable to all sections of the country confers all the benefits of standardization which are so well understood by engineers and need not be recapitulated.

The special significance of this particular standard is the fact that it will become legally enforceable wherever it is adopted, and will therefore be of more direct interest to the public at large than most of the standards published by the Association. Its appearance has caused a great increase of interest in electrical inspection, the result of which will no doubt be the enactment of legislation providing for inspection in districts not now served. This will advance the cause of public safety.

The acceptance by inspection authorities of uniform standards for electrical equipment will remove one of the causes of hardship which former conditions imposed upon electrical manufacturers, and should result in lower manufacturing costs. This will benefit the public and encourage the more extensive use of electricity. The demand for approved equipment will stop the dumping of "junk" on the market, much of which is poorly constructed equipment of foreign manufacture, embodying features dangerous to both life and property.

One of the most important features of the Code work is the establishment of contacts between men in different parts of the country having a common interest in a national problem. The Code has served and will continue to act as a bond uniting different sections of the country in the pursuit of a common aim. Its preparation was accomplished by co-operative effort on the part of all participants; desire to understand the other man's point of view marked the discussions; concessions were made by all sections in the interest of the larger good. While it is admittedly imperfect in many respects, it forms a point of departure for further progress in a branch of standardization in which the public has a direct interest.

Important —

Do not forget to secure a certificate from the ticket agent when you purchase your railway ticket to Montreal for the Annual Meeting.

See announcement on page 41 of the January Journal.

OBITUARIES

Granville Carlyle Cunningham, M.E.I.C.

It is with deep regret that we record the death of Granville Carlyle Cunningham, M.E.I.C., which occurred suddenly at Farnham Common, Bucks, England, on December 18th, 1927. A member of The Institute since its inception as the Canadian Society of Civil Engineers, Mr. Cunningham has always taken a keen interest in its affairs, and in fact served for five years on the Council.

The late Mr. Cunningham was born at Edinburgh, Scotland, on April 27th, 1847, and received his education at Edinburgh Academy and University. In 1870 he went to Honduras, Central America, in charge of a railway location survey. Upon coming to Canada in 1871 he was engaged on various railway works in Ontario and the following year was with the Canadian Pacific Railway on exploration and location work. From 1875-79 he was engineer-in-charge of the Prince Edward Island Railway and of harbours on the island, and the following four years he was engaged with the Canada Southern Railway, later becoming chief engineer. In 1884 he was appointed general assistant to manager of construction of the Rocky Mountain division of the Canadian Pacific Railway. He later engaged in railway contracting in Lower Canada and had contract for part of the Temiscouata Railway, Rivière du Loup, Que. From 1889-92 he was assistant city engineer and subsequently city engineer for the city of Toronto, Ont., and during the next five years he was employed with the Montreal Electric Street Railway as general manager and chief engineer. In 1897 on his return to the Old Country, he was appointed managing director of the City of Birmingham Tramways and the next year general manager of the Central London (Tube) Railway.

Mr. Cunningham joined The Institute in the days of The Canadian Society of Civil Engineers, having been elected a Member on February 3rd, 1887. He served on the Council during the years 1889 and from 1893 until 1897 inclusive, and in 1919 was made a Life Member of The Institute.

James Herbert Bartlett, M.E.I.C.

In the death of James Herbert Bartlett, M.E.I.C., which occurred at his home in Anchorage, Ky., on December 17th, 1927, there has passed another of The Institute's first members.

The late Mr. Bartlett was born at Whetstone, near London, England, on January 22nd, 1850, and received his education, first at a private school in Brighton and afterwards at the Clapham Grammar School, Clapham, and at Owens College, Manchester. At the early age of fifteen he entered the works of Messrs. Beyer, Peacock and Company, locomotive and tool makers, of Gorton, and served a pupilage of six years, passing through the various departments, following which he was employed in the locomotive repair shops and on the line and works of the Manchester, Sheffield and Lincolnshire Railway Company.

The late Mr. Bartlett came to Canada in October 1871 as assistant locomotive superintendent of the Northern Railway Company of Canada, but left this company the following spring to enter the office of Messrs. D. C. Ridout and Company, mechanical engineers. Three years later he entered into private practice in Toronto, until 1878, during which time he erected numerous bridges in various parts of the Dominion. In 1878 he organized the Toronto Bridge Company and in the position of general manager of the company he was engaged in the construction and erection of iron and steel railway and highway bridges until 1882, when he resigned. In 1882 he visited England to arrange for the construction of the bridge over the Fraser river, British Columbia, on the line of the Canadian Pacific Railway Company. The following year he entered private practice as a consulting engineer in Montreal, specializing in the manufacture of iron in Canada.

Some time in 1885 he published a work entitled "The Manufacture, Consumption and Production of Iron, Steel and Coal in the Dominion of Canada," which has been acknowledged as the standard authority on this subject.

The late Mr. Bartlett was elected a Member of The Canadian Society of Civil Engineers on February 3rd, 1887, prior to its incorporation as The Engineering Institute of Canada.

James Hutcheon, A.M.E.I.C.

Deep regret is expressed in recording the death of James Hutcheon, A.M.E.I.C., which occurred at Toronto, Ont., on January 18th, 1928.

The late Mr. Hutcheon was born at Nassagaweya, Ont., on September 8th, 1860, and graduated from the School of Practical Science, University of Toronto, in civil engineering in 1890. In July 1890 he was articled with W. R. Burke, Ontario Land Surveyor, of Ingersoll, and served with him on government surveys in Albert, the North-West Territories, and in the Nipissing district in 1890, and again in 1891 and 1892. In November of 1891 he was commissioned as an Ontario Land Surveyor. At intervals during those years he worked under C. H. Keefer, M.E.I.C., consulting engineer, at Toronto, Mr. Alex. Baird, of Leamington, Ont., and Mr. Henry Carre of Belleville, Ont. In April 1893 he was appointed city engineer of Guelph, Ont., which position he held until 1915 when he joined the surveys branch of the province of Ontario, with which he was connected at the time of his death.

The late Mr. Hutcheon joint The Institute as a Student on October 8th, 1891, and was transferred to an Associate Member on October 11th, 1900.

Eugene O'Sullivan, A.M.E.I.C.

Sincere regret is expressed at the news of the death of Eugene O'Sullivan, A.M.E.I.C., which occurred in Montreal, Que., on January 14th, 1928, following a long illness.

The late Mr. O'Sullivan was born at St. Catharines, Ont., on August 14th, 1870, and received his early education at Ottawa University and by private studies abroad. His first engineering work was with the Department of Public Works of Canada as rodman and leveller. From 1891 to 1894 he was engaged with Mr. Henry O'Sullivan on inspection, township and exploratory surveys, and as assistant to Mr. J. H. Sullivan, engineer of the town of Valleyfield, Que., on general municipal work. In 1900 he was appointed assistant engineer to Messrs. Dean and Main, civil engineers, Boston, Mass., in charge of construction of Gault mills at Valleyfield. The next two years he was engaged as engineer for the Montreal Cotton Company on the construction of the company's mills and the development of water power by Messrs. Wighton and Morrison. Later he had charge of the drainage system for the Truro Condensed Milk Company, at Huntingdon, Que., and the next year he had charge of railway location for the Atlantic, Quebec and Western Railway, at Gaspe, and survey and soundings at the upper entrance of the Soulanges canal for the construction of a breakwater. In 1905 he was placed in charge of a survey for the town of Westmount, under the town engineer, for the proposed waterworks system. Subsequently he was appointed assistant engineer with the Montreal Waterworks, under Messrs. Janin and Lesage, and was resident engineer during the construction of the aqueduct.

Mr. O'Sullivan joined The Institute as an Associate Member on May 14th, 1908.

Pierre Danais, A.M.E.I.C.

In the death of Pierre Danais, A.M.E.I.C., which occurred at Quebec on November 27th, 1927, The Institute has lost one of its young and promising members. At the time of his death Mr. Danais was in the employ of the Department of Roads of the province of Quebec, and had been in ill health for months.

He was a native of the province of Quebec, having been born at Baie Saint Paul on April 25th, 1890. His early education was received at the primary school of that village and at the Seminary of Chicoutimi. He continued his studies at Laval University and at Queen's University, from which he received the degree of B.Sc. in 1917. Following graduation he commenced the practice of his profession and was employed as leveller in connection with water power development at Chicoutimi. From 1918 to 1920 he was in private practice on survey work and for part of the time he was engaged with Provincial Land Surveyors. In 1920 he occupied various positions such as draughtsman on preliminary railway surveys, topographer and transitman, and in 1921 he entered the services of the Department of Roads of the province of Quebec, with which he remained until the time of his death. His work with this department included both field and office duties.

The late Mr. Danais had a host of friends and particularly among his fellow engineers. He was devoted to his chosen work so much that on many occasions during his illness he had been known to say that his duty was to complete the work that was given to him and he would take a rest and care for himself afterwards. As an indication of the high esteem in which he was held by those to whom he was responsible there appears in "La Voirie Sportive," the official organ of the Quebec Sportif de la Voirie, an appreciation by Jos. L. Boulanger, Deputy Minister of the Department of Roads.

Mr. Danais joined The Institute as a Junior on April 27th, 1920 and was transferred to an Associate Member on April 29th, 1924.

Recent Additions to the Library

Reports, etc.

BUREAU OF STATISTICS, CANADA:
- Transportation Branch: Statistics of Steam Railways of Canada, 1926.

DEPARTMENT OF MINES, CANADA:
- Geological Survey: Summary Report, 1926 Part C.
- Mines Branch: Canadian Shale Oil and Bitumen for Bituminous Sands as Sources of Gasoline by Pressure Cracking.

Technical Books, etc.

PRESENTED BY MCGRAW-HILL BOOK COMPANY:
- Time and Motion Study, by S. M. Lowry, H. B. Maynard, G. J. Stegemerten.
- Heating and Ventilation, by Rietschel-Brabbée.

PRESENTED BY JOHN WILEY & SONS:
- The Design and Construction of Dams, by Edward Wegmann, 8th Ed.
- Mining Engineers' Handbook, by Robert Peele.

PRESENTED BY E. & F. N. SPON, LIMITED:
- Faults and Failures in Hot-Water Work, by F. E. Dye.
- St. Lawrence Waterway Project, by D. W. McLachlan, 2 Volumes.
- Photo-Elastic Measurements of Stress Distribution, by E. G. Coker.

PERSONALS

Chas. W. Dill, A.M.E.I.C., who for the past three years has been located in Toronto, Ont., has joined the staff of the Carter-Halls-Aldinger Company, Limited, at Vancouver, B.C.

C. L. Dodge, A.M.E.I.C., of Calgary, Alta., has joined the staff of the Canada Land Irrigation Company, Limited, Medicine Hat, Alta. Mr. Dodge graduated from Colorado State College with the degree of B.Sc. in 1911.

John G. Hall, A.M.E.I.C., of the staff of the Combustion Engineering Corporation, Limited, at Winnipeg, Man., has been transferred to the Montreal office of the company. Mr. Hall is a graduate of McGill University of the year 1921.

A. J. Macdonald, A.M.E.I.C., of Black Avon, N.S., has accepted a position on the staff of the Department of Highways, Halifax, N.S. Mr. Macdonald was for a short time with the Aluminum Company of Canada at Jonquiere, Que.

William Anderson, A.M.E.I.C., who has been power apparatus specialist with the Northern Electric Company, Limited, Calgary, Alta., has been appointed to the position of sales engineer with the Canadian Westinghouse Company, Limited, in the same city.

T. A. McElhanney, A.M.E.I.C., acting superintendent, Forest Products Laboratories of Canada, at the University of British Columbia, Vancouver, B.C., has been appointed superintendent, Forest Products Laboratories of Canada, Department of the Interior, Ottawa, Ont.

C. L. Breithaupt, A.M.E.I.C., chemical engineer, Breithaupt Leather Company, Kitchener, Ont., has joined the staff of the acids and heavy chemical division of the E. I. du Pont de Nemours and Company, Philadelphia, Pa. Mr. Breithaupt is a graduate of the University of Toronto of the year 1922.

Major E. L. M. Burns, R.C.E., A.M.E.I.C., has left to attend the staff course at the Staff College, Quetta, India. 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. Major Burns expects to be in India for a period of two years.

Ross M. Carmichael, A.M.E.I.C., has resigned his position as designing engineer, Hydro-Electric Power Commission of Ontario, to join the engineering staff of the Aluminum Company of Canada, at Arvida, Que. Mr. Carmichael is a graduate of the University of Toronto of the year 1913.

Chas. B. Rorke, S.E.I.C., has returned to Canada to accept a position with the Canadian and General Finance Company at Toronto, Ont. Following his graduation from McGill University in 1923, Mr. Rorke went to East Pittsburgh, Pa., where he entered the graduate students' course of the Westinghouse Electric and Manufacturing Company.

R. B. Stewart, M.E.I.C., is managing director of I. Matheson and Son, New Glasgow, N.S. Mr. Stewart is a graduate of McGill University of the year 1910. He was for several years with the Dominion Bridge Company, Limited, and later manager and engineer for the Maritime Bridge Company, at New Glasgow, N.S.

G. R. Adams, S.E.I.C., who graduated from Queen's University in 1927, has joined the staff of the Tropical Oil Company, Barranca, Bermeja, Colombia, S.A. In June 1926 Mr. Adams was with Messrs. Fraser, Brace, Limited, at Gatineau, Que., and later joined the staff of Price Brothers and Company, Riverbend, Que.

Major N. C. Sherman, R.C.O.C., M.E.I.C., inspector of ordnance machinery, ordnance office, Esquimalt, B.C., has been moved to Headquarters, Military District No. 3, at Kingston, Ont., and is carrying out the same work as in the west, viz., maintenance and inspection of all artillery and ordnance equipment and the technical stores connected with them.

Douglas Norman, S.E.I.C., has been transferred from the engineering department of the Canadian General Electric Company, Limited, at Peterborough, Ont., to the transformer engineering department of the company at Toronto, Ont. Mr. Norman graduated from the University of Manitoba with the degree of B.Sc. in electrical engineering in 1926.

George H. Burgess, M.E.I.C., who for the past three years has been associated with Coverdale and Colpitts, consulting engineers, 66 Broadway, New York city, has now been appointed a member of this firm. Mr. Burgess was for a number of years with the Delaware and Hudson Company as chairman of valuation committee and real estate agent, having first joined the company as chief engineer in 1908.

Willis Chipman, M.E.I.C., well-known consulting engineer of Toronto, has left for an extended trip to the West Indies. Mr. Chipman is one of the first members of The Institute, having accepted membership on June 13th, 1887. He was a member of Council for the years 1899, 1901 and 1902 and has always taken an active part in the affairs of The Institute. He is the founder of the Ontario Land Surveyors' Association, of which he is a past-president.

Duncan Kennedy, A.M.E.I.C., recently with Messrs. Monsarrat and Pratley on the substructure work of the Montreal South Shore bridge, is now acting as resident engineer for Messrs. Robert White and Partners of Westminster, England, on the construction of wharves and jetties at Bharnagar, Kathiawar, India. Mr. Kennedy's engineering work has taken him into many countries, and on coming to Canada in 1924 he became engaged on the hydro-electric project at Isle Maligne, Que., with the Quebec Development Company.

W. Nelson Smith, M.E.I.C., who about a year ago returned to the United States from Winnipeg, Man., in connection with the valuation of the Philadelphia Electric Company's property at Philadelphia, Pa., is now with the organization of E. L. Phillips and Company, engineers, 50 Church street, New York city. While in Winnipeg, Mr. Smith was consulting electrical engineer of the Winnipeg Electric Company and was engaged on several other matters of valuation for that company. He was also on work in Vancouver for the Sydney E. Junkins Company, Limited.

Geo. O. Vogan, Jr.E.I.C., has resigned his position with the Hydro-Electric Power Commission of Ontario to join the engineering staff of the Aluminum Company of Canada, at Arvida, Que. Mr. Vogan graduated from Queen's University with the degree of B.Sc. in 1917. Following graduation he was appointed field draughtsman for the railway department of the Hydro-Electric Power Commission of Ontario until September of the same year when he was transferred to the hydraulic department, with which he has remained ever since.

W. Hamilton Munro, M.E.I.C., has resigned his position as manager of the Nova Scotia Tramways and Power Company and has joined the staff of the Montreal Engineering Company, Limited. In 1919 he joined the staff of Vickers Limited, London, England, and was engaged in field inspection of water power developments, and was later appointed senior hydraulic engineer, hydro-electric department. In 1925 he returned to Canada to take over the duties of sales manager of the Canadian branch of the firm at Maisonneuve, Montreal. Mr. Munro is a graduate of the University of Toronto, (Science), of the year 1904.

Moses Burpee, M.E.I.C., who since 1891 has been the chief engineer of the Bangor and Aroostook Railroad Company, has retired from that position and has been appointed consulting engineer to the company. Mr. Burpee is a native of Sheffield, N.B., where he was born in 1847. His first work in railway engineering was as rodman on the Fredericton Railway in 1868 and on the European and North American Railway in New Brunswick in 1869. He was for many years engaged as assistant engineer on construction, transitman on surveys, assistant engineer-in-charge of surveys and draughtsman on different railways. In 1890 he was appointed chief engineer of the New Brunswick Railway, which was taken over by the Canadian Pacific Railway in the same year.

J. R. Donald, M.E.I.C., managing-director, J. T. Donald and Company, Limited, is spending six weeks in Europe investigating chemical processes and plants. Mr. Donald graduated from McGill University in 1913, following which he joined the Nichols Chemical Company, Limited, at Sulphide, Ont. The next year he was engaged in general consulting with J. T. Donald and Company, Limited. From 1916-18 he was chief inspector of explosives, chemicals, for Ministry of Munitions, Canada. In 1919 he was appointed chemical engineer and chief chemist of the Canadian Packing Company, Limited, Toronto, and later joined the firm with which he is now connected.

F. H. Hibbard, A.M.E.I.C., engineer, maintenance-of-way, of the Quebec Central Railway Company, has been appointed engineer, taking over the duties of the former chief engineer, who has recently been superannuated. Mr. Hibbard has had extensive and varied experience on railway work, particularly with the construction of the National Transcontinental Railway and the Saint John Valley Railway. In June 1913 he become connected with the Quebec Central Railway Company as engineer-in-charge of construction and three years later was appointed assistant engineer with the company, later being promoted to the position which he occupied until recently.

Robert Morham, A.M.E.I.C., has resigned his position with the hydraulic department of the Hydro-Electric Power Commission of Ontario to join the engineering staff of the Aluminum Company of Canada, at Arvida, Que., and will be engaged on the design of the new power plant at Chute a Caron on the Saguenay river. Prior to coming to Canada in 1912, Mr. Morham had considerable experience on engineering works in the Old Country. His first work in Canada was with the Highway Department of the province of Saskatchewan. He was later engaged with the Steel Company of Canada at Hamilton, Ont., and with the Department of Works for the city of Toronto until being appointed to the engineering staff of the Hydro-Electric Power Commission.

W. G. MacNaughton, M.E.I.C., has resigned his position as secretary of the Technical Association of the Pulp and Paper Industry and has joined the staff of the News Print Service Bureau, New York city. 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 connected with the Nekoosa Edwards Paper Company, Port Edwards, Wis., as chemist, and in 1912 was promoted to the position of plant manager. In April 1917 he was appointed general manager of the Inland Empire Paper Company, at Spokane, Wash.

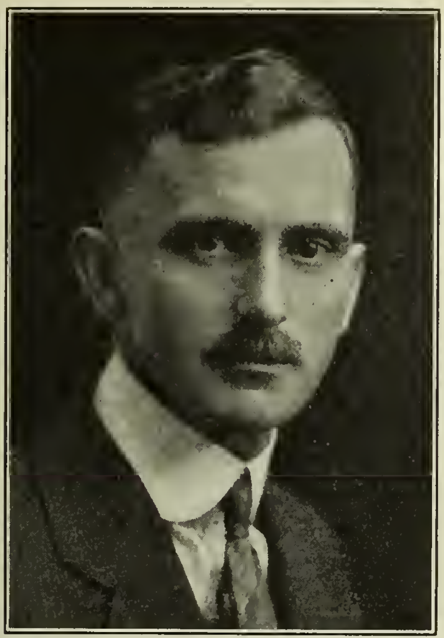
E. A. Cross, A.M.E.I.C., who since 1920 has been engaged as structural engineer with Albert Kahn, architect in Detroit, Mich., on the design of reinforced concrete and steel structures, industrial plants, etc., has joined the staff of Messrs. Chapman and Oxley, Toronto, Ont. Mr. Cross is a native of Petersfield, Hunts, England, and graduated from Birmingham University in 1909. Following graduation he was appointed assistant engineer with Birmingham Canal Navigations, engaged on surveys, designs, estimates and specifications for numerous canal works. In 1920 he came to New York and joined the H. D. Best Company as reinforced concrete designer, following which he was appointed superintendent of construction for W. L. Stoddart, architect, New York city.

A. L. Harkness, A.M.E.I.C., has recently left the staff of the Welland Ship Canal to accept a position with Newton-Dakin Construction Company and will be located in Montreal. Prior to going on the Welland Ship Canal work, Mr. Harkness was chief engineer of the Robert W. Hunt and Company, Limited. He is a graduate in civil engineering of the School of Practical Science of the year 1906 and received the degree of B.A.Sc. from the University of Toronto in 1908. After a number of years engagement in various positions with the Dominion Bridge Company, Montreal, he was transferred, in 1911, to the designing staff of the St. Lawrence Bridge Company in connection with the work on the Quebec bridge and in August 1914 he became assistant engineer, which position he held until the completion of the Quebec bridge contract.

J. A. Knight, A.M.E.I.C., of Toronto, Ont., has been appointed to the engineering staff of the Aluminum Company of Canada, at Arvida, Que., in connection with the design of the proposed power plant at Chute a Caron on the Saguenay river. Mr. Knight is a graduate of the University of Toronto of the year 1914. During the Great War Mr. Knight saw service overseas with the 2nd Canadian Tunnelling Company and with the 11th Battalion Canadian Engineers and was awarded the Military Cross. On his return he joined the staff of the Hydro-Electric Power Commission of Ontario and has been engaged on hydraulic design with the Commission ever since. He has been an active member of the Toronto Branch of The Institute, having been secretary of the branch and on the executive for a number of years and occupying the office of vice-chairman during the present year.

A. Duperron, M.E.I.C., Chief Engineer, Montreal Tramways Commission

A. Duperron, M.E.I.C., engineer of the Quebec Streams Commission, has been appointed chief engineer of the Montreal Tramways Commission. Mr. Duperron is a graduate of Ecole Polytechnique, Montreal, from which he received the degree of B.A.Sc. in 1911. During his college course he was engaged on various survey works and immediately following graduation he was associated with Mr. E. Laignon on hydro-electric and building construction. In September of the same year he was engaged on railway location with the Central Railway of Canada between Hawkesbury and Ottawa. In January of 1912 he accepted a position with W. I. Bishop, M.E.I.C., on hydro-electric surveys on the St. Francis river and on construction work at Drummondville, Que. From September 1912 until May 1913 he was employed in the office of the construction department of the Canadian Pacific Railway at Montreal, subsequently being transferred to the bridge department on the design and



A. DUPERRON, M.E.I.C.

preparation of bridge plans. In August 1915 he joined the staff of the Quebec Streams Commission, first as chief of a survey party in the Lake St. John district and later in charge of construction of the superstructure of a bridge over the Sauvage river in connection with the Lake St. Francis reservoir. Following this he was on the staff of the Commission at Montreal. Mr. Duperron has served on the Executive Committee of the Montreal Branch of The Institute and in connection with the forthcoming Annual Meeting he is chairman of the Papers Committee.

BOOK REVIEWS

The Propagation of Electric Currents in Telephone and Telegraph Conductors

By J. A. Fleming. D. Van Nostrand Company, New York, 1927, Fourth Edition, Buckram, 9 x 6 in., figs., tables, diagrs., $8.00.

This book is primarily intended for engineers and experts in dealing problems of communication, both telephonic and telegraphic, over metallic circuits. However, it contains valuable information for power transmission engineers, such as, harmonic analysis and the solution of transmission problems by hyperbolic trigonometry.

The opening chapter deals briefly with simple periodic functions and their representation by complex notation. This forms a fitting introduction for the work to follow. The balance of the chapter is devoted to an exposition of hyperbolic trigonometry and the development of the various functions. The theory is outlined in a remarkably clear manner and anyone desiring a knowledge of this branch of mathematics would be amply repaid by a careful study of these pages.

In the second chapter a theory for the propagation of electromagnetic waves along wires is developed. The author is successful in explaining this phenomenon by simple illustrations and by the more elaborate method of the calculus.

Equations for the propagation of simple periodic currents in telephone cables are developed in the third chapter. These are identical with equations used in power transmission problems. Practical examples are worked out which are helpful from the mathematical point of view.

The fourth chapter deals with the specific problem of telephony. The analysis of single valued periodic curves into a Fourier's series is explained in detail. The analysis and synthesis of sound and the effect of distortion through different attenuations of the component frequencies serves to emphasize the most important obstacle to be overcome in successful telephone communication. Dr. Pupin's and Campbell's theory of the loaded cable are presented in mathematical detail. It is well known that the invention of the loaded cable made long-distance telephony possible.

Special problems relating to currents in submarine cables are taken up in the fifth chapter. The treatment of this subject is carried out in similar manner to that on telephony in the previous chapter with necessary modifications as the case demands. Following this is a related chapter on the transmission of very high and very low frequency currents.

All classes of cables are nowadays subjected to accurate measurements and tests of their characteristics. The author describes methods for making various tests and in addition detailed descriptions of a number of instruments with diagrams are included. This chapter, number seven, is of special interest to cable manufacturers.

Elaborate theories are valueless unless they can be substantiated by experiment. Chapter eight deals specifically with a comparison of constants as predetermined by calculation and verified by test. Chapter nine is devoted to the practical performance of loaded cables.

Chapter ten is entirely devoted to recent improvements in the field of communication. It treats such subjects as, improvements in construction of loading coils, phantom circuits, characteristics of permalloy and other alloys of high permeability, thermionic repeaters and carrier wave telephony.

Taking the book as a whole it is one which yields its information only through careful and intensive study. It represents a valuable contribution to the art of communication which today is such an essential factor in the business and social world.

W. F. McKnight,, A.M.E.I.C.
Professor of Electrical Engineering,
Nova Scotia Technical College.

Geophysical Methods of Prospecting for Ore, Oil, Etc.

A concise pamphlet on this subject has just been published as technical paper No. 420 of the United States Bureau of Mines, and contains a brief account of the principles involved in these modern methods of prospecting or ore detection.

The authors are two Canadian physicists, Dr. A. S. Eve and Dr. D. A. Keys, who for some time past have been engaged in testing the efficacy of nearly all the known methods of scientific prospecting by geophysical means.

Interest in possible methods of detecting bodies of ore buried beneath the surface is naturally wide-spread, and subject is important on account of the large sums of money and the vast amount of work which can be saved if such methods can be successfully applied.

The authors' investigations lead to the conclusion that the particular geophysical method to be employed must be chosen to suit the particular region and circumstances, each method having its own field of usefulness.

Geophysical prospecting methods may be magnetic, gravitational, electrical or seismic. Those first named depend on the measurements of local variations in the earth's magnetic force by magnetometers or earth inductors, or by means of magnetic variometers. In gravitational methods a sensitive pendulum or a special torsion balance is employed, so as to map out the changes in the earth's gravitational force which are caused by the proximity of masses of material of abnormally high or abnormally low density; electrical methods may depend on the measurements of natural currents existing in the ground, or measurements of the earth's resistance, or on the distribution of an artificially produced electromagnetic field, or on the measurement of equipotential lines due to currents passing between two electrodes placed on the ground.

In nearly all cases the desired result of the observations is a map, on which the hidden mass of material is indicated by irregularities or distortions of the lines or contours of equal potential, equal values of g, or as the case may be.

The pamphlet also describes methods involving the use of so-called seismic methods, in which the time taken for an explosion impulse to pass through the ground is noted and compared with the time taken by the same impulse to pass through another path, usually a quicker one, leading through ore bodies or subterranean masses of low density. These methods are finding application particularly in searching for salt domes in connection with oil explorations.

It will be noted that all the methods in review are based on rational and scientific study; they employ definite physical principles which are generally known. They have nothing in common with the "divining rod" or any other systems whose efficacy, (if any), depends on principles which elude scientific explanation.

The paper will be read with interest by all who are concerned with prospecting or mining developments, and its methods may be found of wide application in connection with other types of engineering work.

EMPLOYMENT BUREAU

Situations Vacant

MECHANICAL DRAUGHTSMAN

Mechanical draughtsman with at least four years experience in newsprint mill work. Good opening for right man in newsprint mill in province of Quebec. Apply, stating salary expected. Apply box No. 179-V, The Engineering Journal.

DESIGNING ENGINEER

Designing engineer, experienced in pulp and paper machinery design, to take charge of draughting office in large newsprint mill in the province of Quebec. Applicant must be technical graduate. Apply, stating salary expected, to box No. 180-V, The Engineering Journal.

DRAUGHTSMAN

Wanted, draughtsman familiar with papermill machinery and experienced in paperboard mill design. Apply box No. 183-V, The Engineering Journal.

DRAUGHTSMAN

Mechanical draughtsman experienced in steam power plant design. Apply box No. 184-V, The Engineering Journal.

MECHANICAL DRAUGHTSMAN

Young mechanical draughtsman with technical training and some practical experience in plant layout and upkeep for large firm in western Canada. Apply Box No. 185-V, The Engineering Journal.

ASSISTANT ENGINEER IN CHARGE OF BUILDING MAINTENANCE

Applications will be received until February 18th for the position of assistant to the engineer in charge of building maintenance with a large financial institution which owns, in addition to a large office building in Montreal, buildings in various centres in Canada. Work to comprise supervision of plant operation and maintenance, purchasing of equipment and supplies, and office equipment. Applicants must be recent graduates in engineering, preferably mechanical or electrical. Apply Box No. 186-V, The Engineering Journal.

MECHANICAL ENGINEER

A well-known company manufacturing equipment for hydraulic plants, pulp and paper mills, and mining, requires the services of a young engineer with shop experience and other relative work, as general assistant in the engineering department. Applicant should have some shop experience and should be a graduate in mechanical engineering. Apply giving full particulars of qualifications, to box No. 187-V, The Engineering Journal.

FOREST PRODUCTS ENGINEER, GRADE 3

A Forest Products Engineer, Grade 3, (Male), Forest Branch, Department of the Interior, Ottawa, at an initial salary of $2,820 per annum, which will be increased upon recommendation for efficient service at the rate of $120 per annum, until a maximum of $3,240 per annum has been reached.

Duties.—To plan, collect and prepare exhibits of forest products; to design and supervise construction of experimental wooden equipment and structures; to prepare exhibits of forest products for educational purposes; to write suitable specifications and descriptions of all wooden materials and structures used in exhibits and in industry; to supervise wood workers; to write special articles regarding wood utilization, and to perform other related work as required.

Qualifications Required.—Education equivalent to graduation in forestry or applied science from a university of recognized standing; at least two years experience with educational, administrative or industrial organizations directly concerned with wood utilization; supervisory ability. Experience in exhibition methods is an important qualification for this position. While no definite age limit has been set for this competition, age may be a determining factor in making a selection.

Application forms properly filled in must be filed with the Civil Service Commission, Ottawa, *not later than February 16, 1928.* Application forms may be obtained from the offices of the Employment Service of Canada, from the Postmasters at Prince Rupert, Vancouver, Victoria, Edmonton, Calgary, Regina, Saskatoon, Winnipeg, Quebec, Fredericton, St. John, Charlottetown, and Halifax, or from the Secretary of the Civil Service Commission.

Situations Wanted

DESIGNING ENGINEER

Extensive experience in design, manufacture and sale of all types of cranes, also works and office organization, seeks position as chief engineer. Can undertake complete development of crane production. Apply box No. 232-W, The Engineering Journal.

ELECTRICAL ENGINEER

Electrical engineer, 27 years of age, University of Toronto graduate, six years diversified experience, two years Westinghouse engineering course, inspection of electrical equipment, industrial construction and maintenance, testing and research; at present employed in United States; wishes to return to Canada. Available on reasonable notice. Apply box No. 231-W, The Engineering Journal.

ELECTIONS AND TRANSFERS

At the Meeting of Council held on January 18th, 1928, the following elections and transfers were effected:—

Associate Members

ARCHIBALD, Samuel Wallace, B.A.Sc., (Univ. of Toronto), private practice in engineering and surveying, Seaforth, Ont.

BARRETTE, Adrien, B.Sc., (Ecole Polytechnique), asst. engr., Tech. Service, city of Montreal, Montreal, Que.

BONAVENTURE, Joseph Eugene, B.A.Sc., (Ecole Polytechnique), asst. dist. engr., Dept. of Public Works, Canada, Three Rivers, Que.

BOURBONNAIS, Paul Emile, C.E., B.A.Sc., (Laval Univ.), senior staff engr., Quebec Streams Commission, Montreal, Que.

HUMPHREYS, David, asst. to ch. engr., hydro-electric dept., Sir W. G. Armstrong, Whitworth and Co., i/c field work installing hydro control equipment and auxiliary plant on the Humberarm development, Deer Lake, Nfld.

McCLELLAND, Harold Langdon, B.A.Sc., (Univ. of Toronto), demonstrator and research asst., Dept. of Mining Engrg., Univ. of Toronto, Toronto, Ont.

McPHAIL, Alexander Lyall, B.A.Sc., (Univ. of Toronto), asst. city engr., St. Catharines, Ont.

Affiliates

CUNNINGHAM, John Ferguson, supt. of test labs., Dept. of Civil Engrg., Univ. of Manitoba, Winnipeg, Man.

TOWNSEND, Charles Rowlatt, B.Sc. and M.Sc., (Univ. of N.B.), with logging division of Laurentide Co. i/c field work of various projects, Grand'Mere, Que.

Transferred from the class of Associate Member to that of Member

DUPERRON, Arthur, B.A.Sc., (Ecole Polytechnique), ch. engr., Montreal Tramways Commission, Montreal, Que.

Transferred from the class of Junior to that of Associate Member

KIDD, William Sidney, B.A.Sc., (Univ of Toronto), asst. ch. engr., E. B. Eddy Co., Hull, Que.

MACKENZIE, John Fenwick Fraser, with Dom. Bridge Co. as asst. ch. dftsman, Montreal.

WALKER, George Stuart, B.Sc., (Queen's Univ.), i/c constrn. and mtce. of roads and ry., inc. location, constrn. and operation, with Imp. Oil Co., Negritos, Peru.

Transferred from the class of Student to that of Associate Member

FARMER, Eric Westover, B.Sc., (McGill Univ.), elect'l engr. on short-wave transmitter development with Can. Marconi Co.

GEIGER, Douglas George, B.Sc., (Queen's Univ.), lecturer, elect'l engr., Queen's Univ., Kingston, Ont.

METHE, Philippe, B.A., C.E., (Ecole Polytechnique), principal, Quebec Tech. School, Quebec, Que.

Transferred from the class of Student to that of Junior

CREASE, Charles Edward, B.Sc., (N.S. Tech. Coll.), industrial control engrg., C.G.E. Co., Peterborough, Ont.

HOLMES, Everett Eric, B.Sc., (McGill Univ.), i/c service order section, plant operations, general plant dept., Bell Telephone Co., Montreal, Que.

SHAW, Gerald Edison, B.Sc., (McGill Univ.), designing reinforced concrete and steel structures, bridge dept., C.P.R., Montreal, Que.

TOUPIN, Valerien, B.A., (Laval Univ.), B.A.Sc., (Ecole Polytechnique), with St. George and Gauvreau, Limited, Montreal, Que.

BRANCH NEWS

Border Cities Branch

Orville Rolfson, A.M.E.I.C., Secretary-Treasurer.

The first meeting of the New Year was held by this branch on January 13th, at the Prince Edward hotel, Windsor, and was one of the largest and most successful meetings in recent years.

The speaker of the evening was E. J. Paulus, chief construction engineer for the McClintic-Marshall Company on the Detroit River International bridge. In beginning his address, Mr. Paulus expressed his appreciation of the splendid co-operation which the builders of this bridge are receiving from the Dominion and provincial govemments, the municipal authorities and the public in general on this side of the river. He also paid a glowing tribute to Lt.-Col. C. N. Monsarrat, M.E.I.C., in regard to his work on the bridge project, in reviewing the design and the report submitted by him thereon to the Minister of Railways and Canals.

Proceeding with a description of the bridge, the speaker explained that it is to be of the suspension type, the main river span being 1,850 feet centre to centre of piers, a record span, until recently, when the McClintic-Marshall Company projected a new bridge across the Hudson river, with a span of 3,500 feet. There will be two parallel wire cables, 20 inches in diameter, of 37 strands each, 216 wires per strand, No. 6 gauge galvanized high carbon heat treated steel, passing over flexible steel towers, approximately 380 feet in height, and fastening to anchors consisting of two concrete blocks 22½ by 100 feet on rock, fastened together by a concrete strut and having a balancing superstructure of concrete as a counterweight.

The pull to be resisted by the anchorage is 20,000,000 pounds. Rock is 117 feet below ground level, but in the design no account is taken of the earth resistance. The cables will be connected to the anchorage a short distance below ground,—about twenty feet,—where the overturning moment on the anchor piers is balanced by the counterweight. The portion of the bridge between main span and anchorages is supported independently. The distance, anchor to anchor, is 3,560 feet, and the entire length of the bridge, including approaches, is 9,000 feet. The maximum grade on the approaches is 5 per cent occurring on the American side, where it has been necessary to introduce an *S* curve. Stiffening trusses, hung from the cable between the main towers, will be 22 feet deep, of the pony truss type. The deck type floor system will be used.

Clearance above recorded high water is 152 feet, at the centre of the span, and 135 feet at the piers. This is about 156 feet above the present water level at the centre of span. Street clearances have been fixed at a minimum of 15 feet.

The width of the roadway is 47 feet to accommodate five lines of traffic. This is a new departure, as traffic lines are usually provided in even numbers, but in this case it was felt that traffic would be greater in one direction. An 8-foot sidewalk is provided on one side of the bridge. Owing to the length of the bridge, the grades to be overcome and the rapid abandonment of the walking habit in these times, it is felt that the tolls from pedestrians will hardly justify the expense of its inclusion.

The progress made to date is satisfactory. The main piers each consisting of two concrete caissons 38 feet in diameter, with an 18-foot well in the centre, are being put in by the Foundation Company. One is down to rock on the American side, and work is being carried on under air.

Several members of the branch engaged in the discussion which followed the address. Harvey Thorne, M.E.I.C., the chairman, in voicing our appreciation of Mr. Paulus' interesting talk, expressed the hope that at some future time, when the work has progressed further, we may again hear from Mr. Paulus, on the problems of construction encountered and the methods used to solve them.

Calgary Branch

H. R. Carscallen, A.M.E.I.C., Secretary-Treasurer.
W. St. J. Miller, A.M.E.I.C., Branch News Editor.

There was a record attendance at the annual dinner and smoker held on January 6th at the Elizabethan room of the Hudson Bay store. Nearly one hundred members and guests sat down to enjoy the evening's repast and entertainment as F. K. Beach, A.M.E.I.C., took the chair by virtue of his office as chairman of the branch. A specially designed programme was produced containing the menu, toasts, and concert features. The chairman had the honour of introducing several prominent citizens and guests some of whom were scheduled on the toast list for speeches. Their words were listened to with much interest and gratification. Both the Mayor and the Ex-mayor of Calgary spoke eulogistically concerning The Institute, its members, its aims, and the engineering profession in general. Mayor Osborne in his reply to the toast to the guests pointed out how dependent civic governments were on heads of departments which often included technical men, and stated that the city of Calgary in particular was fortunate in the calibre of the engineers residing here. His New Year resolution for Calgary would be—a home city of happy citizens in useful occupations.

Ex-mayor Webster was in a reminiscent mood when referring to his early experiences as an engineer-contractor, reminding his hearers of his nickname of "Classification" Webster when on railroad work. There was a third Mayor present at this function in the person of Mayor Stewart of Yorkton, Saskatchewan, whose spontaneous discourse was one of the humorous features of the evening.

J. H. Ross, A.M.E.I.C., in a forceful speech urged that the engineer should aim to secure and hold fast his rightful place among the professions. Engineering failures, he said, produced only an added stimulus to the profession of engineering, and he stressed the point that the part played in the world to-day by the engineer was a most important one, but sadly left out of the picture of success. The speaker questioned how many knew the maker of the engine which carried Col. Lindbergh to Paris, yet his success was due largely to the designer and maker of the plane and engine. Failure of the mechanism has too often been the cause of unsuccessful attempts of flying, and the world looks to the engineer for the remedy. He pointed out how much a government and city council depended on the engineer, and that if he failed the governing body was likely to lose favour and office.

R. M. Dingwall, A.M.E.I.C., replied to R. A. Brown's proposed toast to the E.I.C. in a humorous vein, amusing those present with his jocular personal reflections.

J. W. Crawford, President of the Bar Association, paid compliments to the profession of engineering, going so far as to acknowledge the possibility that it might take precedence in point of age over that of his own profession in reference to the construction of the crude huts of prehistoric man.

Several amusing caricatures were thrown on the screen, which were interspersed with jokes at the expense of the members present. Vocal selections and community singing brought a successful event in the annals of the branch to a close.

W. B. Trotter, A.M.E.I.C., is now a member of the firm of Trotter and Morton, Limited, in Calgary, having taken over the local firm of the James Ballantyne Company, Limited, by whom he was employed for a considerable number of years. His firm is now in the market as contractors for plumbing, heating and power work, also automatic sprinkler systems.

The annual general meeting of the branch is to be held in Saturday, March 10th, at which the election of officers for the coming year will take place.

Hamilton Branch

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

Executive Meeting

A meeting of the executive of the Hamilton Branch was held at 5 o'clock on Friday, January 6th. L. W. Gill, M.E.I.C., the chairman of the branch, presided. Six other members of the executive were present together with some members of past executive committees who were present by invitation.

Two applications for transfer were considered and recommendations made. H. A. Lumsden, M.E.I.C., chairman of the Meetings and Papers Committee, reported that arrangements were practically completed for a meeting to be held on January 31st, the subject being on the St. Lawrence Waterways Development. Other plans for branch activities for the coming year were also discussed.

London Branch

Frank C. Ball, A.M.E.I.C., Secretary-Treasurer.

Visit to Lime Quarries

The regular October meeting of the London Branch was combined with an inspection trip to the Beachville lime quarries and a dinner at Woodstock. The quarries of the Beachville White Lime Company and the operation of their plant proved very interesting.

Members from London, St. Thomas and Woodstock, met at the limestone quarries where officials of the company were present to act as guides. The party was conducted over the quarries and allowed to inspect a charge that had been set ready to "shoot." Drilling operations were also under way for the next "shot." After an inspection of these and the loading and stripping work the quarry was cleared and the shot was fired. Members of the party were interested in the fuse that was used and in the manner in which the stone was completely broken up by the shot. The trip was continued over the crushing and screening plants and to the lime kilns. Many points of interest were found by the members and all questions were ably answered by officials of the company.

Limestone and Its Derivatives

The party motored to Woodstock where dinner was served at the Hotel Oxford, Mayor Parker, of Woodstock, being one of the guests. A paper by Bruce C. Matson, S.E.I.C., on "Limestone and Its Derivatives" was read by W. G. Ure, A.M.E.I.C., in the absence of Mr. Matson. The author of the paper is thoroughly conversant with the limestone industry in Canada, and his paper revealed to the engineers the extent of this industry and the many uses to which limestone and its products are put.

The origin of limestone rocks was briefly described and their classification according to texture and to chemical composition was given in detail. The distribution of limestones in Ontario was quoted from a government report and then the production of limestone products was described with special reference to lime burning and "slaking." The varied uses of limestone products proved to be of the greatest interest to the members present. The paper dealt with the possible discovery of the character of slaked lime and its most common use in mortar. Other uses of lime include its use in aggregates, plasters, Portland cement, and sand lime bricks, paints and varnishes, dyes, paper, textiles, radiators, furnaces, glass goods, leather goods, glues, rubber goods, water purification and softening, ammonia, linoleum, pottery, cosmetics, oils or greases, sugar, etc.

The uses of limestone and its derivatives were divided into three main classes; in agriculture, construction and the chemical industry. The method of using limestone in various ways in these three classes was gone into in some detail. The limestone quarried at Beachville is a high-calcium limestone used entirely for chemical purposes, so the paper included descriptions of many uses under this heading.

Electric Steam Generation

On November 23rd, 1927, a regular monthly meeting was held in the Board Room of the Public Utilities Commission. D. M. Bright, A.M.E.I.C. a member of the London Branch, was the speaker and his subject "Electric Steam Generation."

The method of generation of steam described by Mr. Bright was one not in very common use and therefore was of particular interest to the engineers present.

There are two classes of electric steam generators, (1) metallic resistance type, (2) water resistance type. The latter type was described by Mr. Bright, who pointed out that it can be used only with alternating current. Where there is surplus current and where the demand is intermittent this method is specially adaptable and gives a great saving in labour cost over the coal-fired boiler method.

Cast iron electrodes are immersed in water and current is passed through the water. The resistance of the water raises its temperature to a degree sufficient to generate steam. One advantage of this system is that it lends itself very easily to automatic control, the pressure of the steam generated lowers the level of the water, forcing it back into the storage tank and thus decreasing the area of electrode immersed and reducing the rate of generation of steam until the pressure decreases. At this stage the pressure in the storage tank, controlled by a check valve on the steam line, again raises the water level and increases the rate of steam generation. This simple automatic control is responsible for the great saving in labour cost.

Mr. Bright described, with the aid of drawings and a small working model, the different types used for working pressures up to 250 pounds per square inch. As part of the discussion following the address, E. V. Buchanan, M.E.I.C., spoke on the general aspects and possibilities of electric heating.

W. C. Miller, A.M.E.I.C., our local representative on Council gave a report of the recent Plenary Meeting of Council, explaining in detail some of the more important proceedings.

Executive Meeting

At the executive meeting on December 14th, 1927, the proposed increase in fees was discussed and the situation was explained by Mr. Miller. In view of the points discussed at the Council session the members of this branch executive were of the opinion that the proposal to limit the increase in fees to Members was justified and therefore no action was taken by the London Branch to offer an amendment to the amendment proposed by Council.

Highway and Bridge Construction

The speaker at the December meeting held on December 28th, 1927, was Jas. A Vance, A.M.E.I.C., vice-chairman of the London Branch. Mr. Vance gave an interesting illustrated description of some of the highway and bridge construction jobs with which he has been connected during fourteen years of engineering and contracting.

The illustrations showed the methods of construction and the equipment used in constructing various concrete arch and steel bridges. The speaker also described methods of placing large plate girders and of replacing railroad bridges with a minimum of the interruption of regular traffic. Mr. Vance supplemented the story of his own experiences with illustrations and descriptions of some of the leading Canadian and European bridges of reinforced concrete and steel design.

At the end of the meeting the members and guests spent a social hour together during which time light refreshments were served by the executive.

Moncton Branch

V. C. Blackett, A.M.E.I.C., Secretary-Treasurer.

The regular monthly supper-meeting of the branch was held at the Y.M.C.A. on January 11th. During the evening, members were pleasantly entertained by vocal solos by Mrs. George Ross, and violin selections by Mr. Avard Carter.

Immediately after the supper, the meeting took up the matter of Council's proposed amendment to Section 76 of the By-Laws. The consensus of opinion was that the result of the adoption of this amendment would be that suggestions originating with members from outlying branches might never be allowed to go to ballot. Following a vigorous discussion, a motion condemning the proposed amendment was moved by C. S. G. Rogers, A.M.E.I.C., seconded by A. S. Gunn, A.M.E.I.C., and carried unanimously. The secretary was instructed to advise the various branches and members of Council of the action taken by Moncton Branch. G. C. Torrens, A.M.E.I.C., the presiding chairman, then introduced P. L. Pratley, M.E.I.C., who addressed the branch on the subject of the Montreal South Shore Bridge.

The Montreal South Shore Bridge

For the reason that the single roadway over the Victoria bridge could but inadequately handle the tremendous volume of motor traffic pouring into Montreal from that part of Quebec south of the St. Lawrence river and from the United States the need for additional highway facilities connecting Montreal with the south shore had become imperative. The new structure which will be completed in 1930 will have a total length of two miles and will cost in the vicinity of twelve million dollars. Mr. Pratley discussed at some length the various proposed designs and locations. The progress of the work was described with painstaking attention to detail, and illustrated by slides depicting every phase of construction.

At the conclusion of the address a hearty vote of thanks was accorded the speaker on motion of C. S. G. Rogers, A.M.E.I.C., seconded by J. R. Freeman, A.M.E.I.C.

Niagara Peninsula Branch

Walter Jackson, M.E.I.C., Secretary-Treasurer.
C. G. Moon, A.M.E.I.C., Branch News Editor.

A number of branch members motored to Niagara Falls, N.Y., on the evening of January 13th to attend a joint dinner meeting with the Niagara Frontier Section of the American Institute of Electrical Engineers and the Electrical Section of the Empire State Gas and Electric Association.

Electrical Transients

The programme consisted of an address by Prof. Vladimir Karapetoff of Cornell University on "Electrical Transients." His subject was divided into two parts, "Transients in Time" and and "Transients in Space," and treated in a very simple manner with frequent reference to analogous hydraulic occurrences.

Transients are most important particularly in the design of electrical apparatus, said Professor Karapetoff; and my mission to-night is not to treat with the technical aspects of the subject but rather to try and interest some of the younger engineers in order that they may be able to carry on the studies which have so far been made. Steimetz, Magneson, Franklin, Russel, Rudenberg and Wagner were some of the authorities mentioned by Professor Karapetoff and the "Transactions" of the American Institute of Electrical Engineers to carry a wealth of informative detail.

The facilities for observing and measuring transients have improved greatly in the last generation. Thirty years ago a 300-cycle oscillograph was the most sensitive instrument, to-day the surge-recorder or clynonigraph and the cathode-ray oscillograph will record about 100 oscillations in one micro-second or a hundred million oscillations a second.

Electrical terminal equipment, as it is to-day, evolved mainly from a process of trial and error, but with the present facilities for observation and study the aim of the scientist should be to predict. "To predict rather than to be sorry."

Many of the large corporations have set aside tremendous sums for research along these lines, but individual effort is not to be ignored; "history has indicated that research solely after truth has given greater and better results than that undertaken for purely practical or utilitarian reasons."

During the short intermission between the two parts of his subject this remarkable man sat at the piano and gave a brilliant interpretation of one of Macdowell's latest suites. Both the lecture and the music—or either—were very high examples of artistic ability. Part of the audience wished that he had played for a longer time, part wished that he had talked more and some were satisfied that they had had a glimpse of that rare combination,—"Genius tempered with Humour."

Ottawa Branch

F. C. C. Lynch, A.M.E.I.C., Secretary-Treasurer.

Annual Meeting

Marking the conclusion of a year of considerable progress, the Ottawa Branch of The Engineering Institute of Canada, at its annual meeting, which took place in the Daffodil tea room January 12th, elected Dr. Charles Camsell, M.E.I.C., deputy minister of the Department of Mines, to the chairmanship for the ensuing year.

The report of F. C. C. Lynch, A.M.E.I.C., who was again elected secretary-treasurer, indicated that finances were satisfactory and that the membership of the branch had been augmented.

F. H. Peters, M.E.I.C., chairman of the Proceedings Committee, in his report, pointed out that the large attendance at the luncheons given by The Institute attested to their popularity. Reference was made by Mr. Peters to the suggestion that evening meetings which would produce discussions amongst the members on technical subjects of general interest be revived.

This aroused considerable discussion and it was felt that in the future civic engineering and planning matters should be given special attention. The McGregor lake scheme was mentioned in this connection, the idea being that both sides of the question at issue should be under debate.

Other reports adopted were: Membership, Col. A. E. Dubuc, M.E.I.C.; Librarian, M. F. Cochrane, M.E.I.C.; Sub-committee on Advertising, Alan K. Hay, A.M.E.I.C.

N. Cauchon, A.M.E.I.C., retiring chairman, gave a brief address wherein he expressed appreciation of the co-operation of the various committees, and Dr. Camsell on assuming the chair expressed appreciation of the honour conferred on him.

In addition to Dr. Camsell and Mr. Lynch, the following comprise the committees for the ensuing year: A. K. Hay, A.M.E.I.C., W. Blue, A.M.E.I.C., F. H. Peters, M.E.I.C., V. M. Meek, M.E.I.C., G. A. Browne, A.M.E.I.C.

Consequent to the election of officers, refreshments were served and a motion picture was screened, furnished through the courtesy of B. E. Norrish, A.M.E.I.C., of Montreal, a former member of the Ottawa Branch of The Institute. Mr. Charles O'Reilly officiated at the piano.

Members of Branch Invited to Other Meetings

A lecture on "Making of Optical Lenses in England during War Time" under the auspices of the Royal Astronomical Society of Canada (Ottawa Branch) was given in the Victoria Memorial Museum on the evening of January 17th by A. J. Ames, AFFILIATE E.I.C., of Instruments Limited. A cordial invitation to attend this lecture was extended to the members of the Ottawa Branch of The Engineering Institute.

Through the courtesy of the Department of Mines the Ottawa Branch of The Engineering Institute of Canada was invited to attend a lecture in the Victoria Memorial Museum on the evening of January 9th by Dr. Etienne S. Bieler, professor in the Department of Physics, McGill University. The lecture, which was on the subject of "Electrical Prospecting," gave a brief review of the various methods of prospecting by electric currents and was illustrated by lantern slides and practical demonstrations.

Peterborough Branch

W. E. Ross, A.M.E.I.C., Secretary.
B. Ottewell, A.M.E.I.C., Branch News Editor.

A regular meeting of the Peterborough Branch was held on the evening of January 12th, 1928, at which the speaker was Flight Lieutenant A. Ferrier, A.M.E.I.C., of the aeronautical engineering division of the Department of National Defence. Taking as his subject "The Aeroplane as an Engineering Problem," Lieut. Ferrier described in a most interesting and lucid manner the methods by which the aeronautical engineer attacks the problems in the design and production of an aeroplane.

The Aeroplane as an Engineering Problem

Dealing with his subject under several main headings, the speaker stated that the first important step was to make up specifications for the machine to be designed. This led to definitions of some of the terms used, including bare weight, useful load, gross weight, pay load, disposable load, etc. The speaker defined the maximum range as number of hours at full throttle. Performance requirements vary very widely depending on the service for which the plane is required. The speaker mentioned that the gross weight of a plane may vary from as low as three pounds per horse power in a racing machine to twenty-five pounds in commercial transport planes. Landing speed is settled by considerations of safety and is taken as 40 to 50 miles per hour in this country.

Proceeding to the subject of wing or aerofoil design, the speaker mentioned that aerodynamic and structural requirements are in complete discord and that the design is mostly a question of compromise. A clear exposition of the advantages and disadvantages of monoplanes, biplanes, and sesquiplanes was then given.

The speaker next dealt with the design of the body or fuselage and the requirements for longitudinal balance.

The power plant was the next subject to be discussed and it was shown how the development of aeroplane engines had been carried on by the automobile industry. The weight of modern aeroplane engines varies from three pounds per horse power to less than one pound per horse power in racing machines. Among the important points emphasized were reliability and compactness. The reasons governing the choice of the radial air-cooled and the "in line" water-cooled types were given.

The speaker then described the use of super chargers and boosters for working at high altitudes. The materials entering into the construction of planes were briefly discussed. It was mentioned that with the use of wood on the decrease, steel was most commonly used in England and duralumin in Europe, whereas both materials were used on this continent.

There was considerable discussion subsequent to the paper and Lieut. Ferrier answered a large number of questions. Besides the members of the branch, there were present several representatives from the Canadian Air Services Company, including Captain Ayres. A hearty vote of thanks was accorded Lieut. Ferrier for his paper.

Executive Meeting

A pleasant departure in the way of executive meetings took place on January 4th when the executive and past chairmen of the branch were invited by the chairman, A. E. Caddy, M.E.I.C., to meet at his house. After the business had been dealt with, there was a very enjoyable evening's entertainment at bridge and supper. Novel table decorations were a compass with sights over one hundred years old, a theodolite and a transit theodolite.

Mr. Caddy also exhibited an interesting model of the old railway bridge across Rice lake.

Quebec Branch

Philippe Méthé, S.E.I.C., Secretary-Treasurer.

A general meeting of the Quebec Branch of The Institute was held at the Chateau Frontenac, on November 7th, under the chairmanship of A. B. Normandin, A.M.E.I.C., A. R. Decary, D.A.SC., M.E.I.C., president of The Institute, and about seventy members and friends were present.

Col. H. C. Boyden, formerly dean of the College of Engineering, Ohio Northern University, and well known to members through his previous lectures under the auspices of the Portland Cement Association, addressed the members. The subject chosen was, "Workability in Concrete with Particular Reference to the Use of Diatomaceous Silica."

Col. Boyden reviewed the history of cement. Portland Cement is over a century old. Since its discovery, the building of concrete structures has been a rapidly increasing practice, until to-day there is no more universally used building material known to men.

The production of cement in the United States and Canada was 175 million barrels in 1926, against 85 million in 1919. Allowing 1½ barrel of cement, at an average cost of $10.00 per cubic yard of concrete, there were placed last year, 117 million cubic yards, at a cost of $1,170,000,000. The problem of obtaining the greatest value for the money spent is confronting the constructor everywhere.

Expensive and exhaustive investigations have been and are being carried on, and have given much knowledge regarding the factors that control the quality of concrete. Good results, however, can only be obtained from co-operation between the engineer and the man on the job.

The speaker explained that diatomaceous silica composed of the remains of the simplest form of plant life, called "diatoms," added to the mix to the extent of say two to three per cent, greatly increases the workability, and adds to its bulk, so that construction cost is lowered.

A series of lantern slides showed the greater workability resulting in structures of improved beauty and quality.

Numerous examples were shown of structures embellished with artistic designs, absolutely perfect through the use of this product in the concrete, and the speaker stated that no trowel work was required after the forms were removed.

The members were much interested in the subject, and the speaker had to answer a great number of questions.

Luncheon Meeting

At the Chateau Frontenac, on Monday, December 19th, the members of the Quebec Branch were invited to a luncheon. The guest of honour, the Honourable Frank Carrel, member of the Legislative Council, addressed the members and visitors, on "Industrial Evolution."

Hon. Mr. Carrel outlined the history of the growth of industry in the province of Quebec from the individual or family industry of the time of the pioneers, to the huge consolidations of to-day. "To-day," said Mr. Carrel, "if I were asked who has most contributed to the development of our province and of the whole of Canada, I would not hesitate to answer that it is the engineer. Yet, you engineers do not seem to have confidence in publicity to tell the public of your achievements."

"The large industries of the province of Quebec and Canada will be a lasting monument to the science and skill of the engineers. Canada is proud of their works by which our country is known and appreciated and our natural resources developed.

"The engineers are not sufficiently known to the public; their names are omitted when the papers relate the history of large buildings, magnificent plants, splendid monuments which they have built, and which they have conceived.

"Quebec can judge of the value of engineers by the important positions they hold in the administration of large industrial organizations."

The luncheon was presided over by A. B. Normandin, A.M.E.I.C., chairman of the branch, and was attended by about forty members and guests. W. G. Mitchell, M.E.I.C., heartily thanked the Honourable Mr. Frank Carrel on behalf of the members.

Executive Meeting

At a business meeting of the Executive Committee of the Quebec Branch, held on November 22nd, it was unanimously decided to express the sincere gratitude of the branch to Miss Boswell who generously gave all the books from the library of her father, the late Mr. St. George Boswell, for many years a prominent member of the engineering profession in Canada.

Saint John Branch

W. J. Johnston, A.M.E.I.C., Secretary-Treasurer.

Annual Meeting, Association Professional Engineers, N.B.

On the afternoon of January 10th, 1928, the annual meeting of the Association of Professional Engineers of New Brunswick was held at the Admiral Beatty hotel. The meeting was devoted to routine business and the election of officers for the coming year. The election of officers resulted as follows:—

President—S. R. Weston, M.E.I.C., Saint John; Vice-President—Professor H. W. McKiel, M.E.I.C., Sackville; Councillors—Saint John District—J. P. Mooney, A.M.E.I.C., and W. R. Pearce, M.E.I.C.; Moncton District—G. C. Torrens, A.M.E.I.C., F. Williams, A.M.E.I.C.; Fredericton District—Professor J. S. Stephens, M.E.I.C.; Chatham District—J. O. B. Stevens of Campbellton; Auditors—H. F. Morrissey, A.M.E.I.C., and E. J. Owens, A.M.E.I.C.; Secretary—J. A. W. Waring, A.M.E.I.C.

Joint Dinner—Branch Meeting

In the evening a joint dinner was held of the Saint John Branch of The Engineering Institute of Canada and the Association of Professional Engineers of New Brunswick. S. R. Weston, M.E.I.C., chairman of the Saint John Branch of The Institute, presided. A guest at this dinner was P. L. Pratley, M.E.I.C., of Montreal.

A toast list was observed and was introduced by the toast to The King. The toast to The Engineering Institute of Canada was proposed by C. C. Kirby, M.E.I.C., of Saint John, and replied to by G. C. Torrens, A.M.E.I.C., of Moncton. The toast to the Association of Professional Engineers of New Brunswick was proposed by G. G. Murdoch, M.E.I.C., of Saint John, and responded to by Geoffrey Stead, M.E.I.C., of Saint John.

Following the dinner an illustrated address on the Montreal South Shore Bridge was given by P. L. Pratley, M.E.I.C., of the firm of Monsarrat and Pratley, Montreal. This address was illustrated by a large number of slides and enabled the audience to grasp the various construction features and difficulties met with in the construction of this bridge. To the laymen present probably the most interesting part of the address was the history of the earlier bridges built across the St. Lawrence at Montreal, of the various enlargements of existing bridges to meet ever-increasing traffic, of the need of the present bridge now under construction to take care of motor traffic, and of the various studies made of the locality until the final site was decided on. It was a very interesting address throughout. A vote of thanks to Mr. Pratley was moved by J. N. Flood, A.M.E.I.C., of Saint John and W. J. Lawson, A.M.E.I.C., of Fredericton.

Saskatchewan Branch

R. W. E. Loucks, A.M.E.I.C., Secretary-Treasurer.

The December meeting of the Saskatchewan Branch was held at the Hotel Saskatchewan, Regina, on December 19th. Guests present included Hon. George Spence, minister of highways for Saskatchewan, Mayor McAra and Alderman N. J. Taylor of the city of Regina.

This meeting was referred to as a "Convention Meeting," the purpose being to have reports on a number of Conventions held during the past season, which have been attended by members of the branch. The programme as arranged provided a fund of material and proved to be of a highly educative value to those in attendance.

The Value of Conventions

H. N. Macpherson, A.M.E.I.C., spoke of the value of conventions where papers are read and discussions follow amongst experts closely in touch with their respective lines of work. The delegates are thrown into intimate contact with other representatives, and frequently acquaintanceships and friendships are formed which prove of lasting value. It enables an organization to advertise its work and activities through its delegates.

Street Railway Convention

T. McGuinness, A.M.E.I.C., in a humorous vein told of the Street Railway Convention held in Winnipeg last summer. The exhibits displayed at this convention are of particular merit and value. The attendance at this convention, which is held at various centres each year, has grown to large proportions.

Canadian Telephone Association Convention

Mr. C. W. Doody, traffic superintendent, Department of Telephones, outlined the activities of the delegates at the convention of the Canadian Telephone Association, held at Minaki, Ont., in August last. He referred to the formation of this association some years ago due to necessity of co-operation in the telephone business, where the constituent organizations are closely related one to the other and through traffic is dependent on efficiency of each particular section.

At these conventions the principle of segregating the delegates into groups for round table conferences has been adopted and found to be much superior to the general open convention. Many of the papers presented are of a highly technical nature. These are usually printed and distributed to members of the profession, who look upon them as text books.

Canadian Good Roads Convention

H. S. Carpenter, M.E.I.C., dealt with some of the papers read before the recent Good Roads Convention held at Niagara Falls, Ont., in September last. His remarks covered, bridges, contractors' problems, sand and clay roads, and winter roads. He referred to the work of the Bridge Department of Saskatchewan in erecting and maintaining over 2200 bridges in this province including 3 highway bridges over the Saskatchewan river, also traffic attachments to several of the railway bridges. The use of a mixture of sand and clay is found to be very satisfactory on earth roads in the Prairie Provinces where the nature of the surface soil is unsuitable as a road surface. Right-angled intersections on provincial highways are being abandoned in favour of curves. The latter are found to be more suitable for present day traffic and the reduction in the length of grade more than compensates for the cost of the extra land required. Present day tendency is to build higher grades, thus overcoming drainage problems and snow in winter. Experiments are being carried out at present on the clearing of certain highways in this province for automobile traffic. The opinion was expressed that the packing method would not be found the most practical owing to the delay and damage which would result to the road bed by the melting of this packed surface in the spring of the year. The most generally accepted practice of making winter roads for autos is to clear the snow from the road grade, by means of snow plows, etc.

D. A. R. McCannel, A.M.E.I.C., dealt with gravel roads and their maintenance. A "spring blade" grader attached to a truck and propelled at the rate of 12 to 15 miles per hour is found to be very suitable for maintenance work. He also referred to the consolidation of these roads by a tamping roller and the reshaping of the road bed by means of the blade grader. The use of calcium chloride has proven very effective as a dust palliative.

Mr. McCannel also dealt with traffic regulation and enforcement, and the need for uniformity in the rules of the road, legal speed and road signs. Accidents can be materially reduced by education of both drivers and pedestrians. Enforcement should be logical and enforceable. He referred to the use of various engineering devices such as lights, breaks,' guard rails, traffic signs and safety zones, all of which were for the purpose of preventing accidents.

Sault Ste. Marie Branch

A. H. Russell, A.M.E.I.C., Secretary-Treasurer.

The annual meeting was held in the Y.W.C.A. rooms on December 16th, 1927, following a dinner.

Chairman G. H. Kohl, M.E.I.C., called the meeting to order and the various standing committees reported on their activities during the past year. The Papers and Publicity Committee under J. H. Jenkinson, A.M.E.I.C., is to be commended upon the splendid programme of papers and inspection trips arranged for during 1927.

The secretary-treasurer's report showed the branch in good standing and the average attendance at meetings was thirty-five, which was higher than last year.

The Nominating Committee reported the result of the elections for 1928 as follows:

Chairman	W. S. Wilson, A.M.E.I.C.
Vice-Chairman	J. Hayes Jenkinson, A.M.E.I.C.
Secretary-Treasurer	A. H. Russell, A.M.E.I.C.
Executive	A. E. Pickering, M.E.I.C.
	R. A. Campbell, A.M.E.I.C.
	J. V. Fahey, J.E.I.C.
	J. G. Dickenson, M.E.I.C.
Ex-Officio	C. H. E. Rounthwaite, A.M.E.I.C.
	G. H. Kohl, M.E.I.C.

The retiring chairman, Mr. Kohl, gave a short review of the year's activities under his leadership. He expressed his appreciation for the assistance and co-operation of the members and the various committees during the past year and he felt sure that the branch was in safe hands this year after looking over the new executive. He promised to help in any way that he could to make it a more successful year than the past.

The chairman-elect, W. S. Wilson, A.M.E.I.C., thanked the members for the confidence that they had expressed in him by electing him to fill Mr. Kohl's place for 1928. He gave a short talk on branch activities and the importance of Canadian engineers in Canadian development.

The auditors appointed for 1928 were C. H. E. Rounthwaite, A.M.E.I.C., and C. H. Speer, M.E.I.C.

The advisability of buying a lantern and screen by the branch was discussed and the following resolution was passed.

"That the chairman appoint a committee of three with power to select and purchase a suitable lantern, also a screen mounted upon a roller, the whole to be paid out of the funds of the branch and said committee draw up certain rules regulating the handling of the machine." Mr. Wilson appointed the following committee for this purpose: C. H. Speer, M.E.I.C., F. Smallwood, M.E.I.C., G. H. Kohl, M.E.I.C.

Toronto Branch

Recent Developments in Highway Construction in the Province of Ontario

(Meeting reported by F. B. Goedike, A.M.E.I.C.)

The regular meeting of the Toronto Branch was held in the Mining building, Toronto University, Thursday evening, December 15th, 1927, at 8.15 p.m., with the chairman, R. B. Young, M.E.I.C., presiding. After reading the minutes of the last regular meeting, the chairman in a few words introduced the speaker of the evening, Mr. R. M. Smith, deputy minister of highways for the province of Ontario, who gave a very interesting and instructive paper entitled "Recent Developments in Highway Construction in the Province of Ontario."

Mr. Smith showed that, although Ontario in 1920 had only 42 miles of "hard surface" roads, at the end of 1927 it would have 1561 miles made up as follows:—

577.0	miles	concrete
203.4	"	asphaltic concrete
59.6	"	mixed macadam
288.0	"	bituminous penetration
433.0	"	macadam

The total cost, together with 910 miles of gravel, will amount to approximately $66,000,000. The speaker showed that this expenditure was justified alone by the fact that whereas the ordinary motor tire a few years back was only guaranteed for 5,000 miles; its life on hard surface roads has now increased to 20,000 miles. This saving to the motorist on one item alone amounts to ten per cent on the money invested.

Mr. Smith stressed the point that whereas ten years back, concrete pavements, thick at the centre and thinner at the edges, with transverse joints, were the accepted standard, his Department found that for the varying traffic and climatic conditions in the province. it was at a very early date found justifiable to decrease the thickness at the centre and increase the thickness at the edges, and to do away with the transverse joint and in its stead construct a longitudinal metal joint. They had thus been in the forefront in the development of the present type of standard American concrete highway.

With reference to the asphalt used in the construction of asphalt pavements, it was found that the usual 40 penetration asphalt, as used in the United States, was too brittle for the range of winter temperatures in Ontario, and they are now using 58 to 63 penetration which is giving very satisfactory results.

The Department has developed a new type of highway called "asphaltic mixed macadam" which has been found very satisfactory and economical. This pavement is laid hot under traffic conditions without inconvenience, and the thickness depends on the traffic anticipated. The road when finished has a mosaic appearance, is non-skid, with first class riding qualities, and the cheapness of construction, lack of detours, and the safety of surface commend this pavement for extensive use.

Mr. Smith showed some excellent moving picture reels and lantern slides indicative of different types of Ontario pavements at various stages of construction and also discussed the future policies of the Department, and the likely development of highways influenced by the new International bridges at Fort Erie and Windsor.

The paper was well received, and a discussion then followed, among those taking part being: R. B. Young, M.E.I.C., Hydro-Electric Power Commission; H. C. Patten, Toronto Transportation Commission; Geo. McCarthy, M.E.I.C., Sewer Department, City Hall; H. W. Tate, A.M.E.I.C., Toronto Transportation Commission; R. O. Wynne-Roberts, M.E.I.C., consulting engineer.

A hearty vote of thanks was then moved and tendered to the speaker, after which the meeting adjourned.

Farewell Dinner to J. A. Knight, A.M.E.I.C., Vice-Chairman of the Branch

A dinner was tendered by the Toronto Branch Executive on the evening of Thursday, December 29th, 1927, at the Faculty Union, Hart House, to J. A. Knight, A.M.E.I.C., Vice-Chairman of the branch, to bid farewell to him previous to his regretted departure for Arvida, Que., to join the engineering staff of the Aluminum Company of Canada, in connection with proposed hydro-electric developments there.

The chairman of the branch, R. B. Young, M.E.I.C., after referring with sincere appreciation to Mr. Knight's active, continuous, and always willing work during the last five years in the interests of the branch, first as secretary-treasurer, and then as a member of the branch executive, expressed the great regret of all our members that Mr. Knight had been called away at this time from the branch territory. Seeing that other Toronto members were accompanying their vice-chairman, he fully expected, however, (speaking in a humorous vein), that a new branch of The Engineering Institute would be shortly organized at Arvida, and then the Toronto Branch would have to look to its laurels! As a small mark of the executive's appreciation, he then made the presentation of a writing set.

Mr. Knight replied suitably, expressing his regret at leaving and the pleasure that he had always derived from his work and association with the branch, so that any work he had done had not seemed like work, and thanking the members for the very acceptable mark of their appreciation.

The Design and Construction of Viaduct Structure at the New Union Station, Toronto

(Reported by J. W. Falkner, A.M.E.I.C.)

As has been the custom this year when out-of-town speakers have come to Toronto to address the local branch, the regular meeting of the Toronto Branch on Thursday evening, January 5th, 1928, was preceded by a well attended executive committee dinner to welcome the speaker of the evening, A. R. Ketterson, A.M.E.I.C., assistant engineer, Canadian Pacific Railway. The dinner was held at the Faculty Union, Hart House, and its interest was added to by the presence of our General Secretary, R. J. Durley, M.E.I.C., from Montreal, also by distinguished visitors from the engineering staffs of the Canadian Pacific, Canadian National, and Toronto Terminals Railways.

The meeting was afterwards held in the Mining building, one hundred members being present.

After humorously referring to the fact that as a Montreal man they would not expect him to attempt to describe to a Toronto audience the protracted, musty, and arduous negotiations between "'parties" of the "first," "second," "third," "fourth" . . ."*M*th" and "*N*th" parts that had preceded the final viaduct agreement between the city and the railroads, Mr. Ketterson then launched into his subject,—"The Design and Construction of the Viaduct Structure at the New Union Station, Toronto."

Mr. Ketterson's treatment was most clear and explicit, and after a general description of the general design requirements, he specified the reasons that had led to the choice of 'flat slab" construction. The large size of the panels and the very heavy unsymmetrical moving and concentrated loadings were then discussed, and the derivation of the flat slab design formula, and of the equivalent design loadings were given, the Joint Committee formula, primarily based on tall building conditions, not being considered applicable to a one-storey heavy railroad structure. The use of the slope deflection method in checking these design assumptions was set forth in detail, also extensometer tests on the completed structure. Thus, while the stresses in structure were "statically indeterminate," (it being designed as a monolith five bays long by five bays wide), the design formulae and loadings were for all practical purposes considered reasonably economical, and reasonably conservative. A description of the construction methods and the problem of maintenance of traffic at the station was then given, the paper being illustrated throughout by some fifty excellent lantern slides.

The discussion, contributed to by P. B. Motley, M.E.I.C., engineer of bridges, Canadian Pacific Railway; Wm. Gore, M.E.I.C., G. A. Tobias, A.M.E.I.C., J. R. W. Ambrose, M.E.I.C., chief engineer of the Toronto Terminals, and Prof. Peter Gillespie, M.E.I.C., brought out the fact that the panel size was the largest known to those present as having been yet used for such intensive loadings, and that the method of design had had therefore to be largely based on original work The size of the structure was indicated by its equivalence to a double track structure three miles long.

General Secretary R. J. Durley then briefly addressed the members, and the meeting adjourned after the moving and presentation of a very hearty vote of thanks to the speaker.

Victoria Branch

K. M. Chadwick, A.M.E.I.C., Secretary-Treasurer.

At a meeting of the Victoria Branch on December 21st, J. D. Galloway, provincial mineralogist, addressed the members on the mining industry in British Columbia.

In his opening remarks, Mr. Galloway pointed out that there were many openings for young engineers in the mining field in the province. He then reviewed the mining situation in the province. The value of the production in 1927 was about $62,000,000, as compared with some $67,750,000 for 1926.

"The industry, however," said he, "is in a healthy condition, and I look forward to the province reaching a production of $100,-000,000 a year in the near future.

"Mining," said Mr. Galloway, "is the basic industry in material progress. All modern civilization was built up on the use of metals. The stage of civilization and development of the countries were in proportion to the use that was made of these metals. In America and Europe there were vast quantities used. In Asia there was little."

The speaker, in reviewing the outstanding developments in the province at the present time, paid a great compliment to the work done by the Consolidated Mining and Smelting Company, and remarked with satisfaction the interest that the company was manifesting in coast properties. It was therefore with a good deal of hope that the expectation was held out that the company would carry on on the coast something in the treating of ore that was being done with such great success by that organization at Trail.

It was a matter of regret that there was not the prospecting carried on in the province at present that there should be. He, however, was of the opinion that more prospecting would follow with the taking up of more properties that were now held by prospectors for mining companies. There was now a marked increase in the taking up of prospects upon which some work had been done, and the situation, he felt, would soon right itself.

The public did not realize what was done for the industry by the metallurgists. The development of new processes for the treating of ores was working wonders in the world of mining to-day. In this the Consolidated was carrying on a wonderful work. Not only was that company looking after its own ores, but it was giving the small owner the opportunity to have his ores tested out, and the best methods of handling it conveyed to the owners.

At the Consolidated now there were 90 per cent of the ores treated by concentration before they went to the smelter. The same was true to an extent at Anyox. There a few years ago all the ores went direct to the smelter. Now practically all of these were treated by flotation. The result was that lower grade ores than ever before were being handled there and bigger profits were being made from them than from the higher ones when sent direct to the smelter. The speaker then mentioned that a very large part of the money invested in the British Columbia mining industry came from outside of the province and said he would like to see a greater proportion from residents of the province.

In the coal situation, which was one of special interest on Vancouver Island, the situation was not as encouraging as it might be. This was due to the competition of fuel oil from the United States. There had been various processes discussed of late looking to the devising of means for the getting of greater efficiency from the coal.

At the recent meeting of the Mining Institute in Nanaimo the coal mining men had discussed the situation very frankly. They had been united in expressing the opinion that while these processes might be of importance in some parts of the world they were not likely to be applicable here. The opinion was further frankly admitted by them that coal mining had lagged behind in research work, as compared with the metal mining. The modernizing of the business in which they were engaged was urged as the need to meet competition.

Following the address, Mr. Galloway presented a number of views relating to mining in this province, and which served to exemplify some of the facts that he had brought out in his address.

He was introduced by R. F. Davy, A.M.E.I.C., chairman of the Victoria Branch.

Winnipeg Branch

James Quail, A.M.E.I.C., Secretary-Treasurer.

At a meeting of the Winnipeg Branch on November 17th, J. M. Morton, A.M.E.I.C., presented a paper on the work of increasing the pondage at the Point du Bois plant of the City of Winnipeg Hydro-Electric System by the placing of flash-boards on the existing concrete dam.

In 1925 it was realized by the officials of the city hydro-electric system that in periods of low water the forebay was too small if the head of water was on a level with the spillway. The normal discharge over the spillway was usually about 10 cubic feet per second. To assure some control on the head of supply water, I-beams were placed on top of spillway dam and flash-boards dropped between the I-beams. A walk-way was made over the top of the I-beams to allow for handling the flash-boards. Owing to very high levels of water in the spring of 1927 a number of flash-boards and supports were carried away.

To make a rigid superstructure to support the flash-boards, pre-cast concrete piers were fitted over the existing dam surface, iron pipes being cast vertically in the piers to allow of drilling the dam to obtain anchorage. The bottom of the new piers fitted the curved surface of the dam, irregularities being taken care of by means of wood and felt.

To place these piers in position a floating wooden dam and raft were cantilevered across the piers. The force of the water held the raft in position and the wooden dam kept the level of water over the old concrete dam at a level suitable to carry on the work. There was approximately 6 feet of water flowing over dam at time the work was undertaken.

Fifteen hundred feet of spillway was treated in the manner outlined, giving a forebay level regulation of 5 feet.

The paper was illustrated by lantern slides.

C. H. Attwood, A.M.E.I.C., complimented the Hydro on the excellent work performed under very difficult conditions, pointing out that the methods used were unique and very effective.

Professor N. M. Hall, M.E.I.C., enquired as to method used to hold the bottom of the steel form to the surface of the concrete of the spillway dam. Mr. Morton explained that steel forms were in two halves and anchorage of the form was obtained by holding on to the tip of the forms around the I-beam. Irregularities of the dam surface were taken up by means of wood and felt.

J. W. Sanger, A.M.E.I.C., added to Mr. Attwood's remarks in complimenting Mr. Morton on the paper, and pointed out the difficulties under which the work had been performed.

D. L. McLean, A.M.E.I.C., complimented Mr. Morton on the paper, and on the excellency of work performed, and proposed a hearty vote of thanks to the speaker.

Preliminary Notice

of Applications for Admission and for Transfer

January 18th, 1928

The By-laws now 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 election 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 1928.

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 or 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.

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.

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—VIGGO, of Montreal, Born at Roskilde, Denmark, Nov. 23, 1898; Educ., B.Sc., Royal Tech. College, Copenhagen, Denmark, 1923; 1923-24, designing of paving and sewers, inspection and surveying, Roskilde; 1924-25, structural dfting, Chicago Rapid Transit Co.; May to Sept. 1925, designing of paving and sewers, inspection and surveying, Ferndale, Mich.; June 1926 to Mch. 1927, designing and calculation of reinforced concrete, steel and wood constrns., Mun. Gas Works, Copenhagen; May 1927 to date, structural dftsman, Dom. Bridge Co., Lachine.

References: A. Peden, N. Cageorge, D. C. Tennant, G. G. Clarke.

FLEISCHMANN—ALBERT CHARLES, of Montreal, Born at Lyons, France, July 8th, 1899; Educ., C.E., Cluny, France, 1922; 1922-23, Compagnie Energie Electrique, Rhone-Jura survey and design; Mch. to June 1923, Chicoutimi Pulp Co.; 1923-25, Baulne & Leonard, design and details of concrete; 1925-26, United Pierce Dye Works, Passaic, N.J., general engrg.; Feb. to May 1926, Dom. Bridge Co., Lachine, detailing; 1926 to date, technical engr., Sewers Comm. Tech. Service, Montreal.

References: G. R. MacLeod, J. G. Caron, L. R. Wilson, C. J. Desbaillets, P. Baily.

FORTIN—ROMUALD PHILIPPE, of Saint John, N.B., Born at Three Rivers, Que., Feb. 25th, 1883; Educ., high school grad.; 1899-1906, Bell Tel. Co., lineman, combination man and inspector; 1906, Shawinigan Water & Power Co., at Shawinigan power house on mtce. and constrn.; 1908, i/c plant of Thibeaudeau Elect. Light Co.; 1909, contracting and gen. repair work; 1915-17, mech'l constrn. and repair work, Montreal Ammunition Co.; 1917, i/c elec. plant, Howard Smith Paper Mills, as ch. electrician; 1918, with Vincent & Say, gen. elec. contractors; 1920, entered service of Dom. Govt. as inspector of electricity and gas; 1923 to date, dist. inspector for pros. of N.B. and P.E.I.

References: J. D. Garey, E. J. Owens, G. A. Vandervoort, B. Wilson, F. Vaughan, G. Kribs, S. C. Webb.

BERTRAND—GASTON, of Shawinigan Falls, Que., Born at Montpellier, France, Feb. 1st, 1903; Educ., Ecole Orags, Paris, 1915-19; 1919-25, dftsman on complete layouts of pulp and paper and strass board mills, etc., also i/c sale of Schopper's testing apparatus for pulp and paper mills; 1925 to date, dftsman, St. Maurice Valley Corp.

References: G. Claxton, J. F. Lawrence, H. Dessaulles, N. J. A. Vernette, J. C. H. Jette.

DUBOIS—MARCEL, of Montreal, Que., Born at Geneva, Switzerland, Apl. 16th, 1904; Educ., M.Sc., M.I.T., 1927; 1926, Federal Polytechnical Institute, Zurich; 1927, launching and strength tests, Fore River Shipyard, Quincy, Mass.; at present, hydraulic dept., Dom. Engrg. Works.

References: J. A. Shaw, C. E. Herd, H. S. Van Patter, F. P. Shearwood, C. H. Timm.

DUNLOP—RONALD WILLIAM, of Calgary, Alta., Born at Hamilton, Ont., Sept. 28th, 1902; Educ., B.A.Sc., Univ. of Toronto, 1927; 1924-25, dftsman, Imp. Oil Refineries, Ltd., Calgary; at present, dftsman, Imperial Oil Refineries, Ltd., Calgary.

References: J. J. Hanna, R. W. Angus, W. J. McLelland, E. A. Allcut, R. L. Dunsmore.

KARN—HERBERT CHRISTOPHER, of Montreal, Born at Woodstock, Ont., July 4th, 1890; Educ., B.A.Sc., Univ. of Toronto, 1916; 1911 (summer), bldg. concrete structures with W. Lampman, Woodstock; 1912 (summer), elect'l engrg., Woodstock Water & Light System; 1913 (summer), general shop work, Can. Westinghouse Co., Hamilton; 1914 (summer), general shop work, W. Baird & Son; 1915, teaching machine design, Woodstock Collegiate Night School, and elect'l engr., Woodstock Water & Light System; 1916-17, asst. plant engr., Northern Electric Co., Montreal; 1917-18, plant engr., i/c Brit. Munitions Co., Ltd., Verdun; 1918-20, asst. elect'l engr. with H.E.P.C. of Ont.; 1920 to date, elect'l, mechanical and general commercial engrg., engrg. dept., Canadian Industries, Ltd.

References: L. de B. McCrady, I. R. Taid, W. G. Scott, J. T. Farmer, C. K. McLeod, F. Buchanan.

McGEE—THOMAS ALOYSIUS, of Montreal, Que., Born at New York, N.Y., Jan. 13th, 1900; Educ., M.E., Polytechnic Inst. of Brooklyn, 1923, Stevens Inst. of Technology, 1919-22, Fordham Univ., 1918-19; 1922 (summer), rodman, dept. of parks, N.Y.C.; 1923 (summer), inspector, dept. of water supply, N.Y.C.; 1923-25, engr., test dept., of United Electric Light and Power Company, N.Y.C.; 1925-26, engr. i/c tests with Furnace Engrg. Co., Inc., N.Y.C.; Apl. 1926 to Jan. 1927, western sales mgr. i/c all western dist. offices; 1927 to Dec. 1927, advisory and combustion engr.; Dec. 1927 to date, res. engr. of Furnace Engrg. Co. of Canada and vice-pres. and ch. engr. of F. W. Pennock & Co., i/c engrg. for both companies.

References: R. W. Robb, F. W. Pennock, J. M. Robertson, C. W. Burroughs, D. W. Robb.

FOR TRANSFER FROM ASSOCIATE MEMBER TO MEMBER

DEY—VICTOR ALBERT GEORGE, of Toronto, Born at Aberdeen, Scotland, Feb. 4th, 1883; Educ., St. Andrew's Episcopal School, Robert Gordon's College and Gray's School of Art, Aberdeen, 5 yrs. apptce. with Messrs. Brown & Watt, architects and surveyors; 1903-07, dftsman, ch. engr.'s office, C.P.R., Montreal; 1907-11, office engr., Quebec, Mtl. and Southern Rly., Montreal; 1911 to date, with C.P.R., as follows: 1911-18, asst. engr., constrn. dept.; 1918-20, div. engr., Toronto terminals div.; 1920-24, div. engr., Bruce division; 1924 to date, div. engr., Toronto terminals div.

References: J. M. R. Fairbairn, P. B. Motley, B. Ripley, G. H. Davis, J. E. Armstrong.

FOR TRANSFER FROM JUNIOR TO A HIGHER GRADE

MEDLAR—GEORGE ELMER, of Walkerville, Ont., Born at Saltfelt Twp., Ont., Sept. 24th, 1902; Educ., Hamilton, Ont., schools, course of study during years of field and office experience; 1908-09, jr., Tyrill & McKay, Hamilton; 1909-10, chainman, Dom. Land Surveys, and transitman, miscellaneous surveys, W. H. Waddell, Edmonton, Alberta, district; 1910-11, asst. dist. engrg. work and surveys, Sask. dist., E. H. Phillips; 1911-18, asst. i/c party, Dom. Land Surveys, in pro. of Alberta; Jan. to Dec. 1918, cadet, hon. lieut., Imp. Royal Flying Corps; Mch. to Aug. 1919, asst., surveys and report hbr. development work, Hamilton; 1919-20, asst., sewer and waterworks constrn. and power dam devel. surveys in Northern Ont.; Mch. to Aug. 1920, asst., engrg. and surveying work at Hamilton, Ont., and dist.; 1920 to date, engr. i/c field and office work, Essex Border Utilities Comm., Windsor, Ont.

References: J. C. Keith, W. J. Fletcher, C. R. McColl, M. E. Brian, H. Thorne, W. H. Baltzell, C. G. R. Armstrong, J. J. Newman.

SCARBOROUGH—CHARLES MORTON, of Vermilion, Alta., Born at Hanover, Ont., Sept. 29th, 1890; Educ., B.A., Univ. of Alta., 1927; 1908-09, engaged in drilling operations in Alta.; 1910-11, instrumentman, D.L.S.; 1913-14-15, teaching in Alta.; 1916, enlisted; 1917-18, mech. dftsman, Can. Forestry Corps; 1919-21, dftsman, Alta. govt. telephones; 1922-24, teaching; 1926 (summer), instrumentman on provincial road work; at present, teaching science and maths., High School, Vermilion, Alta.

References: G. L. Law, F. C. Mechin, R. J. Gibbs.

SHOTWELL—JOHN STUART GLOSHAN, of Riverbend, Que., Born at Hawkesbury, Ont., Mch. 9th, 1900; Educ., B.Sc., McGill Univ., 1925; 1920-24, demonstrator, dept. mech. engrg., McGill Univ., sessions; 1921-22, tester for J. T. Donald, Ltd., Montreal; 1923 (summer), engr., lab. bdry. survey, Geodetic Survey of Canada; 1921-22, engr., Nat. Resources Intelligence Branch, Ottawa; 1924-25, asst. chemist, Can. Explosives, Ltd., Beloeil, Que.; 1925-26, post grad. student, Forest Prod. Labs. of Can.; 1926 to date, with Price Bros., Riverbend, as chemist i/c control testing and research chemist.

References: L. N. Shanley, N. E. D. Sheppard, G. F. Layne, N. F. McCaghey, D. J. Emrey, F. C. C. Lynch, A. Cunningham, C. M. McKergow.

THOMPSON—HOWARD GRANT, of Montreal, Born at Belmont, Ont., Aug. 21st, 1896; Educ., B.A.Sc., Univ. of Toronto, 1922; 1915-19, overseas, pte., C.E.F., and 2nd lieut., R.A.F.; 1920 (summer), machine shop work; 1921 (summer), office mgr., Webster Constrn. Co., London; 1922 (summer), student engrg. course, Am. Blower Co., Detroit; 1922-23, Can. Sirocco Co., Ltd., engrg. design, estimating and sale of heating and ventilating equipment; June to Nov. 1923, supply engr. for pulp mill equipment, Riordon Co., Ltd., Temiskaming, Que.; 1923-25, engr. on erection, service and sale of boilers, mechanical stokers, etc., and 1924-25, asst. to Mtl. mgr., Combustion Engrg. Corp.; 1925 to date, dept. head on design, installation, service and sale of mechanical stokers, etc., with Affiliated Engrg. Cos., Ltd.

References: J. T. Farmer, S. W. Slater, F. S. B. Heward, R. A. Ross, N. E. D. Sheppard, R. E. MacAfee.

FOR TRANSFER FROM STUDENT TO A HIGHER GRADE

HINCHLIFFE—JOSEPH EDWARD, of Ford City, Ont., Born at MacLeod, Alta., Apl. 8th, 1897; Educ., B.Sc., McGill Univ., 1926; 1925 (summer), dftsman, Southern Can. Power Co. on preliminary hydro location; June 1925 to date, dftsman with Can. Bridge Co., Walkerville, Ont., making shop drawings for steel bridges, bldgs. & transmission towers, etc.

References: H. M. MacKay, E. Brown, R. de L. French, J. S. H. Wurtele, A. E. West, G. V. Davies.

IRWIN—KARL WEBSTER, of Toronto, Born at Dalrymple, Ont., Apl. 15th, 1900; Educ., B.A.Sc., 1923, M.A.Sc., 1926, Univ. of Toronto; 1917-18, war service, France; 1921 (summer), city engr.'s office, Oshawa, Ont.; 1922 (summer), survey party, city of Toronto; 1923-25, asst. city engr., Oshawa, Ont.; 1925-26, post. grad. and research work, Univ. of Toronto; 1926 to date, Bell Tel. Co. of Canada, as follows: May to July 1926, plant dept., Toronto; 1926-27, engrg. dept., head office, Montreal; June 1927 to date, transmission dept., plant engr.'s office, central div., Toronto.

References: P. Gillespie, A. M. Mackenzie, A. M. Reid, F. C. Ball, A. T. Byram.

LLOYD—DAVID STEVENSON, of Toronto, Ont., Born at Winnipeg, Man., Oct. 5th, 1903; Educ., B.A.Sc., Univ. of Toronto, 1925; 3 mos., 1918-19, wireless operator, Marconi W/T Co. of Canada; 4 mos., 1920, apptced, armature winder, Algoma Steel Corp.; 1922, 5 mos., rodman and clerk, Dept. of Northern Devel.; 1920-21, asst. switchboard operator, Great Lakes Power Co.; 1922-3-4, 8 mos., steel inspector for R. W. Hunt & Co.; 1922-3-4, 6 mos., dftsman and bridge engr., Dept. of Northern Devel.; 1925 to date, welding engr. in engrg. service dept., Dom. Oxygen Co., Ltd.

References: J. L. Lang, C. H. L. Jones, F. Smallwood, T. R. Loudon, J. D. Jones, P. Gillespie, F. F. Griffin, G. H. Kohl.

MORRISETTE—GORDON JOSEPH, of Iroquois Falls, Ont., Born at North Hatley, Que., Oct. 8th, 1895; Educ., B.Sc., McGill Univ., 1922; 1914-15, at McGill Univ.; 1915-16, Fairbanks shop, Sherbrooke, Que.; 1916-19, overseas, 7th Siege Battery; 1919-22, at McGill Univ.; 1920 (summer), Angus shops, C.P.R.; 1921 (summer), engrg. dept., Hollinger mines; 1922 to date, mech. supt., Abitibi Power & Paper Co.

References: C. M. McKergow, A. R. Roberts, R. S. Baker, W. H. Crombie, H. M. MacKay.

PLOW—JOHN FOSS, of Riverbend, Que., Born at St. Albans, Vt., July 28th, 1900; Educ., R.M.C. grad., 1921; McGill Univ., 1921-22; 1922-25, vice-pres., B. Plow & Co., Ltd., Montreal; 1926 to date, with Price Bros., Riverbend, Que., i/c records dept., and Nov. 1927 to date, asst. engr., mechanical dept.

References: W. G. Mitchell, A. A. MacDiarmid, G. F. Layne, D. J. Emery, W. F. McCaghey, A. Cunningham, C. N. Shanley.

THE

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The Requirements for a Durable Concrete as Observed from Structures in Service

An Inquiry into the Question of What Makes Concrete Good or Poor Based on a Consideration of the Conditions Responsible for the Failure of Existing Concrete Works

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Paper presented at the Annual General Professional Meeting of The Engineering Institute of Canada, at Montreal, Que., February 16th, 1928

If properly made and properly used, concrete is an enduring material. Just what its life may be is not yet known, for Portland cement was invented only a little over a hundred years ago, and did not come into common use until the present century. Most of the works made with it are less than fifteen years old, but there are, both here and in Europe, older structures from which may be formed some idea of the probable life of well-made concrete.

A little observation in almost any locality will convince one that, while some concrete is enduring, much of it is not, for in many structures it is already visibly deteriorating although only a few years old. Presumably concrete that deteriorates readily is not good concrete, but granting this, what makes concrete good or poor with respect to its ability to endure in service? It is the author's purpose to inquire into this question by considering the lessons to be learned from concrete that is failing, so that we, as engineers and constructors, may, in future work, avoid similar mistakes and make concrete that is durable and of long life.

How are concretes destroyed in service? They may be attacked chemically by alkali, sea water, dilute acids or even pure water, mechanically by abrasion, frost action or volume changes, or their constituent materials may be faulty and the concretes fail through a breakdown of the cement, or by the disintegration of the aggregate.

These destructive agencies are always present to some degree and the durable concrete is not one that is free from attack but one that has built into it a resistance to attack or is protected externally.

Sea and Alkali Waters

Of the agencies that attack concrete chemically, the best known are sea and alkaline ground waters. Both forms of disintegration are believed to be due principally to the sulphate salts of magnesium, sodium and calcium, reacting with the different ingredients of set cement to form new compounds within the cementing matrix of the concrete. These new compounds occupy greater space than those they replace, and in expanding, shatter the cementing matrix in which they form. In sea water, magnesium sulphate is the principal active salt; in alkaline ground waters they are the sulphates of magnesium and sodium.

More recently, the experiments of Thorvaldson[1] have led him to conclude that the foregoing reactions are supplemented by others more important. He maintains that the sulphate salts interfere with the normal hydration of the cement. At first it assists and speeds the reactions but, in the words of Prof. C. J. Mackenzie, M.E.I.C.[2], "the hydration or hydrolysis does not stop at the point of optimum strength for the cement, as it ordinarily does in pure water, but it is carried on and on until so much of the calcium has been removed by hydrolysis that sufficient strength to withstand the physical action of the crystallation is gone."

Exact knowledge of the mechanism of failure from alkali and sea water is, of course, of first importance to

(1) Dr. T. Thorvaldson, Journal of Industrial and Engineering Chemistry, May 1925.

(2) C. J. Mackenzie, M.E.I.C., Concrete Deterioration in Alkali Soils, The Engineering Journal, Nov. 1925, p. 462.

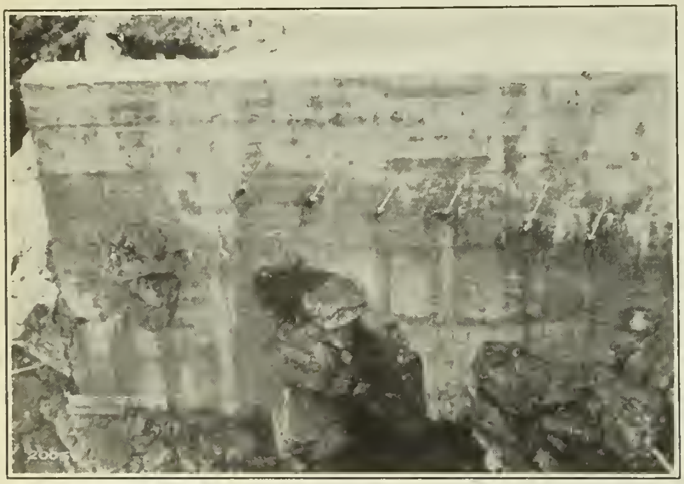

Figure No. 1.—Disintegration Around the Ends of the Drains in a Wall, Due to Frost Action on Concrete Saturated with Water.
It is significant that the rest of the wall, although presumably made of concrete of equal porosity, is in perfect condition.

engineers, but, for the purpose of this paper, some of the less scientific findings of the investigators of these problems are of more immediate significance. For alkali action the more important of these are:

(1) Portland cement, as now constituted, is inherently subject to attack by sulphate salts and no Portland cement mortar or concrete, however well made, is immune from attack if the sulphate content of the ground water in contact with it is sufficiently great.

(2) Field experience has shown that a concrete, to be resistant to sulphate attack, must be of the highest quality, strong, well made and impermeable.

The same general conclusions apply equally to concrete in sea water, but there is some divergence of thought in other particulars. Wig and Ferguson[3], for instance, lay great stress on the protection to concrete in sea water afforded by the carbonated surface skin formed in casting. They observed, in their extended investigations of sea water structures in the United States and Canada, that chemical disintegration always followed the removal of this outer skin. On the other hand, general experience with concrete exposed to alkali attack has not shown that the carbonated surface is a factor of any importance in the resistance of the concrete to sulphate action in alkali soils.

If, as is probable, alkali and sea water attack concrete in a similar manner, then the greater rapidity with which the alkali waters destroy concrete is due to their higher concentrations of sulphate salts. It is the general conclusion of most investigators of the problem, that concrete can be made, which, for practical purposes, may be classed as permanent in sea water, but that, until a cement is found that is immune from the action of both magnesium and sodium sulphate, concrete cannot be made that will withstand severe alkali exposure.

For service in sea water, concrete should be made of selected materials, properly proportioned, well mixed and placed in a manner to avoid all surface imperfections such as construction joints, honeycomb, etc., particularly above low-water level where practically all the deterioration takes place. Where abrasion or erosion of the surfaces may occur, protection of some sort should be employed, such as wooden sheeting or granite facing.

Concrete liable to alkali attack should be equally well made but there seems no certain method of preserving the concrete from deterioration except by preventing its contact with the offending ground water either by adequate drainage or by encasing it with some protective material immune to alkali attack.

Many nostrums claimed to increase the resistance of concrete to the attack of alkali and sea water have been offered to engineers in the form of integral compounds or inert admixtures to be incorporated in the mix. Theoretically it would seem that any material added to concrete that would fill its pores or coat them with a water-repellent substance should be beneficial but available evidence does not entirely support this view.

Concretes to which such substances have been added have been tested by the Committee on Deterioration of Concrete in Alkali Soils[4]. After two years these concretes were reported disintegrating in each of the three localities in which they had been placed. Wig and Ferguson[5], after inspecting a great many structures in sea water, reported that "waterproofing compounds have no beneficial effect." Somewhat the same conclusion has been arrived by the harbour authorities of Los Angeles in connection with marine piling. They found that "neither the painting, the admixtures used, nor the oil residue that collects on the piling in Los Angeles harbour, served to have any effect in retarding the progress of decomposition. The painted piles as well as the piles containing the admixtures seem to deteriorate as rapidly as the untreated piles."[6]

On the other hand Miller[7], from his drain tile tests in Minnesota has come to the tentative conclusion "that certain admixtures, if properly handled, may have sufficient value in developing resistance to justify their use under special conditions," and Tapley[8], from his tests at Saint John, N.B. concludes that, "There are a number of powdered admixtures which have been tried out and which are undoubtedly beneficial to the concrete and greatly lengthen the period of its permanency, especially when used in sea water."

Somewhat the same uncertainty exists with respect to the addition of trass or pozzuolana to concrete. Consider-

(3) R. J. Wig and L. R. Ferguson, Engineering News-Record, vol. 79, (1917), pp. 532, 641, 689, 737 and 795.

(4) Report of Committee on Deterioration of Concrete in Alkali Soils, The Engineering Institute of Canada, for 1922 and 1924. The Engineering Journal, Feb. 1923, p. 57 and Feb. 1925, p. 52.

(5) R. J. Wig and L. R. Ferguson, Engineering News-Record, Oct. 18, 1917, p. 737.

(6) Geo. F. Nicholson, Engineering & Contracting, Feb. 1927, p. 94.

(7) Dalton G. Miller, Tests on Concrete Exposed to the Sulphate Waters of Medicine Lake, South Dakota. Paper No. 726 Journal Series, University of Minnesota.

(8) A. G. Tapley, Concrete in Sea Water, The Engineering Journal, Nov. 1924, p. 663.

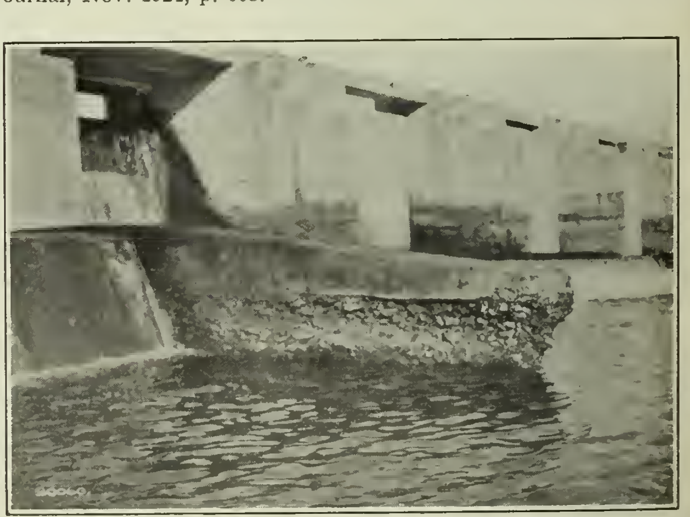

Figure No. 2.—Disintegration Due to Freezing of Concrete that is Saturated with Moisture.
The action stopped at the construction joint, above which the concrete is in good condition.

Figure No. 3.—Failure of the Concrete in a Retaining Wall.
The concrete at the left is similar in all respects except that a different coarse aggregate was used.

able success has been obtained in Europe by its use, yet, there, many structures have been reported where apparently no benefit was obtained. Atwood and Johnson[9] made a very comprehensive study of the technical literature on the use of cement in sea water and found that, " The majority of the authorities agree that this disintegration (sea water) can be prevented by the addition to standard Portland cement of a properly constituted siliceous material, which, by combination with the free lime released in the process of setting, will form a cementing material insoluble in sulphate-bearing waters." The tests of Miller[10] already referred to, indicate that this conclusion may hold for concrete subjected to alkali waters.

This opinion is not shared by Jewett[11]. In a series of tests conducted by the United States Reclamation Service, test blocks were made in which were used " sand cements manufactured by the Service, an " alkali-proof " cement containing blast-furnace slag as the siliceous material as well as various other materials and processes, for which claims of waterproofing properties were made." Quoting Mr. Jewett, who was connected with these tests, " Observations of the action on these specimens showed that a rich mixture of Portland cement concrete was more resistant to the alkali action than any other material used."

The author would venture the opinion that the substances formed when a siliceous material such as trass is added to cement are not insoluble as stated by Atwood and Johnson, but only relatively insoluble, that when they are in contact with sea water they dissolve so slowly that they protect the concrete indefinitely, but when exposed to the more severe conditions of alkali they are dissolved more rapidly and only prevent the destruction of the concrete for a time. It should also be noted that certain siliceous materials combine with lime more readily than others and would therefore give more efficient protection, which might account for the different results obtained by different users.

It seems therefore, in view of the foregoing, that engineers are justified in being somewhat sceptical of the value of any substance, which when added to concrete is claimed to protect it against sulphate-bearing waters. If, however, it is considered desirable to use such a material in concrete, then too great a reliance should not be placed on its protective value, nor should the essential precautions already outlined for the construction of concrete in sea or alkali waters be omitted in any degree.

A slightly different situation exists with surface treatments, for some of these have been used with considerable success in both sea and alkaline waters. Surface treatments depend for their success on preventing the destructive agent from penetrating the concrete. If this is not completely accomplished, and it seldom is, deterioration will take place behind the treated or coated surface of the concrete, in which case the protective treatment may be actually harmful. Surface treatments are likewise to be used with caution and only after satisfactory evidence of the thoroughness of the protection offered by them.

The destruction of concrete by alkali attack is ordinarily believed to be confined to the western portions of the United States and Canada, but such is not the case. Typical examples of sulphate disintegration are occasionally met with in the east, and are probably more common than is generally realized, for eastern engineers are not familiar with this form of deterioration. The author reported a case of this kind two years ago and others have come to his attention[12].

Fresh Waters

Deterioration of concrete may result from the dissolving action of fresh water alone. For instance, Thorvaldson[13] has found that if pure water is allowed to percolate freely through a porous concrete, the cement will eventually become completely disintegrated. The Board of Water Supply, New York City[14], found that the strength of concrete was reduced to a small fraction of its normal strength by allowing water to percolate through it for one year. Lerch and Bogue[15] have also found that all of the six recognized constituent chemical compounds of cement, in their pure form at least, will undergo complete hydrolysis in aqueous solutions, if the solution products are removed as formed.

Carbon dioxide may be an important factor in the corrosion of concrete by natural waters. Newhall[16] states, " When a concrete structure is exposed to moisture and car-

(9) William G. Atwood and A. A. Johnson, The Disintegration of Cement in Sea Water, Trans. American Society of Civil Engineers, vol. 87, (1924), p. 204.

(10) Dalton G. Miller, Tests of Concrete Exposed to the Sulphate Waters of Medicine Lake, South Dakota, Paper No. 726, Journal Series, University of Minnesota.

(11) F. Y. Jewett, Trans. American Society of Civil Engineers, vol. 87, (1924), p. 255.

(12) The Engineering Journal, April 1926, p. 212.

(13) C. J. Mackenzie, M.E.I.C., Concrete Deterioration in Alkali Soils, The Engineering Journal, Nov. 1925.

(14) Engineering Record, Sept. 5, 1914.

(15) William Lerch and R. H. Bogue, Journal of Physical Chemistry, Nov. 1927, p. 1627.

(16) Charles A. Newhall, Trans. American Society of Civil Engineers, vol. 90, 1927, p. 838.

Figure No. 4.—Spalling Caused by the Decay of Unsound Stone. Moisture Reached the Stone Through the Porous Concrete, Causing it to Swell.

bon dioxide, a condition develops whereby normal calcium carbonate is first formed, followed by the change to the bicarbonate of calcium, the latter being relatively very soluble. The solubility of calcium in the form of bicarbonate is generally increased if the water carries dissolved organic matter. All natural ground waters, sewage, and even rainwater are highly charged with carbon dioxide and thus are corrosive to concrete through the bicarbonate reaction."

Similarly the experiments of Baylis[17] show that natural waters will attack the calcium compounds of the hydrated cement, changing some into calcium carbonate and washing some away entirely. He states that if the concrete is porous, this action will proceed until the concrete eventually disintegrates, but with an impermeable concrete the action is confined to the surface and becomes of negligible importance.

Evidence of the truth of these observations is not entirely experimental. Gore[18] reports that in a very porous concrete (cemented gravel) in the floor of a water filter at Toronto, " the cement was being slowly dissolved by the water, so that the bed, although sound, was more open than when placed, six years earlier." Mackenzie[19] reports that two different hydraulic structures of large magnitude of his knowledge, " showed marked signs of water seepage " which he attributes to the same cause. At Vannes, Brittany, a concrete conduit was destroyed in about thirteen years by the corrosive action of the very pure water it carried[20]. The author also knows of structures where the deterioration of the concrete is due to the solution of the cement by the movement of water in its mass.

Another example of this same action is the whitish deposits frequently observed wherever water seeps through concrete. These deposits are usually found to be calcium carbonate and result from the solution of the calcium in the concrete by the passing water. A further instance is the sandy surface of concretes in contact with the soft waters of some of our Canadian rivers. Here the surface is being slowly removed by the waters of these streams which are very corrosive to calcium compounds.

Mechanical Agencies

Mechanical agencies play an important part in the destruction of concrete. Abrasion, as met with in highway slabs; erosion by water, as in hydraulic structures; and volume changes caused either by variations in the temperature of the concrete or its moisture content, are some of these. Others are the action of frost upon moisture held in its pores, and the less common but related phenomenon, the concentration and crystallization of salts in the pores brought about by moisture and evaporation.

In many structures, such as floors, sidewalks and highways, abrasion is a normal condition of service, to be expected, and therefore to be provided for in the design of the concrete. With other types of structures this is likewise true of erosion. Since this paper is intended to deal only with those destructive forces that are natural agencies, and not with those hazards that would ordinarily result from the particular service for which the concrete is intended, neither of these mechanical agencies can properly be considered here. In the majority of cases where concrete is being destroyed unduly by either abrasion or erosion, it will be found to be of an inferior quality, and it is probable that a better concrete would have successfully withstood the same conditions of service.

Volume Changes

Volume changes are caused by differences in temperature, by variations in the moisture content of the concrete, by chemical action and by prolonged stress. Experiments show that the unit changes brought about by temperature are not a constant, for the coefficient of expansion of concrete varies with its temperature, its moisture content and the quantity of cement it contains. Other experiments demonstrate that when concrete dries it shrinks, when wet it expands, and the magnitude of the volume changes resulting are several times as great as those caused by temperature. It has also been found that where concrete dries after having been wet, the volume is not always the same as before. Many investigators have studied these phenomena and in particular instances have reported their action and extent, others have commented upon their possible effect on the integrity of concrete, but our actual knowledge regarding them and how they act to destroy concrete is meagre and the subject but partially understood[21].

A little thought, however, shows some of the possible effects of volume changes. For instance, concrete conducts heat but slowly, and it is possible to have a considerable difference in temperature between the concrete at the surface of a wall and that a fraction of an inch below the surface. If the surface is cooler than the interior, a temperature difference of this kind might easily stress the former so greatly that cracks would develop. The same circumstances would also produce stresses parallel to the surface, which would tend to cause scaling.

Since differences in the richness of concrete cause differences in the coefficient of expansion, variations in the cement content between the surface and interior would cause stresses similar in effect to those brought about by variations in temperature. It is also conceivable that the repeated stressing of the concrete caused by temperature changes might bring about cracking at the surface through fatigue, and cracks thus started would undoubtedly deepen as time goes on.

Volume changes due to moisture cannot occur with the frequency of temperature changes, but because of their greater magnitude will individually have a greater destructive effect. Concrete expands rapidly on wetting, the bulk of the expansion taking place in a few hours, but contracts very slowly on drying, since the drying of the concrete is a slow process, taking days and even weeks to complete. In

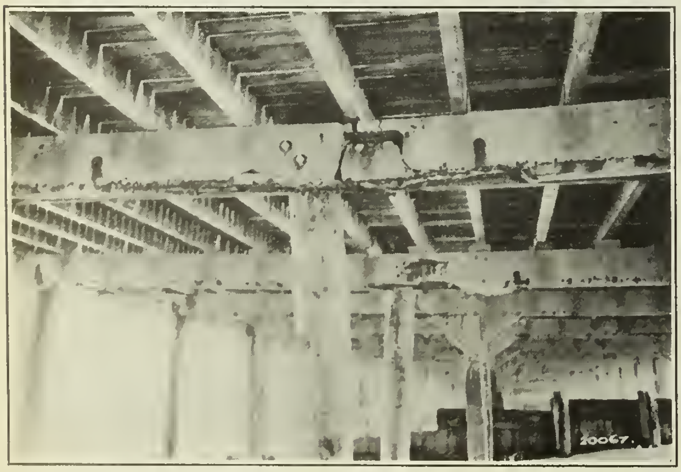

Figure No. 5.—Failure of a Concrete Beam Caused by Corrosion of the Reinforcement Followed by Spalling of the Concrete.

(17) John R. Baylis, Corrosion of Concrete, Trans. American Society of Civil Engineers, vol. 90, 1927, p. 791.

(18) William Gore, M.E.I.C., Engineering News-Record, June 25, 1925, p. 1064.

(19) C. J. Mackenzie, M.E.I.C., The Engineering Journal, Nov. 1925, p. 462.

(20) Engineering, May 20, 1927.

(21) An excellent digest of our present knowledge is given by Prof. W. K. Hatt in Researches in Concrete, Bulletin No. 24, Engineering Experiment Station, Purdue University.

Figure No. 6.—Capillary Pore Determinator as Used on the Absorption Experiments of the Hydro-Electric Power Commission of Ontario.

experiments by the author, water was found to penetrate dry concrete (mix about 1:6) at the rate of an inch an hour by capillary action alone, and the concrete ultimately absorbed about 12 per cent of its own volume of water. In this process, the surface concrete would expand before that of the interior and, as in the case of temperature differences, stresses would be set up.

Frost Action and Crystallization

Frost alone is not destructive to hardened concrete; moisture must be present in its pores or openings before frost can have any harmful effect. But if moisture is present, frost will cause enormous expansive forces within the concrete, for the water gains some 10 per cent in volume on freezing. If the concrete is strong, and the pores few, it will resist this action, but if sufficient pores full of water exist the concrete will be gradually destroyed, and strength alone will not save it. Freeman[22] reports a concrete that disintegrated by frost action although it tested 2,166 pounds per square inch, and the author has seen similar instances where concrete commenced within a year to fail from the same cause although testing 2,500 pounds per square inch and more.

It would seem, with concrete as porous as it is, that in our northern climate disintegration due to frost action would be more common, but several factors work to protect the concrete. Freezing must occur with the pores full of water and it is seldom that such a condition exists. A concrete surface may be saturated by a prolonged rain, yet before it freezes natural drainage and evaporation will remove sufficient water to protect it and this fact saves much poor concrete from destruction. When freezing occurs with the pores full, as at the water line in dams, harbour walls, etc., only the very best concrete can resist the destructive forces set up.

Bates, Philips and Wig[23] report, as a result of their investigations at the Bureau of Standards, that " Portland cement mortar or concrete, if porous, can be disintegrated by the mechanical forces exerted by the crystallization of almost any salt in its pores, if a sufficient amount of it is permitted to accumulate. . . ." Crystallization is a factor in the disruption of concrete by alkali and sea water, but authorities now generally agree that, excepting the freezing of water, crystallization of substances within the pores of concrete is seldom the direct cause of failure, although frequently it is a contributory factor.

Materials

It is obvious that a concrete to be durable must be made from durable materials. Poor materials are naturally to be avoided, and most engineers, recognizing this, take steps to prevent their being used. With cement and water, prevention usually consists of testing the cement and using only potable water. These precautions seem ample, for few failures due to either of these causes have been recorded.

With aggregates, the situation is more complicated. Aggregates may be unsatisfactory in three ways: they may be poorly graded, dirty, or unsound, and if they are deficient in any one of these respects, they lessen the durability of the concrete in which they are used.

A poorly graded aggregate is objectionable largely because of its effect on porosity, and, as will be shown later, porosity and durability are closely related. A dirty aggregate lowers the resistance of concrete to attack in several ways. Lumps of clay, roots, etc., cause unsightly surface spalling, weaken the concrete in which they occur, and tend to break it up. Excessive silt distributes itself throughout the concrete, increasing porosity, coating the particles of aggregate and destroying the bond between them and the cement. Organic impurities lower the strength of the concrete and there is some evidence to show that they will in time cause serious internal deterioration.

Both poorly graded and dirty material can be prevented by requiring that all aggregates meet the specifications of either the American Society for Testing Materials or the Joint Committee on Concrete and Reinforced Concrete. The

(22) P. J. Freeman, Behaviour of Concrete Exposed to Atmospheric Conditions, Proc., American Society for Testing Materials, vol. 23, 1923, part II, p. 186.

(23) P. H. Bates, A. J. Philips and R. J. Wig, Action of the Salts in Alkali Water and Sea Water on Cement. Technologic Paper No. 12, United States Bureau of Standards.

Figure No. 7.—Breakwater Built in 1906 with 1:3:5 Concrete, Illustrating the Effect of Waves and Frost on Porous Concrete, Resulting from too Lean a Mix.

Compare with section of same breakwater shown in figure No. 8

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tests for grading and cleanliness given in these specifications are simple, and if regularly applied, amply protect the user against materials faulty in these two respects.

Occasional cases are met with where concrete is failing because the aggregates from which they are made lack durability. These cases have been widely scattered and no one type of rock has been to blame. Although considerable investigation has been made of these unsound aggregates, our knowledge of them is meagre and does not permit us to generalize as to what rocks are safe and what are not.

Shale is generally recognized as an undesirable constituent of concrete aggregates and few engineers will knowingly permit its use. Occasionally its presence has not been recognized and it has caused serious trouble. In a case of this kind examined by the author, a gravel containing shale was used in a very porous concrete, and water, penetrating to the shale particles, caused them to swell and crack the structure badly. This action went on at considerable depths, affected particles being found fifteen inches and more below the surface.

Chert has proved objectionable in several instances. Reagel[24] reports that certain of the cherts of Missouri are unsound in concrete, causing cracks to form and the surface to spall. Similar experience has been recorded in the case of building stone, for Ries and Watson[25] report " cases are known of bridge abutments constructed of cherty limestone, which split so badly that they had to be torn down and replaced." The author has observed in certain limestones, chert inclusions that disintegrated with successive freezings. However, it should not be concluded from this that all cherts are unsuitable in concrete, for this is not necessarily so, and each case must be investigated on its merits.

(24) F. V. Reagel, Chert Unfit for Coarse Aggregate in Concrete, Engineering News-Record, Aug. 28, 1924, p. 332.

(25) Heinrich Ries and Thomas L. Watson, Engineering Geology, 1914, p. 433.

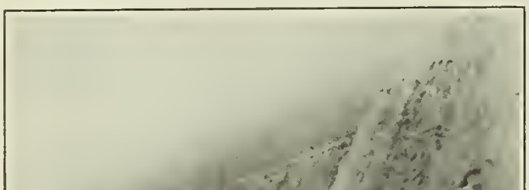

Figure No. 8.—Another Section of Breakwater shown in Figure No. 7.

This section was built in 1904, using a 1: 2: 4 concrete, and is in excellent condition. The right foreground shows a portion of the 1: 3: 5 section illustrated in figure No. 7.

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Several widely scattered failures have been traced to the use of an unsound argillaceous limestone. The defective stone has acted differently in different cases, causing surface spalling in some, in others cracking the concrete to considerable depths. In several of these cases, where a petrographical study was made, the limestone was found to contain the mineral beidellite, which disintegrates on exposure to air.

Pearson and Loughlin [26] cite a series of failures that occurred in 1919 in the vicinity of Los Angeles. In these cases the coarse aggregate proved to be unstable when exposed to the air and the concrete made from it completely disintegrated. The offending rock was an altered soda-lime feldspar of the plagioclase variety known as anorthosite. Anorthosite is not usually a dangerous rock, but was so in this case, because its feldspar had become altered and existed in an unstable form.

Cases have also come to the author's attention where a sandstone has proved unsatisfactory, where the presence of micaceous schist and rotten particles in gravel has resulted in surface imperfections and where serious surface spalling has occurred with blast furnace slag.

Of these aggregates, shale and schist can be identified by visual examination, but it is not possible thus to determine whether an argillaceous limestone, a chert or a sandstone is sound or not. Certain tests are helpful in this respect, such as the sodium sulphate test[27], also absorption and compressive strength tests, but it has not yet been proved that any of these will positively detect unsound materials. However, aggregates that fail to pass the sodium-sulphate test and have a high absorption and a low compressive strength should be avoided, as they are apt to weather badly.

In gravel, the safest way is to determine the quantity and character of the different rock types composing it, by examining and classifying one to two hundred of its particles, and to reject it if found to contain shale, schist or decayed material to more than a few per cent. The percentages that warrant rejection are not as yet agreed upon. Committee E-1 of the American Concrete Institute [28] have limited shale to 1½ per cent and schist and decayed particles to 3 per cent. The state highway departments of Kansas, Iowa and Minnesota limit shale to 0.5 per cent; Kentucky limits shale, slate, etc., to 1 per cent, and Michigan, shale and other non-durable particles to 3 per cent [29]. Reagel[30] recommends that chert be kept below 5 per cent. If more than one type of undesirable material is present the total quantity should not exceed the maximum percentage allowed for any one of them, say from 3 to 5 per cent.

With crushed rock, the surest way by which an engineer, equipped with only the usual knowledge of mineralogy, can protect himself against unsound stone, is by a personal examination of the quarries from which the coarse aggregate is to be obtained, particularly of old ledges of the same rock that have been exposed to the weather for several years. Such an examination will usually reveal the presence of un-

(26) J. C. Pearson and G. F. Loughlin, An Interesting Case of Dangerous Aggregate. Proc. American Concrete Institute, vol. 19, 1923, p. 142.

(27) Test for Soundness of Coarse Aggregate, Bulletin 1216, U.S. Department of Agriculture.

(28) Report of Committee E-1 on Reinforced Concrete Building Design and Specifications. Proc. American Concrete Institute, vol. 23, (1927), p. 643.

(29) Report of Committee E-5 on Aggregates, Proc. American Concrete Institute, vol. 23, (1927), p. 573.

(30) F. V. Reagel, Chert Unfit for Coarse Aggregate in Concrete, Engineering News-Record, Aug. 28, 1924, p. 332.

sound material in the quarry, and if such is found, the product of that quarry should not be used.

Reinforcement

Reinforced concrete structures are subject to an additional hazard due to the steel reinforcement. If moisture and air can penetrate to the reinforcing steel, it will cause rusting. Rust requires 2.7 times the space occupied by the original metal, and therefore in forming exerts great pressure on the surrounding concrete. If the reinforcement is not deeply imbedded, these forces spall or crack the concrete, weakening the structure, and in many cases exposing the steel to further attack. This action is particularly common in structures in sea water and along the adjacent coasts where they are reached by air-borne salt spray.

The remedy is to imbed the reinforcement deeply and to surround it with a tight, impermeable concrete. The Joint Committee on Concrete and Reinforced Concrete recommended that "Metal reinforcement in wall footings and column footings shall have a minimum covering of three inches of concrete. At surfaces of concrete exposed to the weather, metal reinforcement shall be protected by not less than two inches of concrete," and for sea water construction they recommend that, "metal reinforcement shall be placed at least three inches from any plane or curved surface, except at corners when it shall be at least four inches from adjacent surfaces."

Porosity

At this point it is interesting to consider the frequency with which porosity and its related properties, permeability and absorption, are cited as factors in the durability of concrete, but first it might be well to digress for a moment and consider what is meant by these three terms.

Figure No. 9.—A Concrete in which Pockets and Seams of Laitance were Allowed to Remain.

These have weathered away for considerable depths. Apparently this concrete was all deposited at one point and allowed to flow into place.

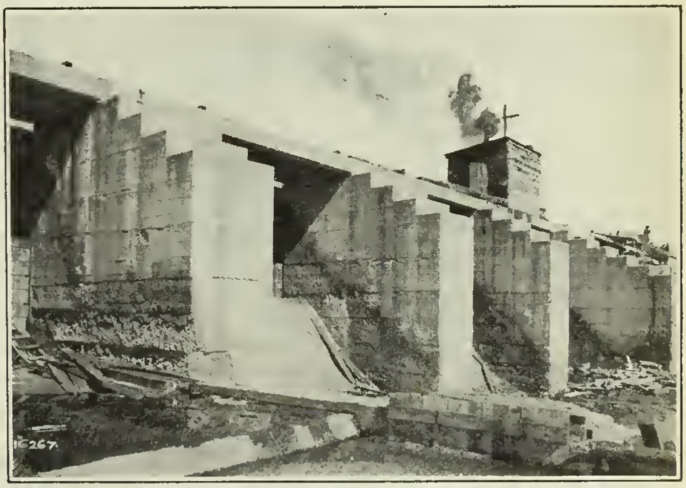

Figure No. 10.—An Example showing that Deterioration Starts First at the Top of the Lift where the Concrete is more Porous because of Accumulation of Water and Laitance and the Settlement of the Coarse Aggregate.

Porosity is a condition of the concrete; permeability and absorption are properties of the concrete dependent upon its porosity. The porosity of a concrete cannot be determined directly, because the total pore space of a concrete cannot be measured, as many of the pores have no access to the surface or are blocked in such a way that they cannot be filled by any measuring medium. Hence porosity must be determined indirectly by measuring the volume of the pores that can be filled, i.e. by determining the absorption. Permeability is usually determined by bringing one surface of a test slab in contact with water under pressure and noting the rate at which water will pass through. Sometimes a hollow block is used instead of the slab. Permeability, therefore, merely indicates a condition of the pores which permits the passage of a fluid through the concrete.

With this explanation, let us return to a consideration of the influence of porosity on the durability of concrete. As has been said, frost cannot harm concrete except its pores contain moisture. The moisture that causes volume changes, that carries the corrosive agents which attack the cement binder and that rusts the embedded reinforcement also enters concrete through its pores. These pores or passages have access to the surface and exist to some extent in all concrete.

The resistance of concrete to the different agencies of attack will depend on the size, character and frequency of its pores. The majority being of capillary size, it is probable that under ordinary exposures they chiefly determine the durability of the concrete. By capillary action such pores will draw water from the surface inward, and once filled, will not be drained by the forces of gravity. Thus if one end comes in contact with a source of moisture, the pore is filled and it does not immediately empty when the source of moisture is removed. This is of importance in frost action, where the pores must be nearly full of water to be dangerous.

Capillary pores will conduct moisture from one point to another. A familiar example of this is the moist band often found above the water level of partially submerged concrete. Here, capillarity lifts the moisture from the water level below to the surface, from which it is removed by evaporation, so that there is a continuous movement of water through the concrete. This movement of water will, in time, dissolve the cement of the concrete through which it passes, and evaporation will cause the dissolved material to be deposited in the pores with disruptive effect. As pointed out by Johnson[31] it is possible that in many cases the deposition of the dissolved salts takes place at some depth and causes a progressive internal disintegration which may lead to ultimate failure. Johnson[32] in his microscopic investigations, found that in crushing a concrete the planes of failure ran from pore to pore and thus the presence of pores in a concrete also deleteriously affects its strength.

In order to separate capillary absorption from absorption as customarily determined, the author has developed an apparatus which he has named a "capillary pore determin-

(31) N. C. Johnson, Mechanical Disintegration of Defective Concretes, Engineering Record, Feb. 6, 1915, p. 160.

(32) N. C. Johnson, Microscope as an Aid in Proportioning Concrete for Strength, Engineering Record, Feb. 13, 1915.

ator." In this apparatus, shown in figure No. 6, the concrete is in contact with water at the lower surface only, and all absorption is capillary. Absorption-time curves of the type shown in figure No. 15 are obtained. As yet, the apparatus has had but a very limited use and it is described here only because some of the results obtained with it will be referred to later in this paper.

The principal causes of excess porosity in a concrete are lack of cement, poorly graded aggregate, the use of excess water in mixing, improper placing and lack of curing. Excepting only concrete exposed to alkali attack, it is probable that 90 per cent of the faulty concrete existing in Canada is defective because of porosity, due to one or more of these five factors, irrespective of whether the immediate cause of its destruction is sea water, corrosion, frost action or volume changes.

Lack of Cement

Cement plays a dual rôle in concrete: it binds the aggregates, and it fills and seals the spaces between them. If the cement content of the concrete is reduced too greatly, its porosity is increased to the danger point. Concretes of low cement content such as those containing one barrel of cement per cubic yard or less are almost certain to disintegrate if the exposure is severe and even concretes containing 1.25 barrel to the cubic yard will fail unless specifically designed to give low porosity.

Instances of disintegrating concretes due to lack of cement are not uncommon. An interesting example was cited in a report of the American Concrete Institute(33). The structure was a breakwater. "That portion which was built of 1:2:4 concrete has stood up remarkably well for twenty years under the extremely severe exposure of a Lake Michigan waterfront, while the portion built two years later with a 1:3:5 concrete has been badly attacked, requiring extensive repairs. Both sections of this wall were carefully placed. . . ." There is another example at an hydro-electric power plant in Ontario. Concrete retaining walls, well made, but containing less than one barrel of cement per cubic yard, were built along a canal. During the early operation of the plant the water level in the canal reached the elevation of these walls and surface disintegration commenced. Similar concrete containing approximately an additional sack of cement per cubic yard has withstood the same exposure for six years without any evidence of distress.

(33) Report of Committee E-6 on Destructive Agents and Protective Treatments, Proc., American Concrete Institute, vol. 21, (1925), p. 266.

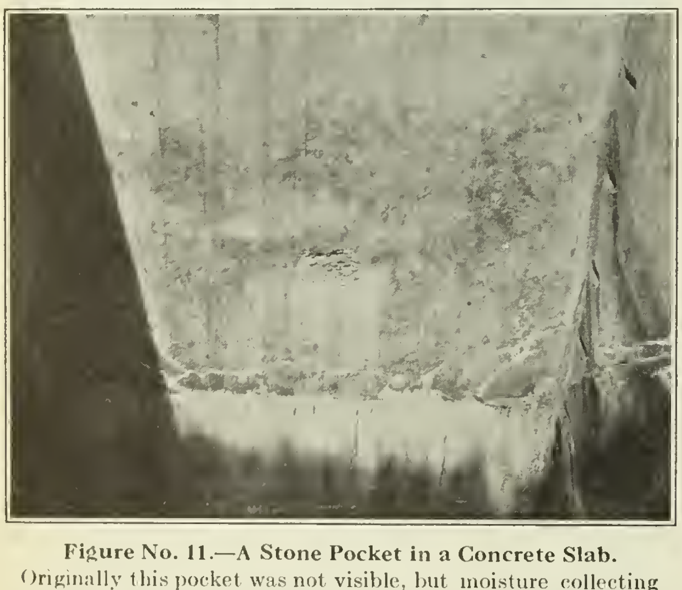

Figure No. 11.—A Stone Pocket in a Concrete Slab.
Originally this pocket was not visible, but moisture collecting and freezing in it has spalled the surface. The concrete immediately surrounding this pocket is more porous than the main body of the slab and it is beginning to deteriorate as evidenced by the darkest areas

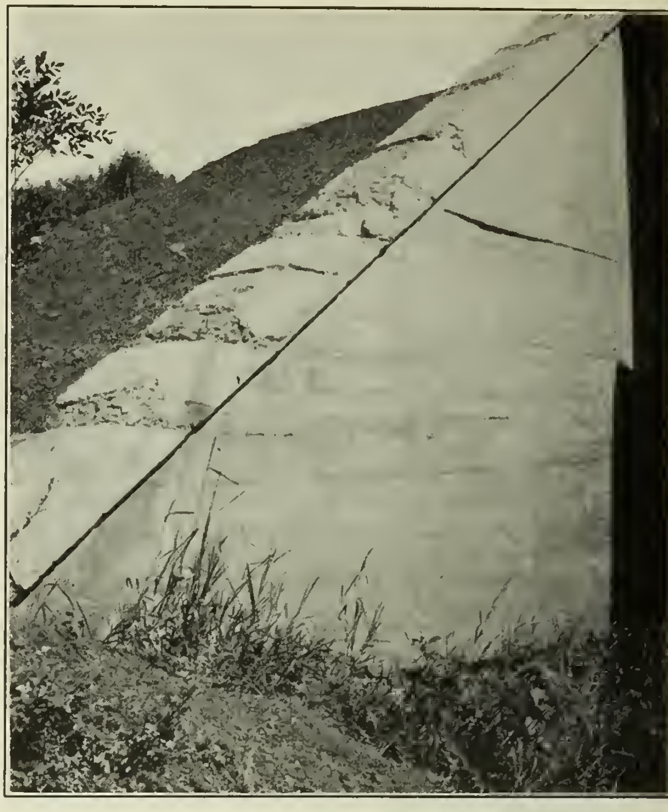

Figure No. 12.—An Example of the Effect of Segregation of Mortar at Corners, along Edges and at the Surface.

The experience of the author has led him to the opinion that any structure in which the concrete is in contact with water, such as dams, power house foundations, etc., should contain not less than 1.25 barrels of cement per cubic yard. For concrete exposed to the weather but not in contact with water, such as bridge piers above high water, retaining walls, etc., the cement content may be reduced safely to 1.10 barrels. For concrete not exposed to weathering, such as the interior columns, beams and walls of buildings, the cement content can be reduced further, but in these cases the amount of cement is usually governed by the strength required and not by the necessity of providing durability.

The foregoing estimates are absolute minima, and are based on a concrete designed for impermeability and manufactured under expert supervision. If the concrete mixtures are not so designed and supervised, these quantities should be increased by at least a bag per cubic yard and in some cases more. For concretes to be deposited under water, for concretes in sea water,—especially reinforced concrete,—and liable to alkali attack, these minimum quantities should also be substantially increased.

Poorly Graded Aggregates

Properly speaking, the grading of the fine and coarse aggregates should be considered together and not separately as is customary. In most cases, however, it is the former that principally determines the character of the porosity and therefore the durability of the concrete; hence it only will be considered here.

Porosity is affected by the relation of the fine and coarse aggregates. There is an optimum ratio at which the porosity is lowest, and if less or more fine aggregate is used, the porosity is increased. From a limited series of tests made with the capillary pore determinator previously described, it appears that the character of the porosity is different in the two cases. Lack of sand tends to cause large pores, there being insufficient mortar to fill the voids in the coarse aggregate, while an excess of sand tends to divide the pore space into smaller units. It is impossible to say positively which of these conditions is the more detrimental, but field experience has demonstrated that both are harmful.

The fine aggregate should not contain too small an amount of the finer particles. Recent specifications of both the American Society for Testing Materials and the Joint Committee on Concrete and Reinforced Concrete place a minimum as well as a maximum requirement on the amount of fine particles passing the No. 50 sieve. The absence of these finer sizes has a tendency to increase the pore space in a concrete and makes placing more difficult. Sands of this character are of common occurrence, and in some localities it is difficult to obtain any other kind. Very coarse sands are almost always of this type, and it is a frequent fault of sands that have been washed and of those obtained by dredging.

Another type of fine aggregate that has proved undesirable is one in which one or two sizes of particles predominate. Very fine and very coarse sands are both of this type, as are sands composed largely of one or two intermediate sizes. Standard specifications ordinarily prohibit the use of very fine and very coarse sands but make no mention of the latter, which are equally objectionable. To provide against such sands the specifications of the Hydro-Electric Power Commission require that " Not more than 75 per cent by weight of the fine aggregate shall lie between the No. 8 and 30 sieves or between the No. 16 and 50 sieves."

Excess Water

Engineers are being told repeatedly that excess water is detrimental to concrete but most writers have emphasized only its ill effect on strength. The harm done, however, is not confined to strength; it increases porosity, causes segregation, washes out the cement and generally makes the concrete more liable to deterioration.

Water is added to concrete partly to hydrate the cement and partly to give it workability. The part that combines with the cement is small,—at most only a few per cent of the total,—leaving the remainder distributed throughout the concrete. Since water is incompressible and therefore will occupy space in proportion to the quantity present, it follows that any water above that required for hydration increases the volume of the concrete by an amount equal to its own volume. The concrete hardens with this water in place, but, as time goes on, the water dries out and leaves pores through which, given proper conditions, water will again enter. The possible effect of excess water is better appreciated if we consider an excess of, say 20 per cent,—a not unusual amount. In a cubic yard of concrete this would add one cubic foot of pore space, which, in a concrete of average density, is an increase of about 25 per cent in the total volume of space present.

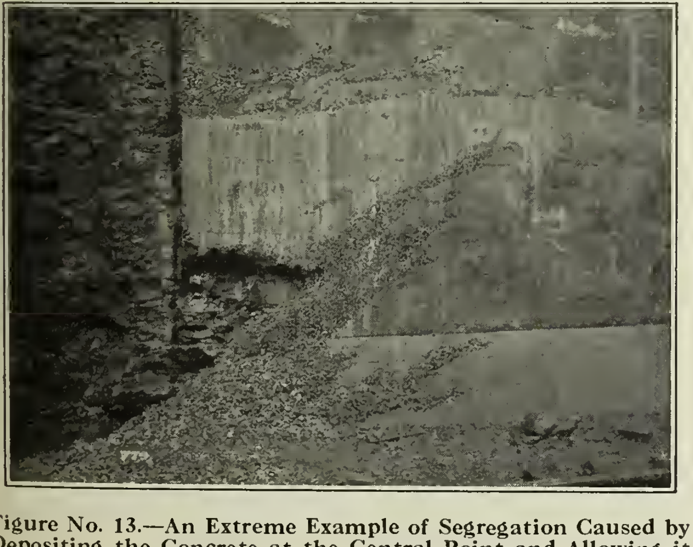

Figure No. 13.—An Extreme Example of Segregation Caused by Depositing the Concrete at the Central Point and Allowing it to Flow into Place.

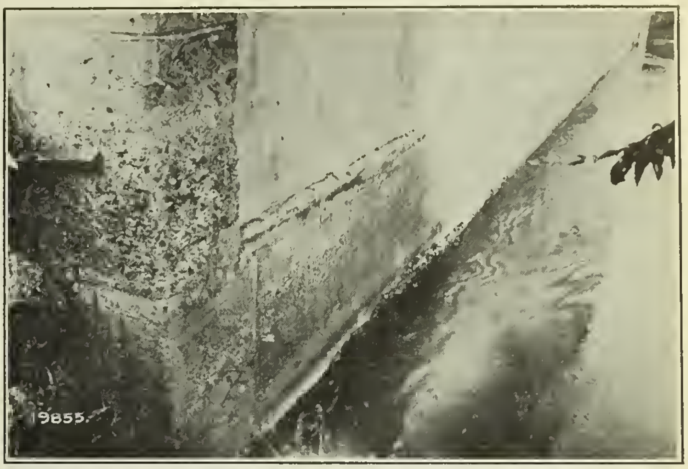

Figure No. 14.—Segregation Caused by the Settlement of the Aggregate through an Over Wet Mix.

Note the coarse aggregate at the bottom, followed by the mortar and topped by a layer of laitance. The concrete is subjected here to a moderate exposure, in fact, the laitance layer is intact, yet the concrete has weathered badly.

Excess water washes the fine particles of the cement and aggregate to the surface as laitance where it collects. Laitance is objectionable, for it not only lacks strength, but is very porous and easily weathered. It also forms planes along which water can readily gain access to and attack the interior of the concrete. Specifications usually require that laitance be removed before concrete is again placed and the necessity for this is generally understood. Unfortunately, all the laitance does not reach the surface but some is trapped, together with water, at varying distances below, forming at the top of each lift, a layer of very porous concrete, which is readily attacked.

Excess water is one of the principal causes of the segregation of concrete mixtures during handling and placing. Concrete must be plastic and workable before it can be placed properly and this requires more water than is needed for the hydration of the cement. The addition of any considerable amount over and above this basic requirement merely thins the mixture to a point where the cement grout cannot float the aggregate. When an attempt is made to handle and place concrete in this condition, segregation is inevitable and trouble results. Segregation is one of the principal causes of lack of durability in concrete and excess water is one of the principal causes of segregation.

Segregation

While segregation is ordinarily due to the use of excess water in the concrete mixtures, yet it may also be caused by improper handling. In fact, almost any concrete mixture will segregate if mishandled, therefore, from the standpoint of quality, the handling and placing of concrete is or is not successful in the degree to which segregation of the ingredients is prevented or overcome.

Segregation influences porosity in various ways. It is obvious that if the coarse aggregate is allowed to collect in pockets, such pockets, containing as they do little or no mortar, will be very porous. If the separation of the mixture is not complete and part of the mortar remains with the coarse aggregate, the porosity is still increased, for then the concrete is in the condition previously referred to, where it lacks the proper complement of fine aggregate. Theo-

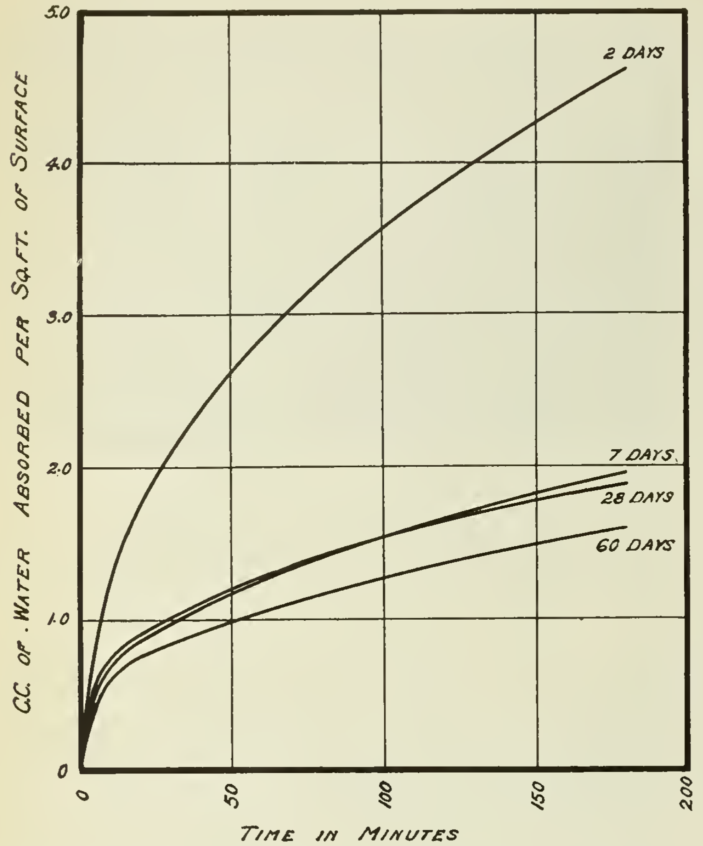

Figure No. 15.—Effect of Curing on the Absorption of Concrete. Absorption Time Curves Obtained with Capillary Pore Determinator.

retically, segregation of the coarse aggregate should not change the porosity of the mortar that separates from it, but practically, where a concrete segregates, the separation of materials usually extends to the mortar,—the fine aggregate also separating from the cement and water. When this occurs the tendency is for such grout to collect in corners, along shoulders, at surfaces and joints, that is, at just those points where experience has shown that concrete structures are particularly liable to deterioration.

Segregation is common to all systems of transporting concrete, whether by chutes, buggies, buckets, belt conveyors, railway or truck, but by proper use, any one of these methods can be made to yield satisfactory results. Even the much maligned chute, if correctly arranged, fed and handled, will transport concrete without segregation, while modern central mixing plants have demonstrated the practicability of long distance transportation of concrete by motor truck,—a method once generally condemned on account of the difficulty of preventing the separation of the aggregates and mortar.

If concrete is dropped from any considerable height, the coarse aggregate will collect in one place and stone pockets result. Dropping concrete through reinforcing steel is also an effective way of separating the stone from the mortar and another is to allow the concrete to strike and bounce off the sides of the forms. A further practice that has proved objectionable, is to dump all concrete at one point in the forms and then to depend upon puddling and shovelling to place it in its final position. In placing concrete the safe rule to follow is to deposit it, with a minimum of interference, as nearly as practicable at its final resting place, puddling and reworking it only sufficiently to consolidate the mass, eliminate entrained air and remove stone pockets.

A little forethought will largely prevent segregation. The first requirement is a properly designed mixture,—one in which the fine and coarse aggregates are correctly balanced. The second is adequate mixing,—not less than a full minute, longer if practicable,—for the cohesiveness of a concrete is increased the longer it is mixed. The third requirement is to use a consistency as dry as circumstances permit, keeping the mixture fully plastic and workable at all times. Most engineers are inclined to use a mixture that is wetter than required. Even in reinforced concrete, it is seldom necessary to use mixtures having a slump greater than three or four inches, and where a mix wetter than this is required, it is usually because the methods of handling and placing are poorly arranged or mismanaged.

Curing

The influence of curing on porosity is more difficult of direct proof than is the lack of cement or the use of excess water. It is usually impossible to ascertain the amount of curing that a given concrete has received, therefore few cases of disintegrating concrete can be definitely attributed to this cause. However, the effect of curing has been investigated experimentally. The author has made tests using four similarly proportioned concretes, cured in water for two, seven, twenty-eight, and sixty days, and when these were tested in the capillary pore determinator previously referred to, absorptions were obtained at the end of a thirty-minute period of 2.1, 1.02, 0.96 and 0.84 cubic centimetres of water per square inch of exposed area respectively, or in the ratio of 1.00, 0.48, 0.46 and 0.40. The results are shown graphically in figure No. 15.

Tests made by other investigators have brought out the same point. Withey[34] has shown that the permeability of concrete decreases very rapidly as the curing period increases. In his tests, concrete cured in water for one day passed five times as much water as that cured similarly for six days, and concrete cured for four days, more than four times as much water as that cured for thirteen days.

Lack of curing has a further detrimental effect on concrete since it reduces its strength and thus its ability to resist attack. Gilkey[35] has shown that concrete cured in water for two days has only 80 per cent of the compressive strength of concrete cured for seven days, and 60 per cent of that cured for a month.

Cold Weather Curing

Lack of curing is one of the dangers of cold weather construction. If concrete is repeatedly frozen before it becomes thoroughly set, its strength is almost totally destroyed and its porosity is greatly increased by the formation of ice in its interior. There is little excuse for allowing concrete to freeze, for freezing can be avoided by simple means, which have been so often described that they should be well-known to all. A number of cases have occurred where complete failure of a structure has resulted from omitting these precautions, but fortunately such failures usually occur before the structure is completed. More frequently, especially in mass work, only the outer surfaces of concrete will be damaged by freezing and the rest will be sound. But whether complete or partial freezing occurs, it may be accepted as a fact that any concrete so damaged will disintegrate, if exposed to the weather or to other destructive agencies.

A less immediate but more subtle effect of lack of curing in cold weather occurs when concrete, although protected

(34) M. O. Withey, Trans. Western Society of Engineers, vol. 19, p. 833.

(35) H. J. Gilkey, The Effect of Varied Curing upon the Compressive Strength of Mortars and Concretes, Proc. American Concrete Institute, vol. 22, (1926), p. 395.

from freezing, is not kept warm while hardening. Standard specifications usually require that concrete be maintained at a temperature of 50° F. or more, for at least seventy-two hours after placing. Concrete so treated, if otherwise sound, will have sufficient resistance to withstand frost action for one season, by which time it will have attained the necessary strength to protect it indefinitely. If less curing has been provided, it is liable to be destroyed while still weak, particularly if it becomes frozen while saturated with moisture. Any structure where the volume of concrete is small or its exposed area is large in relation to its mass is particularly liable to attack of this sort and special care needs to be taken in its curing.

Several cases where trouble has resulted from this cause have come to the author's attention. In one the structure was a thin platform built in the early winter. The aggregates and water were heated, the concrete was protected and steamed, but steaming was discontinued at the end of thirty-six hours. After its initial curing the concrete had no further opportunity to gain strength on account of the continued cold weather. In the spring the melting snow saturated the platform with water and while in this condition it was frozen a number of times by recurring cold nights. The concrete lacked the strength to withstand this treatment and was so badly damaged that it had to be replaced. Seventy-two hours of curing at 50° F. as required by the standard specifications would have saved this structure, for, in tests made by the author in the laboratory of the Hydro-Electric Power Commission of Ontario, similar concrete cured seventy-two hours was undamaged by fifteen alternations of freezing and thawing, but when cured only thirty-six hours it was so badly disintegrated by the same treatment that further tests were impossible.

Figure No. 16.—A Concrete that Has Been Frozen before it Set.
Note the pores left by the ice crystals.

Figure No. 17.--A Concrete Footing Built in the Late Fall.
It was protected until hardened, but never had a chance to cure properly. In the spring it became saturated with water and was frozen.

Determining Causes

It is seldom that the deterioration of a concrete is caused by a single agency for if it is of such poor quality that it is susceptible to one form of attack it is usually susceptible to others. Thus, one finds a concrete being weathered by frost action in which the cement is also being dissolved by an internal movement of water, or one in which both alkali and frost are acting jointly, or another where frost, sulphate decay and spalling from the rusting of the reinforcement are all taking place simultaneously. Engineers, in such cases, are apt to give as the cause the factor most in evidence or the one with which they are most familiar.

Few engineers go beyond these more or less obvious outward manifestations of deterioration and attempt to differentiate between the agency of attack, the condition of the concrete that permitted the attack and the cause of that condition, and it is necessary to do this if means are to be devised whereby the agencies of destruction are to be circumvented. For example, frost may be the immediate agent of destruction through its action on moisture in the pores of the concrete, but the pores are the means by which it is enabled to destroy the concrete. It is seldom possible to

Figure No. 18.—Concrete Eight Years Old that Was Designed to Have Low Porosity but which Tested only about 1,500 pounds per Square Inch at Twenty-eight days.

Note the absence of disintegration and excellent condition of the concrete.

protect an exposed concrete from freezing temperatures, but it is possible to build one in which the porosity has been reduced to a point where it is no longer damaged by frost action.

Durability and Strength

The probable durability of concrete should not be judged by its strength alone. The fact that a concrete has a high compressive strength is no guarantee that it will be durable. This point has already been referred to in discussing frost action, but it will bear repeating. It is true that usually concrete of high strength is durable, but usually the same concrete is also highly impermeable and of low absorption, and it is these qualities, more than strength, that determine its resistance. Concrete of low strength can be made durable, for the Hydro-Electric Power Commission of Ontario have used large yardages of concrete in such places as canal linings, dams and retaining walls that at twenty-eight days tested from 1,500 to 1,800 pounds per square inch. This concrete was proportioned for impermeability as well as strength, and it is proving very durable in service.

Examples of Durable Concrete

The author has dwelt at some length on the ills to which concrete is subject. He has done so purposely, hoping that if the desire to have a good concrete is not sufficient to cause engineers to insist on the requirements necessary to achieve that end, a fear of the consequences might do so. But he would not leave this subject without offering evidence of the enduring qualities of well-made concrete. There are a great many concrete structures that have given years of satisfactory service without appreciable deterioration, but space will permit the citation of only a limited number of these.

For the earliest examples, one has to go to England, where Portland cement was invented. Portland cement was used in 1862 in the mass foundations of the Crystal Palace, London. It was also used in the same structure where the brickwork was stuccoed or rendered, and here it is reported[36] to be standing today, finely moulded with the mitres perfect. Other examples of about the same age are the Thames Embankment and the Metropolitan Main Drainage both built in the same city between the years 1858 and 1865. They are also reported[36] as being in good condition.

A row of fourteen five storey houses was built at Folkestone, England, in 1870, and is still in use. Concrete was used for the front and back steps of these houses and is reported[37] in the same condition as when built over fifty years ago. A flight of about one hundred and fifty stairs leading up the cliff, built at the same time, have been in constant use since and are still in excellent condition and show no signs of wear.

About 1874, a Mr. A. T. Peterson built, near Southampton, England, a tower of Portland cement concrete, 220 feet high and 22 feet square at the base. Figure No. 19 is a picture of this tower, taken in January 1924 by Mr. H. C. Badder of London, England. Mr. Badder, reporting[38] on the condition of the concrete says, "There the tower stands, practically as perfect as it was fifty years ago. . . . Now that it is protected from lightning there is no visible reason why it should not stand for another fifty or even one hundred years."

The oldest concrete structures on this continent of which the author could find record were a concrete barn and several other buildings built at Croton-on-the-Hudson in 1865. The barn is a building 60 by 75 feet, two storeys in height with walls 18 inches thick. The interior of this barn was completely burned out about thirty years ago and since that time the structure has not been in use. In 1923 the concrete of this barn was reported as "exceptionally good"[39].

Crystal Springs dam, San Mateo, Calif., was built between 1887 and 1890. The concrete was mixed approximately 1:2:6, very dry, being rammed into place by heavy iron tampers. In 1923 this concrete was inspected by engineers of the Portland Cement Association, who reported "the structure in very good condition with no deterioration whatever"[40].

During 1888, a number of concrete structures were built in the harbours of Nova Scotia by government engineers. Some of these are in the Bay of Fundy, where tidal conditions are very severe. Mr. R. J. Wig, who examined them a few years ago, reported[41] that at that time "on some, the form marks are yet visible," and that they "will last many more years."

The oldest concrete pavement is thought to exist at Bellefontain, Ohio. It was built in 1892 in the streets surrounding the courthouse and in the courthouse square of that city. A concrete driveway was also built for a local lumber company at about the same time. Both were still in use in 1924[42].

In 1894 the United States government used Portland cement concrete in the construction of locks at Rock Island, Ill., on the Illinois-Mississippi canal. They were made of 1:2:4½ concrete, placed in layers and rammed. Special provision was made for curing. When these, and two other locks built about the same time, were examined in 1923 they were found to be in excellent shape after being in constant use under severe weather conditions for approximately thirty years[43].

The Stanford University building, Palo Alto, Calif., was built in 1896. This building withstood the San Francisco earthquake of 1906 and is still in use at the present time. There has been no deterioration of the concrete in this structure due to weathering[43].

Another building in the same locality is the Ferry

(36) H. C. Badder, Concrete, Oct. 1924.

(37) Concrete, Sept. 1921.

(38) H. C. Badder, Concrete, July 1924.

(39) W. E. Hart, Proc. American Society for Testing Materials, vol. 23, (1923) part II.

(40) W. E. Hart, Proc. American Society for Testing Materials, volume 23, part II, 1923, pp. 219-226.

(41) R. J. Wig, Proc. American Society for Test. Mat., vol. 23, part II, 1923.

(42) A. K. Chenoweth, Concrete, July, 1924, p. 24.

(43) W. E. Hart, Proc. American Society for Testing Materials, vol. 23, part II, 1923, pp. 219-226.

Building, also at San Francisco. This building was built in 1898 and consists of concrete arches and abutments with a small amount of reinforcement. Part of the work is below and part above sea level. The mixture is not known. When inspected in 1923, no deterioration was noticeable and it was apparently in as good condition as when placed[43].

Between 1900 and 1902, the Illinois Central Railroad built a large number of concrete bridges in southern Illinois. In every case the concrete was of a consistency that would quake slightly after being thoroughly rammed. Abutments and wing walls were mixed 1:2½:6 and arch rings, 1:2:5. Four of these bridges were inspected in 1923, three showed little or no deterioration, while in the fourth there were a few cases of spalling and some disintegration in abutment walls where drainage was improperly taken care of. In all cases the concrete was structurally sound[43].

Figure No. 20.—Pavement at Bellefontain, Ohio, Built in 1892 Thought to be the Oldest Pavement in Existence.
(*Published by permission of Concrete*)

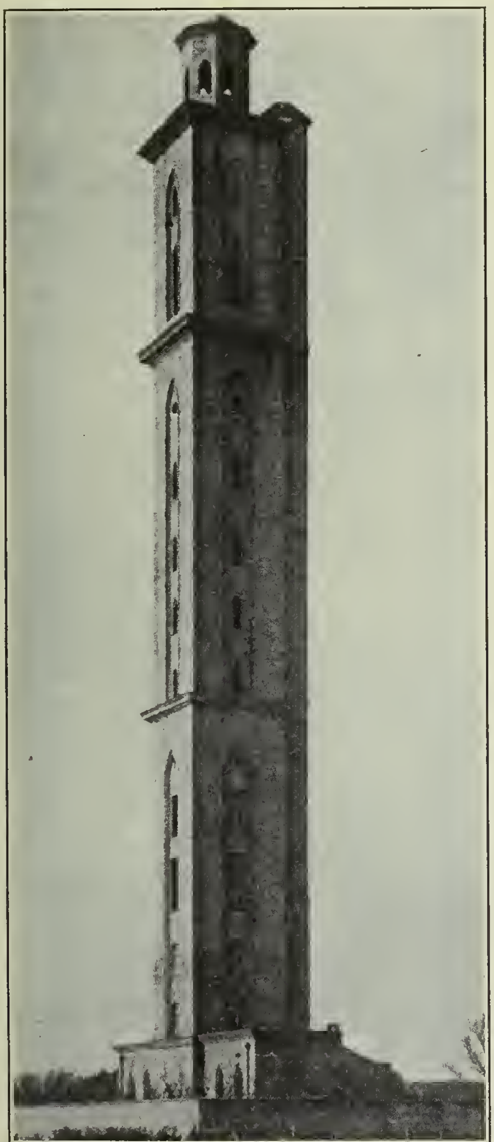

Figure No. 19.—Peterson's Tower, near Southampton, England, Built of Concrete about 1874, 220 feet High, 22 feet Square at the Base.
(*Published by permission of Concrete*)

In 1901-02 the New York Central Railroad built a reinforced concrete arch bridge made up of ten arches of 60-foot span, over West Canada creek, at Herkimer, N.Y. The concrete was mixed very dry and placed by means of buggies. An inspection of this structure in 1923 showed it to be in very good condition[43].

Life of Concrete

These examples serve to show something of the possible life of well-made concrete. The oldest is over sixty years old: others are from twenty-five to fifty years old and all are in good condition. They represent different types of structures,—buildings, bridges, hydraulic and marine,—and different exposures varying from mild California to the rigorous climate of Nova Scotia. The condition of these old structures does not indicate that the concrete is nearing the end of its useful life. They indicate rather that well-made concrete is an enduring material and one that will give long years of satisfactory service under a variety of conditions.

If well-made concrete has proved durable, and poorly-made concrete has not, the lesson is obvious. As the author has attempted to show, the characteristics of a durable concrete are that it shall have low porosity and be made of sound ingredients. Neither special equipment nor methods are necessary to obtain these. What is required is that the concrete shall be made of selected materials, properly proportioned, handled and placed without separation, and well cured.

All materials have their limitations, concrete is no exception to this, but rightly made and rightly used, few materials will give more satisfactory service. Concrete is probably as permanent as any material made by human hands but it is permanent not by chance but by intention. There is no material that is more truly a monument to its builder. Use good materials and right methods and the monument is enduring, but use poor materials and wrong methods and it is only a few years at best before the most inexperienced layman can read the story of the builder's shame. "By their works shall ye know them" is as true of builders of concrete as of others.

The Effect of Steam Treatment of Portland Cement Mortars on Their Resistance to Sulphate Action*

T. Thorvaldson and *V. A. Vigfusson.*
University of Saskatchewan, Saskatoon, Canada.

Paper presented at the Annual General Professional Meeting of The Engineering Institute of Canada, at Montreal, Que., February 16th, 1928

In the prairie provinces of Canada and the corresponding states to the south, failures of concrete structures imbedded in the soil are common. It is now generally accepted that the active agent causing the disintegration of these structures is the sulphate which is often present in large quantities in the ground water. Further, that whereas poorly made concrete disintegrates very rapidly, even the very best concrete made according to the usual methods disintegrates in time under the very severe conditions found in some localities.

During the summer of 1925, the authors began a study of the effect of steam treatment on Portland cement mortars as a part of a general investigation on the action of sulphate waters on cements and concrete. The method used for following the progress of the action of the sulphate solutions on the mortar specimens was that described by Thorvaldson, Larmour and Vigfusson.† This depends on the determination of the curve for the expansion of mortar test pieces during the course of the disintegration. Portland cement mortar specimens when undergoing sulphate action expand in a regular manner, and from the expansion at any point it is possible to predict the extent to which the tensile strength of the specimen has decreased through the action of the sulphate.

This method has decided advantages over the method of following the progress of the action by means of the determination of the tensile or compressive strength of mortar or concrete test pieces. When the latter method is used it is very difficult to predict the time intervals at which the tests are necessary, and this is likely to result in wastage of test pieces broken either too soon or too late. When the expansion method is used the same specimens can be used throughout the course of the experiment, irrespective of the time required for disintegration, as the specimens are not destroyed in making the test as in the case of the other method.

Dalton G. Miller‡ has published results of tests on the sulphate resistance of concrete cylinders cured in water vapour. Cylinders cured in water vapour at 212° F. showed, during exposure to the waters of Medicine lake, South Dakota, which, according to analysis submitted, contains 1.7 to 2.9 per cent sulphate, (SO_4), greatly increased resistance as compared with specimens cured in the damp closet or in water. On the other hand, it was found that similar cylinders cured in water vapour at 100° F. and 155° F. showed less resistance than those cured in water at about 70° F.

In experiments carried out at the United States Bureau of Standards* it was found that "steam up to 80 pounds per square inch gauge pressure has an accelerating action on the hardening of Portland cement mortar and concrete," the effect on the compressive strength increasing with the steam pressure used and with the time of exposure to steam. A compressive strength in some cases of over 100 per cent in excess of that obtained normally after ageing for six months was obtained in two days by using steam under pressure.

This suggests that the increase in sulphate resistance observed by Miller may be due to an increase in the strength of the test pieces during the steam treatment. The results of the experiments described in this paper indicate that this does not constitute a complete explanation.

Physical Tests on the Cements Used**

Laboratory No.	555	126	326
Passing No. 200 mesh sieve	84.4%	88.1%	83.4%
Normal consistency	22.5	24.	22.
Soundness in steam	O.K.	O.K.	O.K.
Time of setting (Gillmore)—			
Initial	2 hr. 45 min.	2 hr. 40 min.	3 hr. 45 min.
Final	6 hr. 30 min.	6 hr. 25 min.	6 hr. 15 min.
Tensile strength, 1:3 briquets, standard sand mortar, pounds per square inch.			
7 day	230	265	305
28 day	335	420	415
Compressive strength, 2″ by 4″ cyl., 1:3 standard sand mortar, pounds per square inch.			
7 day		1295	2740
28 day		2540	3185

Chemical Analysis of the Cements Used

Laboratory No.	555	126	326
Silica (SiO_2)	20.55	22.22	20.02
Alumina (Al_2O_3)	6.85	6.83	6.97
Ferric oxide (Fe_2O_3)	2.65	1.89	2.61
Lime (CaO)	61.95	63.39	63.48
Magnesia (MgO)	3.52	2.45	3.86
Sulphuric anhydride (SO_3)	1.74	1.97	1.85
Loss on ignition	2.10	1.49	1.25
Free lime (White's test)	absent	absent	absent

* This work was done under the auspices of a research committee of The Engineering Institute of Canada with the financial support of The National Research Council of Canada, The Canada Cement Company, The Canadian Pacific Railway and the three prairie provinces of Canada.

† The Engineering Journal, vol. 10, p. 199, (1927).

‡ Proc., A.S.T.M., vol. 24, pt. II, p. 847, (1924).
Public Roads, (U.S. Dept. of Agriculture), Oct. 1925

* Wig. Tech. Paper 5, (1912).

** These tests were made by the Department of Civil Engineering, University of Saskatchewan, and supplied by Prof. G. M. Williams.

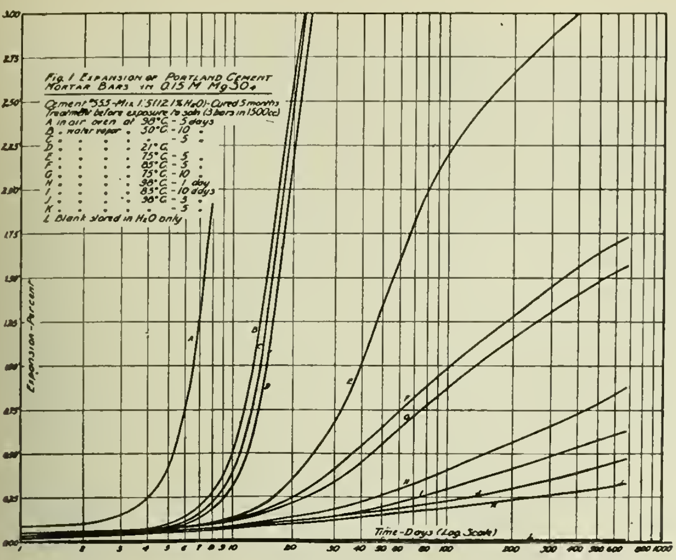

Figure No. 1.

Sulphate Solutions

The solutions of sodium and magnesium sulphate were prepared from recrystallized salts and contained only traces of impurities. The adjustment of the initial concentrations was made by gravimetric sulphate determinations and was accurate to within less than 0.5 per cent of the sulphate content in the solution.

The calcium sulphate was prepared by precipitation from very pure recrystallized calcium nitrate, the precipitate of calcium sulphate being washed thoroughly by decantation.

Preparation of Mortar Specimens

The specimens used for the tensile strength determinations were briquets of the usual form, using cement, standard Ottawa sand and distilled water in the proportions by weight indicated. The mortar bars were made in the same way, using collapsible steel frames to give bars measuring ⅝ by ⅝ by 7½ inches. The bars had a thin layer of neat cement on each end. The ends were thus suitable for making accurate measurements of length, being smooth and free from easily detachable material. They were more resistant to sulphate action than the remainder of the bar so that in general the ends show no appreciable action by the time the bar falls to pieces. The specimens were removed from the moulds as soon as they were strong enough to handle, the time varying from one to eight days according to the richness of the mix, which varied from 1:5 to 1:10. They were stored in a damp closet until treated with steam or placed in the sulphate solutions.

Exposure of the Specimens to Steam and to the Solutions

After the initial period of curing of the bars in the damp chamber their length was determined by means of a micrometer head set in a frame of tool steel. The micrometer was read to one ten-thousandth of an inch. The bars were then exposed to steam either in a vacuum desiccator, over water, placed in an oven regulated to the required temperature, or in a vacuum oven so regulated. The bars cured in water were kept in sealed glass jars filled with water at the required temperature.

After cooling a day in the damp closet the bars were again measured and then exposed to the sulphate solutions in stoppered glass jars. Three bars were placed in one and one-half liters of the solution. Measurements of length were then made as often as necessary for the duration of the experiment and the average percentage increase in length plotted against time of exposure. The curves of figures Nos. 1 and 2 were obtained under the conditions of an ordinary laboratory room where the temperature varied from day to day. As sulphate action is rather sensitive to changes in temperature* this caused certain irregularities in the curves. The curves of figures Nos. 3 to 7 were obtained in a constant temperature room which did not vary more than a few tenths of a degree from the temperature indicated.

Effect of Exposure of 1:5 Mortar Bars to Water Vapour at Different Temperatures

Changes in Length

During the curing of Portland cement mortar bars either in damp air or in water at 21°C. a slight increase in length takes place. The rate of expansion is most rapid at first after removal from the moulds and decreases gradually until the bars attain a constant length. The total expansion during curing is least for lean mixes and increases gradually with the richness of mix.

When Portland cement mortar bars are cured in an atmosphere of steam at the boiling point of water an expansion takes place which varies with the cement used, the richness of mix, the age of the bars and the length of the steam treatment. There is a tendency for well-cured bars to contract during steam curing for short periods, which, however, changes to expansion on longer steam treatment. With 1:5 mortar bars made from cement No. 555, cured five months in the damp closet, the average total linear expansion after three days' steam treatment at 98°C. was 0.04 per cent. There was no further increase in length on five days' treatment. Similar bars treated with water vapour at temperatures below the boiling point of water also showed contraction and subsequent expansion, but at a slower rate. Thus the bars in saturated water vapour at 85°C. showed very slight contraction in five days, which was changed to a slight expansion in ten days. At 75°C. there was contraction in five days, while the bars came back to their original length in ten days, and at 50°C. the bars showed contraction at the end of ten days' treatment.

* The Engineering Journal, vol. 10, p. 199, (1927).

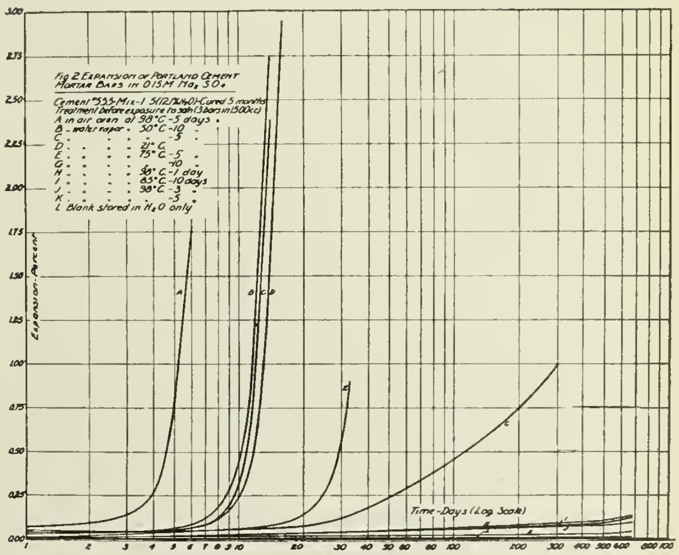

Figure No. 2.

This is rather interesting in view of the differences between the effect of steam treatment at the various temperatures on the sulphate resistance of the mortar. The beneficial effect of steam treatment on the resistance to sulphates seems to be accompanied by an expansion of the mortar.

Changes in Sulphate Resistance

Figure No. 1 indicates the relative rate of expansion of 1:5 mortar bars treated in various ways, in 0.15 molar solutions of magnesium sulphate, (1.8 per cent $MgSO_4$), and Figure No. 2 indicates the relative rate of expansion of similarly treated bars in 0.15 molar solutions of sodium sulphate, (2.1 per cent Na_2SO_4).

In each case the bars after curing for five months in the damp closet were treated with saturated water vapour at 21°, 50°, 75°, 85° and 98°C. respectively, and then cooled in the damp closet before immersion in the sulphate solutions. Comparison of the curves of Figures Nos. 1 and 2 shows that exposure to water vapour at 50°C. for five days, (curve C), causes an increase in the rate of expansion in solutions of magnesium and sodium sulphate as compared with the bars kept at 21°C., (curve D), and that this effect is increased for a treatment of ten days at 50°C., (curve B). On the other hand, exposure to water vapour at 75°, 85° and 98°C., (curves E to K), retards the rate of expansion in both sulphate solutions markedly, the effect increasing with the time of exposure and the temperature, being most marked in steam at 98°C. It is rather striking that heating the bars in dry air at 98°C., (curve A), speeds up the rate of expansion in both sulphate solutions about two and one-half times as compared with the bars cured in moist air at 21°C.

A further comparison of the curves for the bars treated with 0.15 molar magnesium sulphate, (figure No. 1), shows that while a five days' treatment at 98°C., (curve K), retards the expansion enormously, an expansion of 0.33 per cent being attained in seven hundred days as against the same expansion in about ten days for the bars not treated with steam, (curve D), yet this expansion is considerable when compared with the bars stored in pure water, (curve L), which expanded less than 0.02 per cent in seven hundred days. However, the bars treated with steam at 98°C., do not show any visible signs of sulphate action at the end of seven hundred days except that they are coated with a white deposit, while the bars treated ten

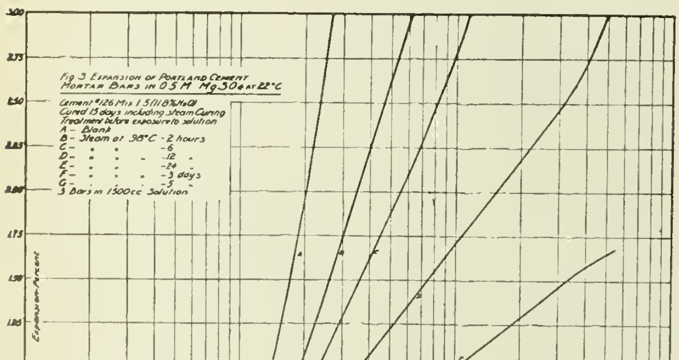

Figure No. 3.

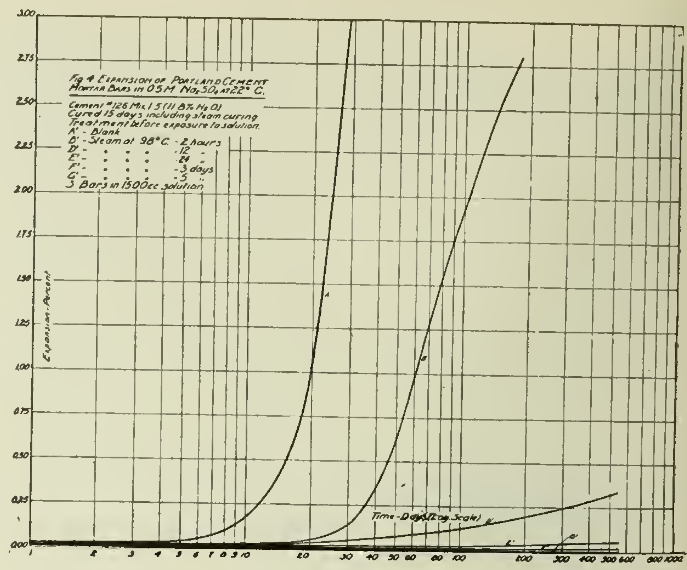

Figure No. 4.

days at 85°C., (curve I), are more heavily coated and are in addition very slightly bent.

On the other hand we see from figure No. 2 that the steam treatment is much more effective in preventing expansion of the mortar bars in 0.15 molar sodium sulphate. Five days' treatment at 75°C., (curve E), more than doubles the time necessary for expansion of 0.75 per cent, and a ten-day treatment at the same temperature, (curve G), increases the time eighteen fold. But these bars, (curves E and G), fall to pieces at an abnormally low expansion of less than one per cent. Treatment at 85°C., for ten days, or at 98°C., for from one to five days almost prevents expansion of the 1:5 mortar bars in 0.15 molar solutions of sodium sulphate. The bars treated at 85°C., show slight signs of attack, while the bars treated with steam at 98°C., all appear in perfect condition at the end of seven hundred days, those treated five days having expanded less than 0.04 per cent as compared with 0.015 per cent for the bars in distilled water.

It may be mentioned here that a comparison* of the expansion of mortar bars and the loss in tensile strength of mortar briquets made from a normal Portland cement and standard Ottawa sand 1:5, cured seven days before exposure to a 0.15 molar solution of sodium sulphate, indicated that a linear expansion of one-half of one per cent corresponds to a loss of approximately sixty per cent of the tensile strength of the specimen.

Figures Nos. 3 and 4 illustrate the effect of steam treatment at 98°C. The bars were of a 1:5 mix. They were cured only fifteen days including the time necessary for the steam curing, before immersion in 0.5 molar solutions of magnesium and sodium sulphate, (5.7 per cent $MgSO_4$ and 6.5 per cent Na_2SO_4). Figure No. 3 shows that the effect of steam on the resistance to the action of magnesium sulphate is evident after a treatment of two hours at 98°C., (curve B), and increases gradually as the time of treatment is lengthened. A five days' treatment with steam at 98°C. increases the time necessary for an expansion of 0.5 per cent thirty fold, (three hundred and sixty days as compared to less than twelve days for the untreated bars). The bars treated in steam three and five days appear in good condition at the end of a five hundred and fifty days' exposure to 0.5 molar magnesium sulphate except that they are covered with a white coating and have expanded

* The Engineering Journal, vol. 10, p. 199, (1927), figure No. 3.

0.95 per cent and 0.60 per cent respectively. There is marked increase in the rate of expansion of the bars in 0.5 molar magnesium sulphate, (figure No. 3), as compared with the 0.15 molar solution, (figure No. 1).

Figure No. 4 again shows the great resistance to the action of sodium sulphate produced by the steam treatment. Two hours' treatment in steam at 98°C., (curve B′), increases the time necessary for an expansion of one per cent more than three-fold, while a twelve-hour treatment, (curve D′), increases the time necessary for an expansion of 0.25 per cent twenty-five fold. Bars treated twenty-four hours and three days respectively show very little expansion in 0.5 molar sodium sulphate, the former expanding as much in one year as the untreated bars in six days, while the latter expanded as much in one year as the untreated bars in two days. The bars treated five days in steam at 98°C. expanded no more during more than five hundred days' exposure to 0.5 molar sodium sulphate than bars stored in distilled water.

Effect of Curing in Hot Water on the Sulphate Resistance of Mortar Bars

Figure No. 5 shows the effect of curing mortar bars in water at 98°C. The mortar bars were of the same batch as those used in obtaining the curves of figures Nos. 3 and 4 and the corresponding curves are therefore directly comparable. A comparison will show that in each case the treatment with water is very slightly less effective than the steam treatment at the same temperature in preventing the expansion of the bars in sulphate solutions, but otherwise the effect is similar. Relatively similar results were obtained from bars cured in steam and water at 85°C., 75°C. and 50°C.

Figure No. 5 gives also a direct comparison of the relative effect of hot water curing on the expansion of 1:5 mortar bars in sodium and magnesium sulphate, curves A, C, E and G and curves A′, C′, E′ and G′ giving corresponding values for expansion in 0.5 molar magnesium sulphate and 0.5 molar sodium sulphate respectively. This shows clearly the much greater increase in the resistance to sodium sulphate produced by the treatment.

Steam Curing of Very Lean Mortars

In order to make certain that the great resistance of steam-treated mortar to sulphate action is due to a change in the cement itself, and not to a physical change in the mortar, such as a decrease in permeability, a series of experiments was started with bars made of one part of cement to ten parts of standard sand. The results so far obtained over a period of nine months show that the 1:10 mortar after steam treatment has as high a resistance to the action of sodium sulphate as 1:5 mortar similarly treated. This fact seems to indicate that steam treatment produces a chemical change in the cement itself which makes it almost immune to the action of the sodium sulphate and which slows up enormously the action of magnesium sulphate.

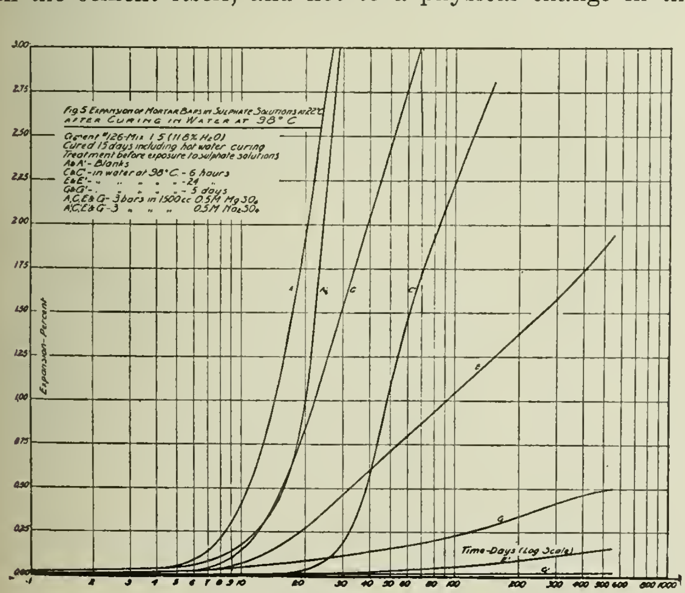

Figure No. 5.

The Action of Sulphates on the Substances Generally Considered to be Present in Portland Cement Clinker

In a paper read before Section III of the Royal Society of Canada, the authors* reported on experiments dealing with the action of solutions of sodium and magnesium sulphate on mortar bars of tricalcium silicate and dicalcium silicate alone and mixed with tricalcium aluminate. According to the researches of Shepherd, Rankin and Wright† these three substances compose over 90 per cent of normal Portland cement clinker, and the action of sulphates on Portland cement should therefore be determined by the action of sulphates on the individual components. It was found that mortar bars prepared from pure tricalcium silicate or from pure dicalcium silicate were not affected when exposed to solutions of sodium sulphate. Mortar bars made from these substances did, however, expand and disintegrate slowly when exposed to solutions of magnesium sulphate. If tricalcium aluminate was present with the silicates in the bars it was found that they expanded and disintegrated rapidly both in solutions of sodium sulphate and magnesium sulphate. Thus, if one accepts the above conclusions of Shepherd, Rankin and Wright, it appears that the disintegration of Portland cement mortars and concrete in solutions of sodium sulphate is due solely to the action of the sulphate on one of the components of the cement, namely, tricalcium aluminate, and that while the rapid deterioration of the same mortar in solutions of magnesium sulphate is due mainly to a reaction with the tricalcium aluminate, the other two components are also vulnerable to the action of solutions of this salt.

Applying these facts to explain the action of steam on Portland cement mortars, it is only necessary to assume that the change produced by steam renders the tricalcium aluminate of the cement resistant to sulphate action. The mortar should then on steam treatment become completely resistant to solutions of sodium sulphate but not immune to the action of magnesium sulphate unless the silicates also were changed so as to become resistant. The action in solutions of magnesium sulphate should be retarded very much, and the expansion of the treated bars in solutions of this salt should be comparable to that of a mortar made of the pure silicates. This is entirely in agreement with the facts as to the effect of steam and hot water treatment of cement mortars, as illustrated in figures Nos. 1 to 5 above.

The Addition of Tricalcium Aluminate to Portland Cement

Further experiments were carried out to determine the effect of adding tricalcium aluminate to Portland cement, and the effect of steam treatment on mortars made from the cement thus modified. In considering the results, it must

* Thorvaldson, Vigfusson and Larmour. Transactions of the Royal Society of Canada. Section III, 1927.

† Jl. Ind. & Eng. Chem. 3, 211, (1911).
Zeitschrift anorg. Chemie 92, 213, (1915).
Jl. Ind. & Eng. Chem. 7, 466, (1915).

be remembered that the cement and the aluminate, after grinding the latter to pass a 200-mesh sieve, were mixed only by mechanical shaking and that we are therefore probably not dealing with such an intimate mixture as in a commercial cement.

It was found that addition of tricalcium aluminate increases the expansion produced during steam treatment of the mortar bars. This expansion rapidly increases with the amount of aluminate, as shown by the following table:—

Cement	Mix of Mortar	Per cent Expansion, 10 days in Steam at 98°C.
No. 326	1:7½	0.028
No. 326 + 5% $3CaO.Al_2O_3$	1:7½	0.036
No. 326 + 15% $3CaO.Al_2O_3$	1:10	0.14
No. 326 + 25% $3CaO.Al_2O_3$	1:7½	0.46

The bars containing 25 per cent added aluminate showed a tendency to warp during the steam treatment.

Figures Nos. 6 and 7 illustrate the effect of the addition of 5 per cent of tricalcium aluminate to Portland cement, on the expansion of cement mortar bars when immersed in sulphate solutions. They also show the effect of steam treatment on the sulphate resistance of mortar bars made from the normal and modified cements. It is evident that addition of tricalcium aluminate increases the rate of expansion in 0.15 and 0.50 molar sodium sulphate, and magnesium sulphate and in saturated calcium sulphate, the increase being greatest for the solutions of highest concentration. There is a rather interesting point brought out by these curves. Mortar bars made from all Portland cements so far examined by the authors expand faster in concentrated than in dilute solutions of magnesium sulphate. But Portland cements fall into two classes with respect to their behaviour with sodium sulphate. Except for the first few days of the expansion curve, where the rate of expansion increases with the concentration, one finds that mortar bars from some cements expand more rapidly in concentrated than in dilute solutions of sodium sulphate while with others the reverse is the case. Cement No. 326 belongs to the latter class, (figure No. 6, curves 1A and 1B). After addition of 5 per cent tricalcium aluminate the modified cement, however, belongs to the first class, expanding more rapidly in the more concentrated solution, (curves 2A and 2B). This suggests that this difference in Portland cements may be determined by the amount of tricalcium aluminate they contain.

A study of the expansion curves of figure No. 6, (A′, B′ and C′), recording the expansion of the bars made from the modified cement, (No. 326+5 per cent tricalcium aluminate), and subsequently treated with steam at 98°C. for ten days, indicates that these bars have become highly resisting to the action of sodium sulphate. The steam treatment, however, has not been quite as effective with the bars from the modified cement as with the bars from the normal cement.

It was found that as the amount of tricalcium aluminate added to cement No. 326 increased, the steam treatment became less and less effective in retarding sulphate action. When 25 per cent of tricalcium aluminate was added to the cement, (the mix being 1 part cement: 0.25 parts 3 $CaO.Al_2O_3$:7½ parts sand), the steam-treated bars expanded in solutions of sodium sulphate at a rate which was approximately one-third of the rate of similar untreated bars made from the normal cement. The bars containing the largest quantity of aluminate expanded so much during the steam treatment that this in itself damaged them.

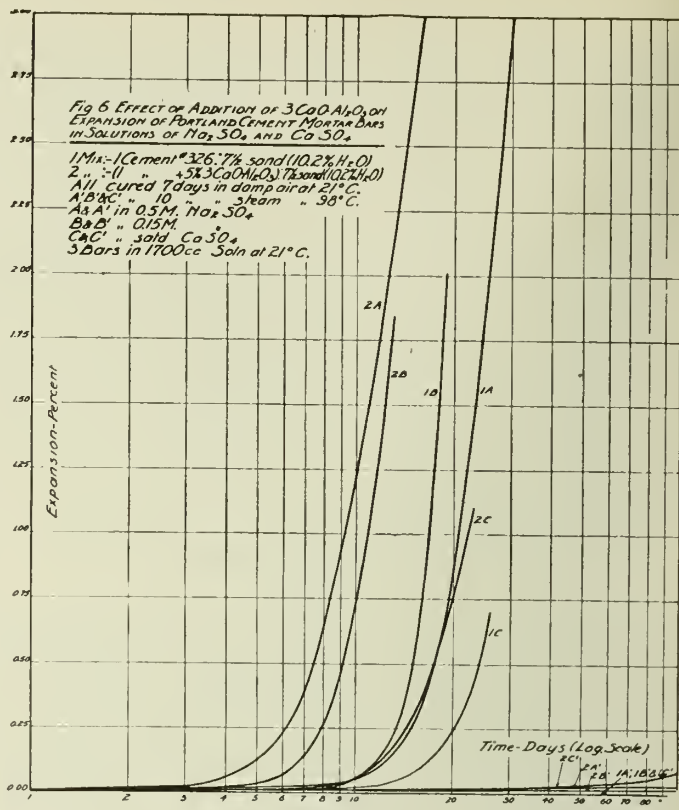

Figure No. 6.

It seems that if the alumina in Portland cement is present in the form of tricalcium aluminate, the failure of the steam treatment in the case of the bars made from the modified cements must be due to some physical factor. It is possible that an intimate mixture of the aluminate and the silicates, such as occurs in a sintered cement clinker, is necessary before the changes produced during steam treatment of a mortar can take place at a reasonable velocity. If this were so then the efficiency of steam treatment would rapidly decrease as the amount of tricalcium aluminate added to a cement is increased. It is also possible that there is a limiting value for the amount of tricalcium aluminate which may be present in a cement if the steam treatment is to be effective and that the aluminate in cement No. 326 was already approaching that value.

Considering the large amount of careful work which has been done on the constitution of Portland cement clinker the alternative explanation of the failure of the steam treatment of mortar bars containing cement and tricalcium aluminate, that the alumina is not present in Portland cement clinker in the form of tricalcium aluminate, seems unlikely.

The Effect of Steam Treatment on the Tensile Strength of Portland Cement Mortars

Figure No. 8 gives the effect of steam treatment on the tensile strength of mortar briquets made from cement No. 126. The first and most pronounced effect of steam is to decrease the tensile strength of the briquets. On continued steam treatment the briquets again gain in strength. As the temperature of the saturated steam increases, the rate at which the briquets lose and gain strength is increased. If one compares the *rate of loss in tensile strength* of the briquets with the *increase in resistance* of similar bars to sulphate action as shown in Figures Nos. 1 and 5, one sees that these are in the same order, the treatment which pro-

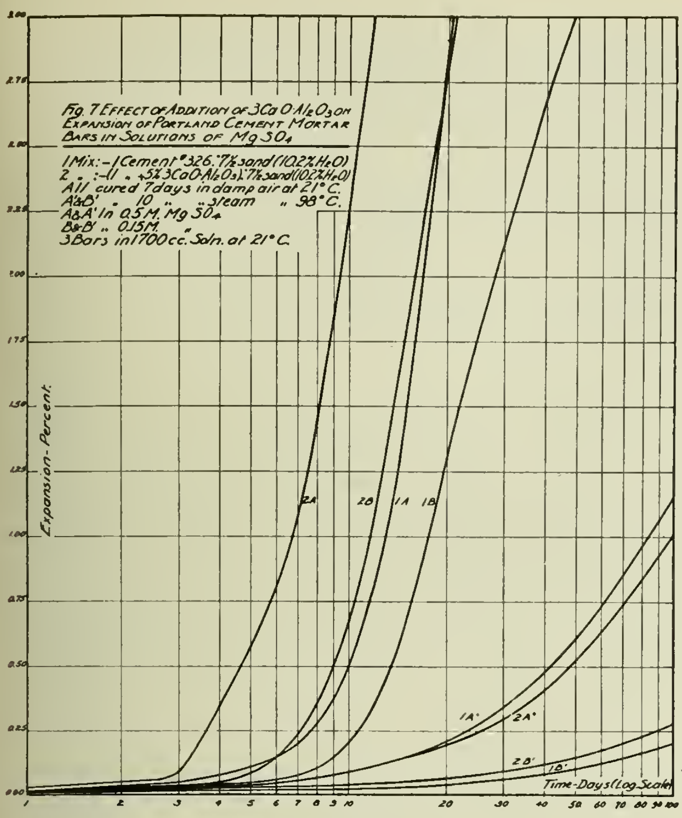

Figure No. 7.

duces the most rapid loss in tensile strength at the beginning of the steam treatment, also producing the greatest increase in the resistance to the action of sulphate solutions. Steam treatment at 50°C. shows no decrease in strength during the first twenty-four hours, and as shown above this treatment lowers sulphate resistance. As the temperature of the saturated steam increases to 75°, 85°, 98° and 150°C., (about 70 pounds per square inch), the rate of the initial loss in strength increases, and the rate of subsequent increase in strength also increases. If one were to reason by analogy one would predict that saturated steam at 70 pounds pressure, (150°C.), would be more effective in increasing sulphate resistance than steam at 98°C. Experiments which are in progress seem to confirm this conclusion.

From consideration of the tensile strength curves, it is evident that two independent changes are taking place during steam treatment, one causing loss in strength, the other an increase in strength of the briquets. Accepting the views of Shepherd, Rankin and Wright as to the constitution of Portland cement clinker, and bearing in mind the studies summarized above on the behaviour of mortars made from tricalcium silicate, dicalcium silicate and tricalcium aluminate in sulphate solutions, and the effect of steam treatment on the sulphate resistance of mortars, as shown in figures Nos. 1 to 5 above, it seems probable that the first action, causing a loss in tensile strength, is due to a change in the tricalcium aluminate of the cement and that this change is the primary cause of the increase in the sulphate resistance of the mortar. The second change, causing an increase in tensile strength, would then probably be due to hydration of the silicates, speeded up by the action of steam or possibly partly due to the formation of stable cementing substances from the aluminate. The change in the shape of the curves as the temperature rises would then be explained on the assumption that the increase in the temperature and pressure of steam speeds up the first action proportionally more than the second action.

Further work, with a view to determining the exact nature of the changes which take place during steam treatment, is now in progress.

Summary

(1) Expansion measurements of Portland cement mortar bars were used to study the effect of steam treatment of mortars on their resistance to the action of the sulphates of magnesium and sodium and calcium.

(2) Treatment of mortars with saturated water vapour at 50°C. reduces their resistance to sulphate action. Saturated water vapour of 75°C. or above 75°C. increases the resistance, the higher the temperature the more effective the treatment is and the shorter the time of treatment required.

(3) Steam treatment of mortars at the boiling point of water makes them practically completely resistant to the action of solutions of sodium sulphate and increases very materially the resistance to the action of solutions of magnesium sulphate.

(4) Immersion of mortars in hot water is nearly as effective in increasing the sulphate resistance as treatment with steam at the same temperature.

(5) Addition of tricalcium aluminate to Portland cement speeds up the rate of expansion of its mortar in solutions of the sulphates of sodium, magnesium and calcium. Steam treatment of these mortars is not as effective in preventing expansion in solutions of sodium and calcium sulphate as steam treatment of mortars from the same cement without the addition of tricalcium aluminate.

(6) The effect of steam treatment on the tensile strength of mortar briquets was determined for temperatures from 50°C. to 150°C.

(7) The theory is suggested that the greatly increased resistance to sulphate action brought about by steam treatment of Portland cement mortars is primarily due to action of the steam on the aluminate in the cement. The speeding up of the hydration of the silicates by the steam treatment, while increasing the strength, is probably of secondary importance in relation to sulphate resistance.

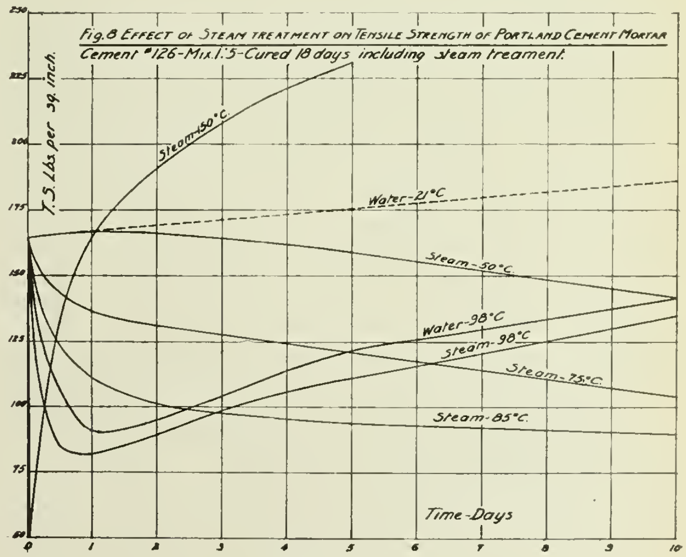

Figure No. 8.

Notes on the Relative Resistance of Various Cements to the Action of Sulphate Waters

Being Appendix A. to the 1927 Report of the Committee on the Deterioration of Concrete in Alkali Soils to the Council of The Engineering Institute of Canada

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Professor of Chemistry, University of Saskatchewan, Saskatoon, Sask.

Presented at the Annual General Professional Meeting of The Engineering Institute of Canada, at Montreal, Que., February 16th, 1928

The resistance of a concrete structure to the action of alkali water is determined by a number of factors, one of which is the natural resistance of the cement itself to the action of sulphates. Other factors influencing the resistance of the concrete produced from the cement may be grouped under two headings; first, those pertaining to the method of manufacture of the concrete, such as richness of mix, proportioning of aggregate, amount of mixing water, uniformity of mixing, etc.; second, the factors influencing the physical and chemical changes which take place during the curing period, such as the temperature during curing, the humidity of the atmosphere during curing and any treatment of the concrete after manufacture.

The present discussion deals almost wholly with the first of these, namely, the natural resistance to sulphate action possessed by the cement when exposed under conditions where the sulphate water has free access to the cementing material. Some data will be introduced incidentally on the effect of richness of mix, but the effect of other conditions pertaining to the manufacture and curing of the test specimens was eliminated as far as possible by the adoption of a standard procedure modelled on that used for the preparation of the mortar test pieces used in testing cement according to standard methods.

The natural resistance of a cement to alkali action may be studied by exposing the finely ground hydrated cement to alkali water and measuring the rate of the chemical reactions which take place. The difficulty met with is in interpreting the results of such a study in terms of the effect on a piece of mortar or concrete or in terms of the life of a concrete structure. A method expressing its results in terms of some fundamental change taking place in a mortar or concrete specimen during the action of alkali would be much better suited to actual conditions met with in practice. Such a method* depending on the determination of the expansion of mortar test pieces during the course of disintegration by alkali waters has been developed. Portland cement mortar specimens when immersed in solutions of alkali salts, (sulphates), expand in a regular manner during the action of the sulphate on the mortar. From the amount of expansion which has taken place one can predict the changes which have taken place in the tensile strength of the specimen. Thus, it has been found that in the case of specimens made from a Portland cement and standard Ottawa sand 1:5 cured seven days before exposure to a 2 per cent solution of sodium sulphate a linear expansion of one-half per cent corresponds to a loss of approximately 60 per cent of the tensile strength.

A study of the natural resistance of a cement to sulphate action can be made effectively by this method, by using test pieces of very lean sand mortar. Such test pieces are very permeable to the salt solutions. The sulphate has then almost as free an access to each particle of cement as if the cement, in finely powdered condition, were shaken with the solution, yet the results of the action may be determined directly in terms of changes in a mortar test piece. In making the comparisons given below, mortar bars, 5/8 by 5/8 by 7½ inches, made of 1 part of cement to 10 parts of standard Ottawa sand, (20-30), were usually used, although for some of the comparisons mortar bars of 1:5 and 1:3 mix were used. These bars, prepared and cured under carefully standardized conditions, were exposed to sulphate solutions and the expansion curve determined until disintegration took place. This method is described in detail in the paper referred to above.

* Thodvaldson, Larmour and Vigfusson, The Engineering Journal, April 1927.

Factors Which Have to be Considered When Comparing the Sulphate Resistance of Cements

When one attempts to make a general statement as to the resistance of a cement to alkali action, or to make a definite statement as to the relative resistance of several cements, difficulties are met which should be discussed briefly. The so-called " alkali " action on cement is caused primarily by sulphates. While a large number of different sulphates studied in this laboratory were all found to cause disintegration of cement mortars, the action is modified very markedly by the nature of the metal combined with the sulphate radical. The action on cement mortars is also modified materially by the presence of other salts, such as chlorides and carbonates. The alkali waters on the Canadian prairies are found to contain mainly the sulphates of sodium, magnesium and calcium, but sometimes contain also large quantities of chlorides and carbonates. In some places sodium sulphate is found to predominate, while in other places magnesium or calcium sulphate may be the predominating salt.

When making a study of the action of the three sulphates which are the most common in natural alkali waters, one finds not only that the resistance of two Portland cements, (both of which have passed the prescribed standard tests equally well), to solutions of sodium sulphate may differ markedly, but also that their relative resistance to solutions of sodium sulphate may differ from their relative resistance to solutions of magnesium sulphate or solutions of calcium sulphate. Thus, cement No. 1 may show greater resistance than cement No. 2 to solutions of sodium sulphate but lower resistance than No. 2 to solutions of magnesium sulphate. It is therefore not possible to make a general statement as to the resistance of a cement to alkali water without reference to the kind of sulphate present. In the comparisons made below the sulphate used is therefore stated in each case.

Another matter which must be considered in making comparisons is the peculiar difference in the case of some Portland cements between the action of dilute and concentrated solutions of sulphates. All the Portland cements studied in this laboratory disintegrate faster in concentrated solutions than in dilute solutions of magnesium sulphate. On the other hand, while one cement may disintegrate faster in concentrated than in dilute solutions of sodium sulphate, a second cement may disintegrate at the same rate in both, and a third cement may disintegrate much more rapidly in the dilute solution. Thus, comparing cements by exposing concrete specimens under natural conditions to alkali water, in the one case to low concentration of alkali and in the second case to high concentration,—usually referred to as "the most severe conditions of alkali,"—might lead to opposite conclusions as to the relative sulphate resistance of the cements. Therefore if one wishes to make a general statement as to the relative resistance of two cements in solutions of a particular sulphate it is necessary to take an average of the results over a wide range of concentrations of the sulphate or else state the concentration at which the comparison was made.

A Comparison of the Resistance of Five Cements to Sulphate Solutions

The comparisons given below are made only for the two sulphates present in high concentration in western alkali waters, namely, sodium sulphate and magnesium sulphate. The curves represent averages for each sulphate, the comparisons being made at two concentrations, namely, 0.15 molar and 0.50 molar solutions of the salts. (2.1 per cent and 6.7 per cent for sodium sulphate; 1.8 per cent and 5.7 per cent for magnesium sulphate.) The bars were prepared from cement and standard Ottawa sand in the proportion of 1:10 by weight. The amount of mixing water was that called for by the standard specifications for making 1:3 standard sand briquets for tension tests. The bars were cured for two weeks before being exposed to the sulphate solutions.

Figure No. 1 gives the average expansion curves in sodium sulphate solutions for the five cements *A*, *B*, *C*, *D* and *E* which were obtained from different sources. The time required for an expansion of one per cent of the total length varies from thirteen days for cement *A* to thirty-four days for cement *E*, indicating a large variation in the sulphate resistance of the cements.

Figure No. 2 gives the average expansion curves for similar mortar bars in solutions of magnesium sulphate. Here the time for attaining an expansion of one per cent varies from eight days for cement *B* to eighteen days for cement *E*. It will also be noticed that the order of expansion of the cements, while in general the same, is not identical in solutions of the two salts, cement *A* being the least resistant in solutions of sodium sulphate, while cement *B* is the least resistant in solutions of magnesium sulphate. Much larger variations of this nature are sometimes found in making comparisons of Portland cements.

The bars immersed in solutions of magnesium sulphate expand much faster than those immersed in solutions of sodium sulphate of equivalent concentrations. It is, however, not safe to assume that this would be the case when richer mixes of mortar are used. During the action of magnesium sulphate on the mortar, insoluble magnesium hydroxide is formed, and this deposits in the pores of the mortar, hindering free access of further quantities of magnesium sulphate and thus slowing up the action. As the mortar becomes richer and less permeable this effect becomes more marked.*

It is of interest to compare these cements as to their tensile and compressive strengths. The tests were made by Professor G. M. Williams, of the College of Engineering, University of Saskatchewan. The values for tension are given in pounds per square inch for 1:3 standard sand briquets, while the values for compression are given in pounds per square inch for 1:3 standard sand cylinders 2 by 4 inches.

* Thorvaldson, Larmour and Vigfusson, The Engineering Journal, April 1927, figure No. 6.

Cement	Tension Tests			Compression Tests	
	3-day	7-day	28-day	7-day	28-day
A	210	235	340	1370	2540
B	320	375	435	3085	3785
C	275	305	415	2740	3185
D		240	340	2170	3290
E		300	415	1980	2810

It is evident that there is no direct relation between the sulphate resistance of a cement as determined above and the strength of the cement as determined by tension and compression tests with 1:3 mortar. Thus, the two cements lowest in resistance to sulphate solutions give the lowest and the highest values respectively for tension and compression.

While the primary factor causing high resistance to sulphate action in a cement does not seem to be necessarily connected with the capacity of developing high strength, it seems that high strength is an important secondary factor contributing to sulphate resistance, especially in richer mixes. Thus, it was found that as the proportion of cement to sand is increased, mortar bars made from cement *C* above increase much more rapidly in sulphate resistance than similar mortar bars made from cement *A*.

Of the above cements, *A*, *C* and *E* are ordinary Portland cements manufactured by the Canada Cement Co., *A* being the Portland cement used in the field tests in 1921. *D* is a super cement supplied by the Super Cement Co., (of Detroit), from one of their mills, and *B* is a special Portland cement recommended for its high strength.

High Alumina Cements

High alumina cements such as "ciment electrique," "ciment fondu" and "lumnite" are so different from Portland cement in their behaviour with sulphate solutions that a comparison can hardly be made by the same methods. An extensive laboratory investigation on these cements has been in progress during the last five years, one of the cements used being the "ciment electrique No. 170" used in the field tests. This cement has been found to have an extremely high resistance to sulphates, especially to solutions of magnesium sulphate. Lean mixes disintegrate slowly in solutions of sodium sulphate, but richer mortars exposed to concentrations up to 5 per cent show no appreciable action in the course of years. This cement disintegrates much more rapidly in solutions of ferrous sulphate than in solutions of the sulphates of sodium and magnesium. It also disintegrates fairly rapidly in solutions of sodium carbonate and in solutions of sodium phosphate. The action of sodium carbonate is rather important in view of the fact that natural carbonate waters are common.

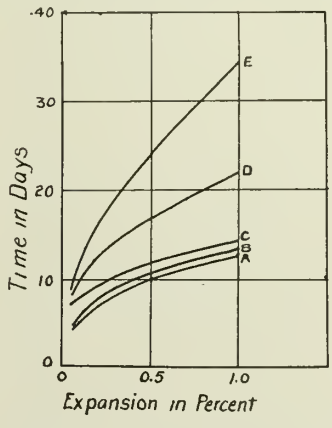

Figure No. 1.—Expansion of 1:10 Cement Mortar Bars in Solutions of Na_2SO_4.

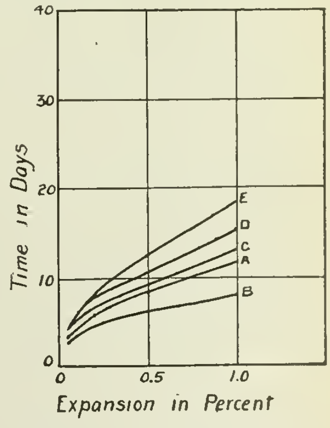

Figure No. 2.—Expansion of 1:10 Cement Mortar Bars in Solutions of $Mg.SO_4$.

Other samples of high alumina cements available on the American market have been found to be low in sulphate resistance when compared with cement No. 170 used in the field tests. These cements do not show the exceptional resistance to magnesium sulphate shown by cement No. 170. The variation in sulphate resistance between different brands of high alumina cement was found to be greater than the variation with different brands of Portland cement. It should, however, be stated that the resistance of all the samples of high alumina cement in *moderately rich mixes* was found to be greater than that of any Portland cement. In very lean mixes the alumina cements of low resistance do not possess materially greater resistance than mortars of corresponding mix made from Portland cements of high resistance.

Slag Cements and Natural Cements

Other cements, such as slag cements and natural cements, have also been compared in the laboratory as to sulphate resistance. The difference between different brands as compared in the laboratory varies from cements of very low natural resistance to some of much higher resistance than that of the best Portland cement. This is especially the case when comparing the resistance to solutions of sodium sulphate, the resistance to solutions of magnesium sulphate being usually much lower.

In connection with the interpretation of these results one very important fact must be mentioned. Test pieces from slag and natural cements as a rule have low strengths when compared with test pieces from normal Portland cements, and the structures made from them are as a rule more permeable to water than those made from good Portland cement concrete. The strain imposed on structures made from these low strength cements when exposed both to sulphate and frost action is therefore much greater in proportion to their strength than is the case with concrete of higher strength. The result is that while these cements may show high resistance in the laboratory, concrete made from them may fail during the first winter of exposure to field conditions. For the same reasons, laboratory experiments with low strength Portland cements must always be discounted heavily if one wishes to predict the resistance of these cements to combined alkali and frost action.

Super Cement

One of the interesting points raised by the field experiments is the comparison between concrete specimens made from Portland cement and Super cement. The writer has been asked to present any evidence he may have obtained in the laboratory tests which could throw light on the question whether the apparent superiority of the Super cement specimens is due to a higher resistance to sulphate action of the clinker from which the Super cement was made, or if the higher resistance observed in the field tests was due to the special treatment used in the manufacture of Super cement.

Unfortunately, the writer did not obtain a sample of the Super cement used in the field experiments, or of the ordinary cement produced at that time by the mill where the particular sample of Super cement was manufactured. No direct comparison can therefore be made with the cement actually used. A number of tests have, however, been made on the sulphate resistance of samples of Super cement, and also an especially careful study of cement *D*, for which curves are given in figures Nos. 1 and 2 above. It will be seen that this cement, supplied directly by the manufacturer to Professor G. M. Williams, has a fairly high resistance to sulphate action, although the ordinary Portland cement *E* has a materially higher resistance.

The manufacturer of Super cement *D* forwarded to Professor Williams at the same time a sample of an ordinary Portland cement *F*, said to be made from the same clinker as Super cement *D*. Careful comparisons of the sulphate resistance of the two cements were made, using mortar bars of the following mixes by weight:—

1 part of cement to 10 parts of standard Ottawa sand.
1 part of cement to 5 parts of standard Ottawa sand.
1 part of cement to 3 parts of standard Ottawa sand.

With the 1:10 bars two series of comparisons were made, i.e., one series with bars cured fourteen days, the second series with bars cured twenty-eight days. With the 1:5 bars three similar series were made with curing of seven, fourteen and twenty-eight days respectively, while with the 1:3 bars two series of comparisons with bars cured seven and twenty-eight days are being made, the results of the first series being given below.

The figures given below represent averages for all the series done with each mix, using 0.15 and 0.50 molar solutions of sodium sulphate and solutions of magnesium sulphate of the same molar concentration.

Table Showing Sulphate Resistance of Cements "*D*" and "*F*."

Mix	Expansion in per cent	Time required for Expansion—in Days			
		In Na_2SO_4 Solution		In $MgSO_4$ Solution	
		Cement "*D*"	Cement "*F*"	Cement "*D*"	Cement "*F*"
1:10	0.05	8	7	4	4
	0.1	10	9	5.5	5
	0.2	13	11	7.5	7.5
	0.5	17	16	10	10
	1.0	22	21	15	14.5
1:5	0.05	7.5	7.5	4.5	4.5
	0.1	9.5	10	6	6.5
	0.2	12	12	8	9
	0.5	17	17	13	14
	1.0	21.5	21.5	19	21
1:3	0.05	10	10.5	4	4
	0.1	17.5	16.5	7.5	7.5
	0.2	26	26	13	14.5
	0.5	35	36	24.5	26.5
Average for all mixes	0.05	8	8	4	4
	0.1	12	12	6	6
	0.2	17	16	9.5	10
	0.5	23	23	16	17

Note;—Cement *D*—Super cement
Cement *F*—Portland cement from same clinker.

The two cements thus behave very similarly when exposed in the form of 1:10, 1:5 or 1:3 mortar bars to sulphate solutions. The values for time corresponding to a certain expansion agree usually within one day, which is all that can be expected for duplicate determinations on the same cement. What slight difference there is is in favour of cement *D* for the 1:10 mix and in favour of cement *F* for the 1:5 and 1:3 mixes. Averaging the results for the three mixes makes the curves for the two cements identical.

It may also be pointed out that as the richness of the mix is increased from 1;10 to 1:3 there is no greater increase in resistance of cement *D* than cement *F* to sulphate action.

In the above discussion, only the expansion of the bars has been considered. Careful observations as to visible signs of action such as bending, softening at the edges and cracking were made from the time the exposure to the sulphate solutions began until the bars had disintegrated. No distinction could be drawn between the behaviour of the test pieces made from the two cements.

From the experiments described above, there is no evidence that the treatment which cement *D* was exposed to in the manufacture of Super cement has increased the resistance of the cement to the action of solutions of either sodium or magnesium sulphate as compared with the Portland cement *F* made from the same clinker.

The Action of Sulphates on Neat Cement

In the spring of 1926, two of the neat cement cylinders, one of batch No. 1, (Portland cement), and one of batch No. 2, (Super cement), exposed to alkali water at Brooks, Alberta, were reported to have cracked into pieces. There was only a slight evidence of sulphate action on the surface of the cylinders while the mass of the material appeared perfectly sound and unaffected except for the peculiar fracture. It seemed, therefore, that the primary cause of these failures might be weathering or frost.

In a series of laboratory experiments begun in 1923 a study was made of the action of solutions of sulphates and other salts on Portland cement mortars varying in richness from 1:7½ to neat cement. The test pieces were bars ⅝ by ⅝ by 7½ inches, these being immersed in the solutions contained in stoppered glass jars. Among the liquids used were (1) distilled water, (2) sodium sulphate 0.4 molar, (5.4 per cent), (3) magnesium sulphate 0.4 molar, (4.6 per cent), and several other salt solutions.

The results of the experiments with the neat cement bars only will be considered here. After immersion for nearly four years the bars in water have expanded about 0.16 per cent of their length. Otherwise there is no evidence of any effect on the bars. The results with the neat bars immersed in solutions not containing sulphate were similar except that the expansion proceeds more slowly than in distilled water.

On the other hand, there was evidence of action on the neat cement bars immersed in solutions of sodium and magnesium sulphate within less than one year, small cracks appearing at the edges and corners. Within less than two years large transverse cracks appeared in some of the specimens and during the third and fourth year a number of the bars cracked into small pieces. There was some considerable decay of cement on the surface of the bars, especially at the corners, but when this was scraped off the remaining pieces of neat cement appeared entirely sound. The expansion of bars at the time of breaking varied, but averaged about one-half of one per cent.

A determination of the sulphate content of the bars, which have been immersed in sodium sulphate, was made. The pieces were first scrubbed to remove all decayed material and the determinations made on the apparently sound core. The loss on ignition was 25 per cent and the sulphate calculated on the basis of the ignited residue was 3.25 per cent sulphur trioxide, (SO_3). The cement used for preparing the neat cement test pieces contained originally 1.77 per cent sulphur trioxide, (SO_3), calculated to the ignited basis, so that the apparently sound core had taken up sulphate from the solution to the extent of 1.5 per cent of its weight as sulphur trioxide (SO_3). Neat cement briquets stored in sulphate solutions in the laboratory have also fractured in a similar manner. Neat cement briquets made from several cements, including the Canada Portland and the Commercial cement used in preparing the original specimens for the field tests, have been in the laboratory, exposed to the laboratory air, for a number of years without showing any similar effects.

Since the neat cement bars immersed in water and in the other salt solutions, not containing sulphates, and the briquets exposed to the laboratory air, show no tendency to fracture in the same way as the bars and briquets stored in sulphate solutions, it would seem that the cracking of the apparently sound core of the bars is connected with the absorption of sulphates. As neat cement bars stored in sulphate solutions expand considerably before they fracture, an explanation of the failure may be proposed on the basis of stresses caused by the progressive action of the sulphate from the surface inwards.

It has been found* that the extent to which a concrete structure has undergone sulphate action may be estimated by determining the sulphate which has been taken up by the concrete, provided that conditions after the action has taken place have not been favourable for leaching out the sulphate from the damaged concrete. This method could be used to obtain evidence as to the extent of the action of the sulphate on different parts of a specimen of neat cement. If the fracture is due to stress caused by a tendency of the specimen to expand unevenly, then taking the apparently undecayed portion of the test piece we should find uneven distribution of sulphate.

Two samples were selected from the broken Portland cement cylinder. Sample 1 was taken from the apparently sound surface layer after all loose or foreign material had been removed, and sample 2 was taken near the centre of the cylinder. The loss on ignition and sulphate were determined with the following results:—

Sample	1 per cent	2 per cent
Loss on Ignition	23.3	23.3
Sulphate (SO_3) calculated for ignited sample	2.30	1.68

This specimen was made in 1921 from a Portland cement which contained, according to analysis made at that time, 1.67 per cent sulphur trioxide, (SO_3). Thus, it appears that while the portion of the cylinder represented by sample 1 has taken up sulphate to the extent of about 0.6 per cent sulphur trioxide, the central portion has not undergone any appreciable sulphate action.

Analyses of corresponding portions of the fractured Super cement cylinder showed that, calculated on the same basis, the surface layer had taken up sulphate to the extent of 0.6 per cent, (SO_3), as compared with the central portion, the sulphate content of which had remained unchanged.

If the fracture of the field specimens is caused by uneven expansion due to the action of the sulphate on the neat cement, then one would expect that the cylinders partly buried in the soil and partly exposed to air would be subjected to the greatest stress near the surface of the soil. This is the point at which fracture usually occurs in the field tests. It is, of course, evident that stresses caused by rapid and extreme changes in temperature may contribute to the final failure in the field. In explaining the cracking of the bars in the laboratory experiments this factor was, however, excluded.

Considering both the laboratory experiments with neat cement bars and the analysis of the fractured cylinder used in the field tests, it appears probable that the results observed at Brooks represent failures of neat cement through sulphate action.

It is a great pleasure to acknowledge the very efficient assistance of Messrs. R. K. Larmour, C. R. Peaker, V. A. Vigfusson and D. Wolochow, who have at various times co-operated in the experiments on which the conclusions arrived at in this paper are based. The further financial aid which has been received from the National Research Council of Canada towards defraying the expenses of the investigation is also recorded with appreciation.

* C. J. Mackenzie and T. Thorvaldson,—The Differentiation of the Action of Acids, Alkali Waters and Frost on Normal Portland Cement Concrete, The Engineering Journal, Feb. 1926.

The Condition of Field Specimens of Concrete Exposed to Alkali Soils and Waters Examined in December, 1927

Being Appendix B of the 1927 Report of the Committee on the Deterioration of Concrete in Alkali Soils to the Council of The Engineering Institute of Canada

Presented at the Annual General Professional Meeting of the Engineering Institute of Canada, at Montreal, Que., February 16th, 1928

At the first Committee meeting held in April 1921 it was agreed that no extensive programme of field exposure tests should be undertaken in view of the results of previous field tests and investigations which had been made in Canada and the United States. These previous studies had demonstrated that Portland cement concretes of good quality would be disintegrated when exposed to high concentrations of the so-called "alkali" soils and waters, consisting mainly of sulphates of sodium and magnesium. However, in order that there might be a basis for comparison of the durability of plain Portland cement concretes with concretes treated with the numerous alkali and waterproofing compounds on the market, as well as modified or improved cements which might be developed in the chemical laboratory, a limited programme of exposure tests was authorized.

Programme of Work

As a result of consultations with Committee members a programme was drawn up for the preparation of field test specimens to be exposed in duplicate at each of three sites to be located in the three Prairie provinces.

The bulk of the specimens were to be made with Portland cement and concrete aggregate commonly used in the vicinity of Saskatoon. Similar concretes were to be made with the same lot of cement and aggregates available in Manitoba and Alberta. Two qualities of concrete were to be made, one having a compressive strength of 1,200 to 1,500 pounds per square inch at twenty-eight days and the other 2,500 to 2,800 at the same period, to be moulded in the form of cylinders 7 inches in diameter and 21 inches long. Additional specimens in the form of 6-inch by 12-inch cylinders were prepared for compressive strength tests. In addition to the above, such other cements and special treatments as might be suggested by Committee members were to be included for comparison. The preparation of test pieces, as described later, was carried out substantially as planned, and the bulk of the specimens were prepared in the concrete laboratory at the University of Saskatchewan during the summer of 1921 and later shipped to the sites which had previously been selected by the Committee.

Selection of Exposure Sites

The deciding factor in the selection of exposure sites was the concentration of sulphate salts in soils and ground waters.

In Manitoba the site selected was near mile post 15.2 along the line of the Winnipeg aqueduct, near Deacon. Since the ground water level was about eight feet below the ground surface and it was desired to place the specimens so that the lower ends would be embedded in moist soil a great portion of the time, it was necessary to excavate a pit about eight feet deep and 50 feet square, provided with drainage, so that inspections could readily be made.

In Saskatchewan, high sulphate concentrations were found in Grandora lake, about 14 miles west of Saskatoon, and it was decided to place the specimens in the saturated soil along the water line.

In Alberta, the site selected was located near Cassils syphon on seeped ground below an irrigation canal on the eastern block of the Canadian Pacific Railway irrigation project. The ground water level was near the surface of the ground and the concentration of soluble salts was high, so that the installations, as at Grandora, consisted of digging shallow holes and imbedding the blocks to one-half their length. Later in 1923, due to change in ground water level, which reduced the severity of exposure, the unaffected specimens were moved to a new site near Antelope Creek syphon.

Chemical analyses of waters from the exposure sites are shown in table No. 1.

Materials Employed

The following is a list of materials used in the preparation of test pieces. The date following each material indicates the year it was used:—

Cements.

Canada Portland cement from Winnipeg mill of the Canada Cement Company,—1921.

St. Mary's Super cement furnished by the Super Cement, (America), Ltd.,—1921.

"Commercial" Natural cement supplied by the Commercial Cement Co. Winnipeg,—1921.

"Cement Electrique," a high alumina cement made in France,—1922.

"Watch Tower" cement, made in France,—1924.

Ciment de Laitier, made in France,—1924.

Aggregates.

Warman pit-run aggregate,—a natural bank gravel from Warman, Sask., used for concrete construction in Saskatoon,—1921.

Carseland aggregate—a natural gravel from near Carseland, Alberta,—1921.

Winnipeg aggregate—a natural sand passing a ¼ inch screen and coarse aggregate of crushed limestone passing a 1½ inch screen,—1921.

Integral Compounds.

Sodium silicate,—1921.
Medusa water proofing powder,—1921.
Truscon waterproofing paste,—1921.
Toxement waterproofing powder,—1921.
Waterex, a liquid waterproofing,—1921.
Erdahl's Alkagel,—1921.

Surface Coatings.

Vulcan asphalt,—1921.
Barrett tar,—1921.
Ironite,—1921.
City of Calgary asphalt,—1921.

Sodium silicate,—1921.
Vortex asphalt,—1921.
Hard rubber varnish,—1924.
Paravar rubber varnish,—1924.

Special Treatment.

Impregnation with molten sulphur,—1923.

The materials listed above were used in preparing concretes during the years indicated, most of them having been included during the first year. Chemical analyses of the cements are shown in table No. 2, and the results of routine physical tests are given in table No. 3. Physical characteristics of aggregates are shown in table No. 4.

Following are descriptions of the use of the various integral compounds and surface coatings:—

Sodium Silicate—Integral. The sodium silicate as received was in the form of a 59.4 per cent solution. It was diluted in mixing so as to result in a 5 per cent solution in the mixing water as used.

Medusa Waterproofing Compound.—Two per cent by weight of cement in the batch.

Truscon Paste.—One part paste mixed with 24 parts of water, by weight, and the resultant mixture used.

Toxement Powder.—Two per cent by weight of the cement in the batch.

Waterex.—A liquid used in the proportion of 15 pounds per bag of cement.

Alkagle.—Received in the form of a quaking bluish tinted gel having a strong odor of ammonia. Prepared according to manufacturer's directions.

Vulcan Asphalt.—First application of an asphaltic paint followed by asphalt which was heated and mopped onto the surface of the hardened concrete.

Barret Co. Tar.—Tar was heated and mopped on in two coats.

Ironite.—Surface of block wetted, and one coat Ironite applied with medium stiff brush. The ironite was in the form of a thin paste. After drying twenty-four hours the previous application was repeated, followed by a 1 cement—1 sand mortar of whitewash consistency to which 1 per cent ironite was added.

City of Calgary Asphalt.—Heated and mopped on to the surface of specimen. Two coats.

Sodium Silicate.—Three per cent solution mopped on to surface, allowed to dry one day, followed by 5 per cent solution.

Vortex Asphalt.—First coat mopped on after dilution with naphtha, followed with coat of unthinned asphalt.

Hard Rubber Varnish.—Applied to surface with a brush.

Paravar Rubber Varnish.—Applied to surface with a brush.

Preparation of Concrete

Prior to the preparation of test specimens, preliminary tests were made with the aggregates which had been provided. The Warman aggregate as received contained from 60 to 90 per cent sand with about 90 per cent of the total passing the ¾-inch screen. There appeared to be considerable pulverized clay in the sand which was removed by washing. The preliminary tests indicated a sand-gravel ratio of .45-.55 to furnish concrete of best quality, and this combination of fine and coarse was used throughout the work for Warman material. As noted in table No. 4, the Carseland sand was rather fine and the usual 1-2 sand gravel ratio was found best. The Winnipeg fine aggregate was found to give best concretes when two volumes of sand were combined with three volumes of the Winnipeg limestone coarse aggregate.

The preliminary tests on Warman aggregate indicated that a proportion of 1-5 by volume would furnish the 1,200-1,500-pound concrete and that a 1-3 mix by volume would result in a 2,500-pound strength for the flowabilities employed.

For accuracy in preparing successive batches, all quantities of cement, aggregate and water were weighed, the weights being dependent upon the previously determined unit weights of each. Each batch of concrete prepared was large enough to provide six, (in most cases eight), cylinders 7 by 21 inches, three compression test cylinders 6 by 12 inches, and two permeability slabs 2½ by 12 by 12 inches. All specimens moulded from a single batch were given the same batch number, stamped into brass plates and pressed into the green concrete.

Since a sufficiently large mixer could not be obtained to take the batch which weighed more than 750 pounds dry, the mixtures were prepared by hand on a concrete floor in the following manner:—after the concrete floor was first sprinkled to reduce absorption of mixing water, the proper quantities of coarse aggregate, fine aggregate and cement were spread in consecutive thin layers and the whole mass shoveled through until of uniform colour. The dry mixture was then formed into a crater and the mixing water added as dry material from the outside was thrown in. After adding sufficient mixing water to result in a fairly plastic consistency the mix was shoveled through a minimum of three times with as many additional turnings as was necessary to result in a homogeneous uniform appearance of the desired flowability.

Flowabilities were determined and controlled by means of the flow table. As much mixing water was used as would result in the desired flow. No predetermined quantity of water was employed, but the amount used was noted in every case. It was aimed in all cases to attain a flow of about 180. This is a plastic, mushy consistency well suited to shallow mass work or portions of a structure which can be well tamped, spaded and vibrated, but which does not contain the excess of water which is required when concrete is chuted. The consistency employed is one which should result in low permeability and give a concrete of high strength for the cement content used.

All cylinder test specimens were moulded in tight sheet metal forms with bottoms. Concrete was placed in approximately 6-inch layers and each tamped in succession. The compacting was aided by tapping the sides of the form. The form was heaped full at the last filling and allowed to stand for thirty minutes, after which the excess was cut away with a trowel, the brass identification plate placed in position and the top trowelled smooth. The top was then covered with an oiled metal plate to prevent evaporation. Permeability slabs were cast on edge so that the 12- by 12-inch faces would be free from trowelling. After 24 hours the specimens were removed from the moulds and placed in wet sand in tar paper enclosures where they were sprinkled daily for twenty-seven days. Comparative tests during the period indicated this method of curing to be fully as effective as curing in water.

Test pieces for compression tests were moulded and cured in the same manner.

Such specimens as were to be given the different surface coatings were treated after removal from sand storage and after they had become air dried.

To protect specimens during shipment, each was wrapped in heavy building paper and placed in a separate wooden crate. The shipment to each exposure site included two specimens from each batch of concrete. As indicated in table No. 5, practically all of the specimens were prepared during the summer of 1921 and shipped early in the fall, so that installations could be made before the cold weather. A few additional specimens were prepared in

1922, 1923 and 1924 with cements or special treatments which were not available when the work was started. Most of these later specimens were in the form of 6- by 12-inch cylinders.

A list of all concretes prepared is included in table No. 5.

Inspection of Field Concretes

The plan of making yearly inspections at each site was not fully carried out owing to water and weather conditions in the fall when inspections were usually undertaken. Results of analyses of water samples taken during inspection periods are shown in table No. 1. The chemical analyses of samples from Cassils and Grandora were made by the Chemistry Department of Saskatchewan University under Dr. Thorvaldson's supervision, and those on Deacon samples by the testing laboratory of the city of Winnipeg under the supervision of Mr. Blackie. Inspection generally consisted in the withdrawal or tilting of each specimen so that the condition of the surface embedded might be noted. The first visible signs of disintegration, (in the case of high strength concretes), is the flaking off and pitting of the smooth mortar surface of the specimen. This exposes sand grains still embedded in the unattacked mortar just within, a condition which is easily apparent to the eye and as easily detected to the touch if a metal scraper is rubbed over the injured surface. The contrast between the smooth surface of an apparently undamaged specimen and one in the first stage of disintegration is unmistakable, but it is not so easy to distinguish, in a few words, between different degrees of disintegration, since the rate of roughening and pitting of the surface concrete is very slow in the best quality specimens.

The tables Nos. 6, 7 and 8 show the condition of all specimens after the 1927 inspections. Inspection at Cassils and at the new Antelope Creek syphon site was made in April 1927 by engineers of the Irrigation Branch, Department of Natural Resources, Canadian Pacific Railway. Inspections of specimens at Deacon and at Grandora were made in September 1927 by members of the Committee.

Summary and Conclusions

The results of observations and inspections of the concrete blocks during 1927 are included in tables Nos. 6, 7 and 8. It should be kept in mind in comparing the results of the field tests that the specimens have been exposed to liquids of varying concentrations and of different relative proportions of sulphate and other salts at the three exposure sites as indicated by the water analyses of table No. 1. In order to avoid reaching unwarranted conclusions from observations of the field specimens, all field tests should be considered in the light of the finding of the laboratory research as set down in appendix A of this report.

(1) Severity of Action at the Block Sites.

Basing the severity of alkali action upon the number of blocks found unattacked at each site the rating would be as follows:—

Site	Number of Undamaged Specimens
Grandora, Sask.	5
Cassils and Antelope Creek, Alta	7
Deacon, Man.	20

All specimens reported in "good" or "perfect condition" have been classed as undamaged. Specimens reported as "weathered," "roughened" or having "scaled surface" have been classed as damaged since this condition is usually the first stage of progressive disintegration.

The same tabulation indicates more severe exposure conditions at the Alberta and Saskatchewan sites than at the Manitoba sites.

At Cassils and Antelope Creek syphons in Alberta the ground water level has been high, and constant seepage during the summer months has subjected the blocks to fresh supplies of ground water. At Grandora, Saskatchewan, the blocks have been completely submerged at times with the ground at the surface completely saturated during the intervals between immersions. At Deacon, Manitoba, the soil at the surface level has been saturated for a great portion of the time, but the salts are probably more evenly distributed through the soil than is the case at the other two sites, so that concentrations have probably been lower. A comparison of ground water analyses given in table No. 1 shows that at the Saskatchewan and Alberta sites the predominating sulphate is sodium sulphate, while at the Manitoba site the magnesium sulphate predominates, it also indicates lower concentrations at Manitoba than at the other sites.

The results obtained from these exposure tests when compared with results obtained in previous field investigations of the durability of concrete in alkali soils, would indicate that the exposures were fully as severe as anticipated by the Committee in selecting these particular sites.

(2) Quality of Concretes as Affected by Aggregates.

Aggregates from the three provinces were made up into concretes with approximately equal compressive strengths and exposed at each site. From the results of exposure tests it cannot be said that one aggregate has shown itself to be superior to the others. The types and gradings employed appear to constitute a minor factor in determining resistance of concrete to alkali action.

(3) Integral Compounds.

Results obtained with various so called integral waterproofing and alkali-proofing compounds are consistent with the findings reported by other investigators. No integral compound used appreciably prolonged the life of the concrete beyond that found for untreated concrete of the same mix and in some cases the use of such a compound seemed to accelerate the disintegration.

(4) Surface Coatings.

Surface coatings of the bituminous types tend to retard the disintegration during the early exposure periods but none employed in this work have proven to be permanent. Eventually the surface protection is broken down and disintegration proceeds in the usual manner.

(5) Portland Cement.

Portland cement from one mill only was used in preparing the test blocks. Excluding from the comparison those Portland cement specimens containing integral compounds or treated with surface coatings, it will be found that of a total of fifty-six Portland cement specimens installed four have been found unaffected. These four specimens include two neat, one rich concrete, and one lean concrete, the latter being exposed since 1923 as a part of the sulphur treated group. The lean concretes have in most cases been entirely disintegrated, while with one exception the rich concretes have been seriously affected. The neat cement specimens, excepting those at Deacon, have been shattered and broken up above the ground line. The shattered pieces appear hard and sound, but, as indicated by Dr. Thorvaldson in appendix A under "the action of sulphates on neat cement, the sulphate content has been considerably increased." In a previous investigation* of the durability of Portland cement in sea water it was also found that neat cement specimens were less resistant than mortars for a number of the cements employed. Since this investigation was started it has been proved beyond question (see appendix A under "Comparison of the Resistance of five Cements to Sulphate Solutions"), that different Portland cements, all meeting standard specifications and often with similar chemical analyses, have widely different resistances to the action of sulphate solutions. It is an important fact, as found in the laboratory, that the Portland cement used in these field tests was one with a very low resistance to sulphate solutions as compared with other Portland cements of Canadian manufacture.

(6) Natural Cement.

Natural cement from one mill only was used in the preparation of the field test specimens. Of a total of twelve natural cement specimens none are reported in good condition. At Deacon the tops of the two neat specimens have broken off while the tops of the two rich concrete specimens are reported as chipped. In Saskatchewan and Alberta all specimens have been badly disintegrated above ground but the portions of the neat specimens are apparently undamaged below ground. The combination of salt in the ground water together with frost action results in a short life for natural cement specimens. The field tests furnish no information as to the relative severity of these factors.

(7) High Alumina Cement.

One high alumina cement, "Cement Electrique" of French manufacture was used in the preparation of the field test specimens. Of a total of twelve high alumina cement concrete specimens two are reported in good condition. The unattacked specimens are two of rich concrete exposed at Deacon. All lean concretes have deteriorated. Disintegration has generally been slower than for the Portland cement specimens with most of the apparent action above the ground line. It has been found in the laboratory that this particular cement shows an especially high resistance to magnesium sulphate, which is the predominating salt at Deacon where the rich concretes have apparently not been attacked.

(8) Super Cement.

Super cement (Canadian) from one mill only was employed in preparing the test blocks. Of a total of forty-two Super cement specimens installed, twenty-three have been found unaffected. These twenty-three specimens include three neat, fifteen rich concrete and five lean concrete. Two neat specimens at Grandora, Sask., and one neat specimen at Antelope Creek, Alta., have been cracked and shattered above the ground line in a similar way to the neat Portland specimens referred to.

A comparison of the Super and Portland cement specimens in our field tests show that the former are less affected than the latter, however, as stated before (see Appendix A under "Comparison of the Resistance of five Cements to Sulphate Solutions,") we now know that different Portland cements show equally great variations in their resistances to sulphate action.

* Technologic Paper No. 12, United States Bureau of Standards.

It will be seen from the above information that we did not have in our field tests comparable blocks of Super cement and of a Portland cement made from the same clinker. We have, however, the results of laboratory tests on a Super cement and a Portland cement from the same clinker supplied by the Super Cement Co., and as reported by Dr. Thorvaldson in Appendix A, under "Super cement," it is possible to state that with the cements tested the special treatment given, the Super cement has not increased its resistance to sulphate action in the mixes used in the experiment, i.e., 1-3; 1-5 and 1-10 parts by weight of cement to standard sand.

Summing up all the available evidence, the general conclusions from both field and laboratory experiments are as follows:—

(1) Our field tests indicate that the particular Super cement used is more resistant to alkali action than the particular Portland cement used. It was found, however, in the laboratory that the particular Portland cement used is much less resistant to sulphate action than Portland cements from some other mills.

(2) That as our field investigation did not include tests with Portland cement and Super cement from the same clinker we have no evidence that one is more resistant to alkali action than the other when subjected to the same field conditions.

(9) General.

The results obtained from the field exposure tests are quite in accord with those obtained in other field investigations, as well as with the objects which the Committee had in mind when the field work was planned. That the main effort should be centred upon the research in the chemical laboratory was the original decision of the Committee, and this plan has proven sound. Few new data or ideas have been brought out by the field, but the chemical research has greatly extended our knowledge of the behaviour of cements when exposed to sulphate solutions. Perhaps one point of greatest interest to the cement user is the fact that there are chemical differences in the constitution of the so-called standard Portland cements which greatly shorten or extend the life of these cements when exposed to sulphate soils and waters. It has been known to testing engineers that Portland cements differ considerably in their concrete making properties as measured by compressive strength, but the variation in resistance to alkaline solutions has only been brought out by investigators in the last few years.

The field investigation has indicated that with the cement produced from any given clinker, durability as well as compressive strength increases as permeability decreases, up to some undetermined richness of mix, beyond which point durability in sulphates decreases rapidly. Rich concretes are more resistant than lean concretes but neat cements are less resistant than rich concretes. Impermeability increases and density decreases from lean concretes toward neat cements, but sulphate resistance drops off as neat mixtures are approached. The results of this investigation do not establish this point, but it is believed that the richest concretes generally used in practice are well within such a limit. It should also be emphasized that conclusions drawn from a small group of field exposure tests, such as was included in this work, may be too broad and in some cases contrary to the truth, unless consideration is given to laboratory studies where important variable factors can be more accurately controlled and measured.

Table No. 1— Chemical Analyses of Waters from Block Sites

Location	Date	Material	Total Solids	Parts per Million						
				Na	*Ca*	*Mg*	*Cl*	SO_4	HCO_3	CO_3
Deacon, Man.	....	....	......	......	...	.....	.....	......	.....	.....
N. E. corner	Nov. 1921	Water	......	1,905	524	2,560	440	14,180	.....	413
N. W. corner	"	"	......	1,110	552	2,680	310	13,210	.....	450
S. W. corner	"	"	......	66	208	400	60	1,600	.....	348
Centre hole	"	"	......	1,047	390	1,610	280	8,980	.....	120
Grandora, Sask.	June 1921	"	......	5,909	...	63	2,321	8,531	939	111
	June 1923	"	......	......	...	.....	.....	28,856	.....	.....
	Sept. 1924	"	......	......	...	.....	.....	21,184	.....	.....
	Oct. 1924	"	......	......	...	.....	.....	107,726	.....	.....
	Sept. 1927	"	52,000	17,906	61	107	7,450	24,776	1,187	1,195
Cassils Syphon, Alta.	Sept. 1921	Water sump *A*	13,055	3,025	424	421	.....	8,392	232	28
		" " *C*	18,890	4,541	433	655	.....	12,453	350	.....
		" " *E*	16,650	4,013	405	502	.....	11,043	186	.....
		" " *G*	18,492	4,504	432	607	.....	12,153	429	.....
		" " *B*	15,270	3,607	428	493	.....	10,150	221	.....
	May 1925	" " *F*	3,920	......	...	.....	.....	2,060	.....	.....
		" " *G*	12,962	......	...	.....	.....	7,264	.....	.....
		" " *C*	4,858	......	...	.....	.....	2,710	.....	.....
		" " *E*	17,664	......	...	.....	.....	9,912	.....	.....
Antelope Creek Syphon, Alta.	Nov. 1925	" " *L*	16,089	......	...	.....	.....	11,020	.....	.....
		" " *J*	37,268	......	...	.....	.....	25,140	.....	.....
		" " *H*	51,360	......	...	.....	.....	35,476	.....	.....
		" " *M*	26,093	......	...	.....	.....	17,641	.....	.....
		" " *N*	23,232	......	...	.....	.....	15,803	.....	.....
	May 1927	" " *L*	3,938	......	...	.....	.....	2,592	.....	.....
		" " *J*	15,460	......	...	.....	.....	9,868	.....	.....
		" " *H*	11,412	......	...	.....	.....	7,404	.....	.....
		" " *M*	6,449	......	...	.....	.....	4,146	.....	.....
		" " *N*	24,680	......	...	.....	.....	15,727	.....	.....

Table No. 2—Chemical Analyses of Cements

Cement	*CaO*	SeO_2	Al_2O_3+ Mn_3O_4	Fe_2O_3	*MgO*	SO_3	Ignition Loss	Insol. Residue
"Commercial" Natural	53 22	20.92	10.76	3.74	.86	4.99	1.91	1.78
Canada Portland	61.20	20.38	7.90	2 58	3.56	1.67	2.37	0.37
St. Mary's Super	63 22	21.22	7.23	2.75	3.89	1.62	2.03	0.34
Ciment Electrique (French)*	38.67	7.44	42.38	12.60	2.32	0.19	.....	.....

*The cement gained considerably in weight on ignition. Only a small quantity of the iron present was in the ferric state, the greater proportion being in the form of metallic iron. The cement evolved hydrogen sulphide on treatment with acid, the sulphur (0.58 per cent) being present mainly as sulphide.

Table No. 3— Physical Tests of Cements

Cement	Mixing Water per cent	Fineness through 200 mesh	5-hour Steam test	Time of Setting Gillmore		Tensile strength 1-3 briquettes Pounds	
				Initial	Final	7-day	28-day
Commercial	29.5	80.0	sound	35 min.	60 min.	72	148
Canada Portland	23.0	84 2	sound	5 hrs. 15 "	7 hrs 15 "	247	350
St. Mary's Super	24.5	89.8	sound	15 "	28 "	250	366
Ciment Electrique	22.5	92.8	sound	7 " 15 "	10 "	410	435
Watch tower	23.5	74 0	sound	25 "	60 "	115	210
Ciment de laitier	24.5	77.9	sound	5 " 45 "	16 "	105	205

Table No. 4— Physical Tests of Aggregates.

Aggregate	Weight per cu. ft. pounds	Surface Area sq. in. per 100g.	Cumulative per cent. Retained on Sieves.									
			1½	¾	⅜	4	8	14	28	48	100	p. 100
Carseland gravel.........	105	25.5	0	23.3	85.8	99.4	....	....	....	....	....	....
" sand..........	112	900.0	....	....	0	6.4	12.3	16.1	22.5	79.1	95.6	4.4
Warman gravel..........	99	36.6	....	12.2	53.5	96.1	99.7	....	....	....	....	....
" sand...........	106	397.0	....	....	....	0	24.1	58.8	80.7	93.7	98.5	1.5
Winnipeg limestone......	89	....	63.5	95.7	97.7	100.0	....	....	....	....	....	....
" sand..........	112.5	369.0	....	....	2.7	28.7	48.9	63.0	76.3	94.0	99.0	1.0

Table No. 5—List of Concretes Prepared for Field Exposure Tests.

Specimens for exposure were cylinders 7 inches diameter and 21 inches long. Compression test specimens were 6 by 12-inch cylinders.

Batch Number	Cement	Aggregate	Proportions by volume	Special Treatment	Pounds of Cement per Cu. yd. of Concrete	Comp. Strength 28 days Pounds	Year Prepared
1	Canada	None	Neat	None	2,760	5,988	1921
2	Super	"	"	"	2,760	8,695	"
3	Commercial	"	"	"	2,320	1,495	"
4	Canada	Carseland	1-1-2	"	738	2,100	"
5	Super	"	1-1-2	"	753	3,120	"
6	Canada	Winnipeg	1-1.3-1.8	"	778	2,515	"
7	Super	"	1-1.3-1.8	"	788	3,505	"
20	Canada	Warman	1-1.36-1.66	"	783	2,520	"
21	Super	"	1-1.36-1.66	"	783	3,540	"
22	Commercial	"	1-1.36-1.66	"	750	615	"
23	Electrique	"	1-1.36-1.66	"	785	*3,500+	1922
24	Commercial	"	1-1.36-1.66	"	735	500	1922
30	Canada	"	1-1.36-1.66	{One lot untreated One lot impregnated with sulphur}	780	{4,355 7,620}	1923
60	Canada	"	1-2.3-3.0	None	515	1,260	1921
61	Super	"	1-2.3-3.0	"	515	1,885	"
62	Canada	"	1-2.3-3.0	Integral 5 per cent. sod. silicate	500	680	"
63	Canada	"	1-2.3-3.0	Medusa integral	500	1,270	....
64	Canada	"	1-2.3-3.0	Truscon "	500	1,320	"
65	Canada	"	1-2.3-3.0	Toxement "	495	1,030	"
66	Canada	"	1-2.3-3.0	Waterex "	490	1,195	"
69	Canada	"	1-2.3-3.0	Alkagel "	475	590	"
70	Canada	"	1-1.36-1.66	Alkagel "	709	2,245	1922
72	Canada	"	1-2.3-3.0	Vulcan asphalt coating	516	1,530	1921
73	Canada	"	1-2.3-3.0	Barrett tar coating	517	1,395	"
74	Canada	"	1-2.3-3.0	Ironite coating	514	1,565	"
76	Canada	"	1-2.3-3.0	Calgary asphalt coating	508	1,341	"
77	Canada	"	1-2.3-3.0	Sodium silicate "	507	1,162	"
78	Canada	"	1-2.3-3.0	Vortex asphalt "	509	1,290	"
80	Canada	"	1-2.3-3.0	Alkagel integral	522	1,365	1922
81	Canada	Carseland	1-1.67-3.33	None	493	1,802	1921
82	Super	"	1-1.67-3.33	"	497	2,291	"
83	Canada	Winnipeg	1-2.16-3.10	"	527	1,850	"
84	Super	"	1-2.16-3.10	"	532	†	"
85	Electrique	Warman	1-2.3-3.0	"	525	(a)*3,500+	1922
86	Canada	"	1-5 Mortar	{One lot untreated One lot sulphur impregnated}	422	{1,610 6,000}	1923
87	Canada	"	1-2.3-3.0	Hard rubber varnish coating	508	1,670	1924
88	Canada	"	1-2.3-3.0	Paravar varnish coating	513	1,620	"
89	"Watchtower"	"	1-2.3-3.0	None	520	805	"
90	"Ciment de laitier"	"	1-2.3-3.0	"	506	960	"

*Specimens exceeded capacity of available testing machine.

†Not enough aggregate to permit moulding of strength-test specimens.

Table No. 6—Inspection of Concrete Blocks, Deacon, Manitoba, 1927

Batch No.	Cement and Mixture	Special Treatment	Condition, September 1927
*1-5	Neat Canada		No action. Side chipped with trowel during examination.
1-6	Neat Canada		Perfect condition.
2-5	Neat Super		No action. Side chipped during examination.
2-6	Neat Super		Perfect condition.
3-5	Neat Commercial		‡No alkali action. About 5 inches of top broken off probably due to frost action.
3-6	Neat Commercial		‡No alkali action. Top broken off probably due to frost action.
4-5	Rich Canada		Base very badly affected, quite soft.
4-6	Rich Canada		Alkali action on one corner of base.
5-5	Rich Super		No action.
5-6	Rich Super		Perfect condition.
6-5	Rich Canada		Distinct action all around base. Slight action at ground line.
6-6	Rich Canada		Slight action at one spot at side near large stone in aggregate.
7-5	Rich Super		No action.
7-6	Rich Super		Perfect condition.
20-5	Rich Canada		Slight action on one side of base.
20-6	Rich Canada		Perfect condition.
21-5	Rich Super		No action.
21-6	Rich Super		Perfect condition.
22-5	Rich Commercial		No alkali action. Top chipped.
22-6	Rich Commercial		No alkali action. Top chipped.
23-5	Rich Electrique		Perfect condition.
23-6	Rich Electrique		Perfect condition.
30-3	Rich Canada	Sulphur impregnated	Very badly affected all over surface.
30-4	Rich Canada	“ “	Top and bottom affected. Worse than 30-12.
30-11	Rich Canada	Untreated	Badly affected around base.
30-12	Rich Canada	“	One corner of base affected.
60-5	Lean Canada		Very badly affected.
60-6	Lean Canada		Alkali action all around top. No action on base or sides.
61-5	Lean Super		Perfect condition.
61-6	Lean Super		Perfect condition.
62-5	Lean Canada	Integral sodium silicate	Badly affected on top and base.
62-6	Lean Canada	“ “ “	Badly affected—top broken off.
63-5	Lean Canada	“ Medusa	Badly affected top and bottom—not so bad as 62.
63-6	Lean Canada	“ “	Base badly affected on all sides—no action on sides or top.
64-5	Lean Canada	“ Truscon	Badly affected on bottom and sides—no action on top.
64-6	Lean Canada	“ “	Slightly worse than 63—also affected spot on side.
65-5	Lean Canada	“ Toxement	Badly affected on top bottom and sides. About the same as 63.
65-6	Lean Canada	“ “	About same as 64 but no spot on sides.
66-5	Lean Canada	“ Waterex	Badly affected top and ground line.
66-6	Lean Canada	“ “	About same as 65.
69-5	Lean Canada	“ Alkagel	Almost completely gone.
69-6	Lean Canada	“ “	Almost completely gone—top broken off.
70-5	Rich Canada	“ “	Completely gone.
70-6	Rich Canada	“ “	Completely gone.
72-5	Lean Canada	Vulcan asphalt coating	Not examined.
72-6	Lean Canada	“ “ “	Alkali action on top.
73-5	Lean Canada	Barrett tar coating	Badly affected all around the base.
73-6	Lean Canada	“ “ “	No action.
74-5	Lean Canada	Ironite coating	Badly affected all around base at ground line.
74-6	Lean Canada	“ “	Two affected spots on base line.
76-5	Lean Canada	Calgary asphalt coating	Badly affected on one side of base. Coating perished above ground line.
76-6	Lean Canada	“ “ “	No alkali action. Coating perished.
77-5	Lean Canada	Sodium silicate coating	Base badly affected.
77-6	Lean Canada	“ “ “	Two affected spots on base, no action on sides or top.
78-5	Lean Canada	Vortex asphalt “	Very badly affected all over surface.
78-6	Lean Canada	“ “ “	Two affected spots on base. One side also affected.
80-5	Lean Canada	Integral Alkagel	Completely gone.
80-6	Lean Canada	“ “	Completely gone.
81-5	Lean Canada		Badly affected all over—base affected spots on sides. Scaling on top.
81-6	Lean Canada		Top affected all round. One corner of base affected.
82-5	Lean Super		Distinct action over two-thirds of base. Affected spot on sides, not so bad as 81.
82-6	Lean Super		No action.
83-5	Lean Canada		Badly affected on top base, at ground line and on top.
83-6	Lean Canada		Two spots on base and one spot on side affected.
84-5	Lean Super		No action.
84-6	Lean Super		Perfect condition.
85-5	Lean Electrique		No action.
85-6	Lean Electrique		No action, top weathered.
86-3	Lean Canada	Sulphur impregnated mortar	Slight action on base and top.
86-4	Lean Canada	“ “ “	No alkali action—frost action on top.
86-11	Lean Canada	Untreated	Completely gone.
86-12	Lean Canada	“	Almost completely gone.
87-5	Lean Canada	Hard rubber varnish coating	Top affected. No action on sides and base.
87-6	Lean Canada	“ “ “ “	Two spots on base and half of top affected.
88-5	Lean Canada	Paravar varnish coating	Distinct action on top base and sides.
88-6	Lean Canada	“ “ “	One spot on base and one spot on top affected.
89-5	Lean "Watchtower"		Top and base completely gone.
89-6	Lean "Watchtower"		Top affected on all sides. No action on base.
90-5	"Ciment de laitier"		Very badly affected.
90-6	"Ciment de laitier"		Top affected on all sides—no action on base.

*Numbers in first column are batch numbers which correspond to the numbers in the first column of table No. 5. Second column numbers indicate the block numbers.

‡In the case of Portland and Super cements this cracking has been found to be due to sulphate action.

Table No. 7—Inspection of Concrete Blocks, Grandora, Sask., 1927

Batch No.	Cement and Mixture	Special Treatment	Condition, September 1927
*1-3	Neat Canada		Sound below ground. Top split by sulphate action.
1-3	“		“ “ “ “ “ “ “ “
2-3	“ Super		“ “ “ “ “ “ “ “
2-4	“ “		“ “ “ “ “ “ “ “
3-3	“ Commercial		‡Sound below ground. Top cracked and chunks broken off.
3-4	“ “		“ “ “ “ “ “ “ “
4-3	Rich Canada		Pitted ½ inch deep, below ground line.
4-4	“ “		“ 1 “ “ “ “ “
5-3	“ Super		Good, except for slight surface roughening at ground.
5-4	“ “		Good.
6-3	“ Canada		Pitted ½ inch deep, near bottom.
6-4	“ “		“ 1½ “ “ “ “
7-3	“ Super		Good.
7-4	“ “		Good.
20-3	“ Canada		Surface scaled and some pitting below ground line.
20-4	“ “		Pitted 1½ inch deep below ground line.
21-3	“ Super		Good.
21-4	“ “		Good, surface scaling above ground line.
22-3	“ Commercial		Completely disintegrated.
22-4	“ “		“ “
23-3	“ Electrique		‡Pitted ½ inch deep, below ground. Top cracked like neat specimens.
23-4	“ “		Disintegration 1½ inch deep, below ground line.
24-3	“ Commercial		Completely disintegrated.
24-4	“ “		“ “
30-5	“ Canada	Sulphur impregnated	Swollen and cracked. Deep pitting below ground line.
30-6	“ “	“ “	Pitted ½ inch deep, top cracked.
30-13	“ “	Untreated	Pitted ½ inch deep, below ground line.
30-14	“ “	“	“ ¼ “ “ “ “ “
60-3	Lean “		Completely disintegrated.
60-4	“ “		“ “
61-3	“ Super		Pitted ¼ inch deep, below ground line.
61-4	“ “		Surface scaling above ground line.
62-3	“ Canada	Integral sodium silicate	Completely disintegrated.
62-4	“ “	“ “ “	“ “
63-3	“ “	“ Medusa	Pitted 1 inch deep below ground line.
63-4	“ “	“ “	Completely disintegrated.
64-3	“ “	“ Truscon	Disintegrated through at ground line.
64-4	“ “	“ “	Completely disintegrated.
65-3	“ “	“ Toxement	Pitted below ground line.
65-4	“ “	“ “	Completely disintegrated.
66-3	“ “	“ Waterex	Disintegrated through at ground line.
66-4	“ “	“ “	Completely disintegrated.
69-3	“ “	“ Alkagel	“ “
69-4	“ “	“ “	“ “
70-3	Rich Canada	“ “	“ “
70-4	“ “	“ “	“ “
72-3	Lean Canada	Vulcan asphalt coating	Coating gone. Pitted ¼ inch deep at ground line.
72-4	“ “	“ “ “	“ “ “ ¼ “ “ “ “ “
73-3	“ “	Barrett tar coating	“ “ “ ¼ “ “ “ and below ground line.
73-4	“ “	“ “ “	“ “ “ ½ “ “ “ “ “ “
74-3	“ “	Ironite coating	Completely disintegrated.
74-4	“ “	“ “	“ “
76-3	“ “	Calgary asphalt coating	Coating gone. Concrete good.
76-4	“ “	“ “ “	“ “ Pitted ½ inch deep at ground line.
77-3	“ “	Sodium silicate coating	Pitted ½ inch deep at ground line.
77-4	“ “	“ “ “	Completely disintegrated.
78-3	“ “	Vortex asphalt coating	Coating gone—some pitting below ground line.
78-4	“ “	“ “ “	Completely disintegrated.
80-3	“ “	Integral Alkagel	“ “
80-4	“ “	“ “	“ “
81-3	“ “	None	“ “
81-4	“ “	“	“ “
82-3	“ Super		Scaling ⅛ inch deep, at and above ground line.
82-4	“ “		Pitted 1 inch deep, at and below ground line.
83-3	“ Canada		Pitted ¼ inch deep.
83-4	“ “		Completely disintegrated.
84-3	“ Super		Surface scaling above ground line.
84-3	“ “		Pitted 1 inch deep below ground.
85-3	Lean Electrique		Pitted 1 inch deep below ground line, top badly cracked.
85-4	“ “		“ 1 “ “ above and below ground line.
86-5	Lean Canada	Sulphur impregnated mortar	Completely disintegrated.
86-6	“ “	“ “ “	Pitted ¼ inch deep, below ground line.
86-13	“ “	Untreated mortar	Surface scaling above ground line.
86-14	“ “	“ “	Good.
87-3	“ “	Hard rubber varnish	Completely disintegrated.
87-4	“ “	“ “ “	“ “
88-3	“ “	Paravar varnish	“ “
88-4	“ “	“ “	“ “
89-3	“Watchtower”	None	“ “
89-4	“	“	“ “
90-3	“Ciment de laitier”	“	“ “
90-4	“ “ “	“	“ “

*First number is the batch number, the second is the block number.
‡Probably due to sulphate action as in the case of the neat Portland and Super cement blocks.

Table No. 8—Cassils Syphon and Antelope Creek Syphon, Alta.— Inspection of Concrete Blocks, 1927

Blocks preceded by "A" in the Batch Number Column were removed from Cassils and installed at Antelope Creek, 1925.

Batch No.	Cement and Mixture	Special Treatment	Condition — April 1927
A 1-1	Neat Canada		Broken in 3 section, sulphate actions.
A 1-2	" "		Broken in 3 sections and concrete disintegrating in fracture below ground surface. Sulphate action.
A 2-1	Neat Super		Specimen broken through 6 inches above lower end. Sulphate action.
A 2-2	" "		Good.
3-1	" Commercial		Entirely broken down above ground, bottom good.
3-2	" "		Fair condition below ground.
4-1	Rich Canada		Rapid progressive disintegration.
4-2	" "		Broken off at ground line and all gone below.
A 5-1	Rich Super		Good.
5-2	" "		Action continuing slowly on one side.
6-1	Rich Canada		Slow progressive disintegration.
6-2	" "		Small affected spots still spreading and penetrating.
A 7-1	Rich Super		Good.
A 7-3	" "		"
20-1	Rich Canada		Rapid progressive disintegration.
20-2	" "		Entirely gone.
A 21-1	Rich Super		Good.
A 21-2	" "		"
22-1	Rich Commercial		Rapid progressive disintegration.
22-2	" "		Entirely gone.
A 23-1	Rich Electrique		All gone above ground—good below ground.
A 23-2	" "		Disintegrating rapidly on south and west surface above ground. Good below ground.
30-1	Rich Canada	Sulphur impregnated	Practically all gone.
30-2	Rich Canada	" "	Entirely gone above ground, and going rapidly below.
30-9	" "	Untreated	Broken off at ground and going fast.
30-10	" "	"	Going rapidly on south side and below ground.
60-1	Lean Canada		Completely disintegrated.
60-2	" "		" "
A 61-1	Lean Super		East face at ground line going and all of bottom and at edges.
A 61-2	" "		Slight disintegration one side weathering slightly above ground.
62-1	Lean Canada	Integral—5 per cent. sodium silicate	Entirely gone.
62-2	" "	"	" "
63-1	" "	Integral Medusa	" "
63-2	" "	" "	Rapidly disintegrating.
64-1	" "	" Truscon	Entirely gone.
64-2	" "	" "	Rapidly disintegrating.
65-1	" "	" Toxement	Entirely gone.
65-2	" "	" "	" "
66-1	" "	" Waterex	" "
66-2	" "	" "	" "
69-1	" "	" Alkagel	" "
69-2	" "	" "	" "
70-1	" "	" "	" "
70-2	" "	" "	" "
72-1	" "	Vulcan asphalt coating	Breaking down rapidly.
72-2	" "	" " "	Disintegrating rapidly one side.
A 73-1	" "	Barrett tar coating	Disintegrating rapidly on north and east faces and at bottom southwest side.
73-2	" "	" " "	Rapidly disintegrating.
74-1	" "	Ironite "	Completely disintegrated.
74-2	" "	" "	" "
76-1	" "	Calgary asphalt coating	Protective coating gone and lower end going fast.
76-2	" "	" " "	Coating peeling and action continuing rapidly on one side.
77-1	" "	Sodium silicate coating	Entirely gone.
77-2	" "	" " "	" "
78-1	" "	Vortex asphalt coating	" "
78-2	" "	" " "	Practically all gone.
80-1	" "	Integral Alkagel	Entirely gone.
80-2	" "	" "	" "
81-1	" "	None	" "
81-2	" "	"	" "
82-1	Lean Super		Rapid progressive disintegration.
82-2	" "		Rapidly disintegrating.
A 83-1	Lean Canada		Disintegration progressing rapidly at ground line and lower 8 inches all sides.
83-2	" "		Slow progressive disintegration.
84-1	Lean Super		" " "
84-2	" "		Action continues slowly.
85-1	Lean Electrique		Going slowly all sides above ground. Good below ground line.
A 85-2	Lean "		End above ground entirely broken down. Good below ground.
86-1	Lean Canada	Sulphur impregnated mortar	Slow alkali action.
86-2	" "	" " "	Good.
86-9	" "	Untreated	Entirely disintegrated when examined in 1925.
86-10	" "	"	Entirely gone.
87-1	" "	Hard rubber varnish	" "
87-2	" "	" " "	" "
A 88-1	" "	Paravar varnish	Disintegrating rapidly small sides above and below ground line.
A 88-2	" "	" "	Disintegrating rapidly small sides above and below ground line.
89-1	"Watchtower"		Entirely gone.
89-2	"		" "
A 90-1	"Ciment de laitier"		Practically all broken down.
A 90-2	" " "		" " " "

Cracking and splitting caused by sulphate action.

Report of Council for the Year 1927

During the past year members of The Institute have continued to take a prominent part in the industrial activity of the country, and in the construction of the numerous engineering works which are being carried on or contemplated. When we note such enterprises as the Welland canal, the Montreal South Shore bridge, the Toronto railway terminals and the general activity in construction, power development and the engineering industries, it is evident that the engineer is doing his share in building up the Dominion.

As regards The Institute's affairs, the outstanding feature of the year has been the evidence of a more active interest on the part of our branches in the development and progress of The Institute. This has been indicated by the action taken by a number of the branches in forwarding expressions of opinion regarding such subjects as the proposed amendments to By-laws and the work of various Institute committees, showing that our members regard themselves as belonging to an active organization and are concerned with its growth, development and betterment, a state of things which is most encouraging.

This year, for the first time in the history of the Institute, special arrangements were made for a three-day Plenary Meeting of Council, at which The Institute's affairs were debated with all the advantages arising from personal intercourse and exchange of opinion. The topics discussed included such important questions as the relations of the Institute with the various Provincial Associations of Professional Engineers, the desirability of making changes in the present qualifications for membership, and the vital problem of Engineering Education. Proposals regarding the formation of Students' Sections and the relations between the employer and the young engineer also received attention, and the members of Council present at the meeting were able to take back and communicate to their Branch Executive Committees a comprehensive view of the working of the Institute as a whole which would otherwise not have been possible.

During the past year an unusually large number of amendments to the By-laws have been proposed by Council and by Corporate Members; some of them are of considerable importance as affecting the method of election of members, the annual fees payable, and the way in which proposed amendments are to be discussed and decided upon. These proposals have been duly considered by Council, and will all be submitted to the Annual General Meeting, at which time they will be open to full discussion.

An important series of papers was presented at the Annual General Professional meeting in Quebec, on the success of which the Quebec Branch is to be congratulated. The discussions which form so prominent a part of the work of a professional meeting were unusually active, particularly in regard to the recent hydro-electric developments in Quebec and British Columbia, and lines of work associated with various engineering pulpwood operations and mining.

Council would draw attention, however, to the fact that while the papers presented at our professional meetings have given rise to good discussions, many of those submitted at Branch meetings during the year have merited a more ample discussion than they received. The usefulness of such papers, many of which deal with important engineering works, would be enhanced if more effective measures were taken to ensure an organized discussion. This would require the co-operation of authors, in sending in their papers in time to permit of their circulation before the meeting, and would place an additional tax upon the time of the Branch officers and secretaries, but it is believed that the benefits resulting would be well worth while.

Council recognizes with special appreciation the debt which the Institute owes to the officers of its Branches, for branch activities are one of the means by which the benefits of membership in the Institute are effectively demonstrated.

During the year the relations of the Institute to the Associations of Professional Engineers of the various provinces have been the subject of considerable thought and discussion, and it is satisfactory to record that the first step has been taken towards the very desirable object of greater uniformity in the requirements of admission to these bodies and the Institute itself. The Institute's Board of Examiners and Education, in preparing its revised syllabus for examinations for admission, is in consultation with the Examination Boards of the several Professional Associations with a view of ascertaining what steps can be taken towards uniformity in this matter.

The Committee appointed in 1926 to study the best method of utilizing the funds available for The Institute's prizes has completed its work, and its report, which recommends a number of changes in the present system and proposes a set of rules governing the various awards, will be submitted for the approval of the Annual General Meeting.

Attention should be drawn to the further satisfactory progress of the work of the Committee on the Deterioration of Concrete in Alkali Soils, the latest results of its important investigations being shown by the paper on the subject and the report of the Committee, which are to be presented at the forthcoming General Professional Meeting.

Council records with regret the deaths during the past year of a number of prominent senior members of the Institute, including three Past-Presidents, W. P. Anderson (President 1904), G. A. Mountain (President 1909), and C. H. Rust (President 1911), and four members who joined the Canadian Society of Civil Engineers at its inception, J. H. Kennedy, R. B. Rogers, W. L. Scott and H. K. Wicksteed.

The finances of The Institute as shown on the report of the Finance Committee are in sound condition, the revenue having been spent with due economy, as is evident from the existence of a surplus. It will be noted that neither Transactions nor Year Book have been issued this year; both of these are, however, to be issued during 1928, and it has been possible by the exercise of care to set aside a reserve against the 1927 share of the cost of these publications, and, in addition, to add to the fund set aside to pay off the mortgage on the Headquarters building.

Meetings

Annual General Meeting

The Forty-first Annual General and General Professional Meeting convened at Headquarters on Thursday evening, January 23rd, 1927, Vice-President K. B. Thornton, M.E.I.C., in the chair. After the reading of minutes and appointment of the scrutineers the meeting was adjourned to reconvene on Tuesday, February 15th, at the Chateau Frontenac, Quebec.

At the Quebec sessions, Vice-President K. B. Thornton, M.E.I.C., took the chair on the morning of February 15th, when the report of Council for 1926 was considered and adopted, together with the reports of the various Committees and Branches.

In the unavoidable absence of the retiring president, Major Geo. A. Walkem, M.E.I.C., his valedictory address was read by the secretary and the thanks of the meeting were forwarded to Major Walkem, the message also expressing regret that he was unable to be present.

The afternoon session was devoted to a discussion arising from the report of the Committee on Engineering Education, after which the scrutineers' report was presented, and the newly-elected president, Dr. A. R. Decary, M.E.I.C., took the Chair.

General Professional Meeting

On February 16th and 17th three technical sessions were held, at which thirteen papers were presented, all giving rise to active discussion.

Other functions in connection with the meeting included a luncheon on the first day given by the Quebec Branch, a smoking concert, visits to the Quebec Bridge on the ice-breaker "Mikula," and to the Anglo-Canadian Pulp and Paper Mills; the Annual Dinner of The Institute, at which the principal speaker was Sir Henry Thornton, president of the Canadian National Railways, and a very enjoyable supper-dance held on the last evening.

All present felt that the Quebec meeting was an outstanding success, and that the thanks of The Institute were due to the officers, members and ladies of the Quebec Branch for their untiring efforts and generous hospitality.

Branch Meetings

Particulars of the meetings and financial condition of the various branches will be found in the attached Branch reports, which show that the Branch activities have been well maintained during the year.

Roll of The Institute

During the year nineteen-twenty-seven, one hundred and eighty-eight persons have been elected to various grades of The Institute. These are classified as follows:—thirteen Members, forty-eight Associate Members, sixteen Juniors, one hundred and seven Students, and four Affiliates. The elections during the year nineteen hundred and twenty-six totalled two hundred and twelve.

Transfers from one grade to another were as follows:—Associate Member to Member, twenty-two; Junior to Associate Member, thirty-three; Junior to Affiliate, two; Student to Associate Member, thirty-three; Student to Junior, forty-four; Affiliate to Associate Members, one; a total of one hundred and thirty-five, as compared with one hundred and fifty-seven in 1926.

A summary of these elections is given below. The names of those elected or transferred are published each month in the Journal, immediately following the election, and are added to the membership roll.

Elections

	Members	Associate Members	Juniors	Students	Affiliates
January	1	1	2	4	..
February	0	0	0	0	..
March	2	10	.	19	1
April	1	6	4	25	.
May	2	8		7	1
June	1	4	3	7	..
July	..	.	.		..
August					.
September	0	5	2	4	1
October	5	7	2	3	..
November	0	1	0	0	..
December	1	6	3	38	1
	13	48	16	107	4

Transfers

	A. M. to M.	Jr. to A. M.	Jr. to Affil.	S. to A. M.	S. to Jr.	Affil. to A. M.
January	4	2	.	4	1	0
February	0	0	0	0	0	0
March	4	2	..	3	4	0
April	3	2	..	2	5	1
May	3	4	..	2	1	0
June	2	3	..	0	0	0
July	.	..	..	..	..	..
August	.	.	..	.	.	..
September	1	1	.	1	3	..
October	4	9	2	15	11	..
November	0	4	..	2	8	..
December	1	6		4	11	..
	22	33	2	33	44	1

Removals from the Roll

There have been removed from the membership roll during the year nineteen hundred and twenty-seven, by resignation and for non-payment of dues, sixteen Members; thirty-seven Associate Members; twenty-seven Juniors; eighty Students; and one Affiliate; a total of one hundred and sixty-one. Twenty-three reinstatements were effected, and two Life Memberships were granted in 1927.

Deceased Members

During the year 1927 the deaths of thirty-three of The Institute's Members have been reported as follows:—

Members

Anderson, Col. W. P., C.M.G.
Boswell, St. George James
Campbell, Archibald William
Donnelly, Col. O'Connor Coslette
Forrest, Benjamin James
Gamble, Francis Clarke
Going, Alvah Seymour
Hamilton, James
Haney, Michael James
James, Edgar Augustus
Kennedy, James Henry
Kircher, Paul
Mountain, William Alphonso
Pilsworth, William Robert
Russell, William Russell
Rust, Charles Henry
Scott, William Lemuel
Shewen, Edward Thornbrough Parker
Wetmore, Andrew Rainsford
Wicksteed, Henry King

Associate Members

Brown, Donald McDonald
Cole, Donald
Dawson, Heber William
d'Orsonnens, Arthur
Gardner, Col. Robert
Hutchinson, Eric Charles
Locke, Robert T.
Read, Guy Carleton
Roe, William Evlyn
Webster, Jas. Clarence
Wilson, Joseph Lovitt
Wrong, Frederick Hay

Students

Forbes, Robert Clarence

Total Membership

The membership of The Institute at present totals four thousand, seven hundred and eighty-one. The corresponding number for 1926 was four thousand seven hundred and thirty-eight.

The total number of corporate members stands at three thousand five hundred and one, as compared with three thousand four hundred and fifty-three on December 31st, 1926.

	Dec. 31st, 1927	Dec. 31st, 1926
Honorary Members	10	9
Members	1,151	1,154
Associate Members	2,349	2,298
Juniors	460	460
Students	758	770
Affiliates	53	47
	4,781	4,738

Respectfully submitted on behalf of the Council.

A. R. Decary, M.E.I.C., *President.*
R. J. Durley, M.E.I.C., *Secretary.*

Finance Committee

The President and Council:

It will be seen from the attached financial statement for the year ending December 31st, 1927, that expenditures have been kept well within the budgeted amount. After reserving amounts to cover the 1927 portion of costs for Year Book and Transactions, the Balance Sheet shows a surplus of receipts over expenditures of $3,458.41.

Your committee wish to point out, however, that the above mentioned reserve and surplus was made possible by the increased advertising earnings of the *Journal*, amounting to $3,172.00, and to collecting of arrears of dues, totalling $3,636.16, also by practising the strictest economy throughout the year in all departments, and by the curtailment of any new activities on the part of The Institute which would entail extra expenditure.

While it is hoped that the earnings of the *Journal* will continue to be as favourable during the coming year as they were in 1927, there is no guarantee that they will be. The amount collected from arrears of dues will be reduced considerably during 1928, as the outstanding amounts are now considerably reduced.

Respectfully submitted,

JAS. H. HUNTER, M.E.I.C., *Chairman.*

STATEMENT OF ASSETS AND LIABILITIES AS AT 31st DECEMBER, 1927

Assets

PROPERTY		$ 89,041.64
FURNITURE:		
Balance at 1st January, 1927	$ 4,748.53	
Additions during year	781.53	
	5,530.06	
Less 10% depreciation	553.00	
		4,977.06
LIBRARY:		
Estimated value of books	3,364.03	
Less 10% depreciation	336.40	
		3,027.63
STATIONERY		541.74
GOLD MEDAL		45.00
INVESTMENTS:		
Canada Permanent Mortgage Corporation, 20 shares, par value $10.00 each	215.00	
Montreal Light, Heat & Power Consolidated, 18 shares, no par value	120.50	
$6,000 Montreal Tramways bonds, $5,000 5%, 1955; $1,000 5%, 1941	5,639,30	
$5,000 Dominion of Canada, 1931, 5% bonds, cost	5,071.75	
		11,046.55
ACCOUNTS RECEIVABLE:		
Sundry and *Journal* advertising	3,593.56	
Advances to Branches	675.00	
	4,268.56	
Less Reserved for bad and doubtful debts	599.40	3,669.16
ARREARS OF FEES, estimated		2,500.00
CASH:		
Canadian Bank of Commerce—		
Current account	1,984.99	
Savings account	891,87	
Petty cash on hand	100.00	
		2,976.86
UNEXPIRED INSURANCE		164.93
SPECIAL FUNDS, as per schedule attached:		
Investments	16,506.05	
Cash in savings bank	2,574.34	19,080.39
		$137,070.96

Liabilities

MORTGAGE ON PROPERTY:		
Royal Institution for the Advancement of Learning	$ 10,000.00	
Interest accrued to date	108.33	
		$ 10,108.33
ACCOUNTS PAYABLE:		
Sundry	630.44	
Reserve for Year Book	2,000.00	
Reserve for cost of 1927 Transactions	4,071.56	
Amounts due to Branches	324.40	
		7,026.40
SPECIAL FUNDS:		
As per schedule attached		19,080.39
LIFE MEMBERSHIP FEES for Investment		300.00
SURPLUS:		
Balance as at 1st January, 1927	103,042.29	
Furniture, being difference between book value and price realized	31.20	
	103,011.09	
Less appropriated for Mortgage Fund	5,913.66	
	97,097.43	
Add surplus for year	3,458.41	
		100,555.84
		$137,070.96

MONTREAL, 17TH JANUARY, 1928.
Verified as per our report of this date.
(Signed) RIDDELL, STEAD, GRAHAM & HUTCHINSON, C.A.
Auditors.

STATEMENT OF REVENUE AND EXPENDITURE FOR THE YEAR ENDED DECEMBER 31st, 1927

Revenue

Membership Fees:		
Arrears	$ 3,636.16	
Current	27,257.58	
Advance	527.72	
Entrance	2,720.00	
		$34,141.46
Interest:		
On overdue fees	228.87	
On Victory Loan bonds	647.53	
On Montreal Tramways bonds	300.00	
On savings bank accounts	87.72	
		1,259.12
Dividends:		
Canada Permanent Mortgage Corporation stock	24.00	
Montreal Light, Heat & Power Consolidated stock	33.00	
		57.00
Publications:		
Journal subscriptions	7,947.57	
" advertising	26,563.08	
Transactions sales	923.94	35,434.59
Refund of Expenses of Hall		716.70
Certificates		192.11
Badges		38.22
		$71,839.20

Expenditure

Building Expense:		
Interest on mortgage	$ 650.00	
Taxes—property and water	1,695.65	
Fuel	391.84	
Insurance	116.22	
Light and gas	319.77	
Caretaker's wages and service	1,209.00	
Repairs and expense	933.56	
		$ 5,316.04
Office Expense:		
Salaries—Secretary and Office Staff	14,708.97	
Office supplies and stationery	1,280.94	
Postage and telegrams	1,169.80	
Audit, 1926 and 1927	600.00	
Legal expenses	22.00	
Telephone	293.43	
Messenger and express	77.67	
Miscellaneous	286.70	
		18,439.51
Publications:		
Journal	24,886.52	
Sundry printing	291.48	
Transactions: Reserve against estimated cost	3,000.00	
Year Book: Reserve against estimated cost	2,000.00	
		30,178.00
General Expense:		
Annual and Professional Meeting	1,852.48	
Plenary Meeting of Council	1,834.36	
Travelling Expense—Secretary	1,096.30	
Branch stationery	165.72	
Students' prizes	100.00	
Examinations	69.00	
Library expense and magazines	1,606.55	
Depreciation on furniture, 10%	553.00	
" " books, 10%	336.40	
Bad debts written off	3.10	
Bank exchange and discount	224.85	
Gzowski Medal	26.00	
		7,867.76
Rebates to Branches		6,579.48
		$68,380.79
Balance—being excess of revenue over expenditure for the year ended 31st December, 1927		3,458.41
Montreal, 17th January, 1928.		$71,839.20

Verified:
(Signed) Riddell, Stead, Graham & Hutchinson, C.A., Auditors.

Schedule No. 1—Special Funds

Mortgage Fund

Balance as at 1st January, 1927		$2,223.05	
Add amount appropriated from Surplus Account		5,913.66	
			$ 8,136.71
Represented by:			
Victory Loan, 1934, par value $8,000. Cost	$8,136.71		

Leonard Medal

Balance as at 1st January, 1927		$ 533.71	
Add bond interest		27.50	
bank interest		1.19	
			562.40
Represented by:			
Balance in bank		562.40	

Plummer Medal

Balance as at 1st January, 1927		$ 561.23	
Add bond interest		27.50	
bank interest		2.03	
		590.76	
Less paid for medal		52.00	
			538.76
Represented by:			
Victory Loan, 1934, 5½%	$ 500.00		
Balance in bank	38.76		
	$ 538.76		
Forward			$ 9,237.87

Forward			$ 9,237.87

Prize Fund

Balance as at 1st January, 1927		$ 559.85	
Add bank interest		16.90	
			576.75
Represented by:			
Balance in bank		$ 576.75	

Fund for Relief of Members' Families

Balance as at 1st January, 1927		$1,614.59	
Add bond interest		77.00	
bank interest		7.09	
			1,698.68
Represented by:			
$1,400 Victory Loan, 1934	$1,400.00		
Balance in bank	298.68		
	$1,698.68		

Past Presidents' Fund

Balance as at 1st January, 1927		$2,967.74	
Subscriptions		199.85	
Bond interest		125.00	
Bank interest		18.81	
			3,311.40
Represented by:			
$2,500 Dominion of Canada (C.N.R.) 1954	$2,489.55		
Balance in bank	821.85		
	$3,311.40		

War Memorial Fund

Balance as at 1st January, 1927		4,090.37	
Add bond interest		100.00	
bank interest		54.77	
subscriptions		10.55	
			4,255.69
Represented by:			
$2,000 C.P.R. Coll. Trust 5%, 1934 bonds	1,979.79		
$2,000 Dominion of Canada, 1931	2,000.00		
Balance in bank	275.90		
		$4,255.69	$19,080.39

Nominating Committee—1928

The following nominations to the Nominating Committee for the year 1928 have been made by the various branches, have been noted by Council, and are herewith presented to be announced at the Annual Meeting in accordance with the By-laws.

Halifax Branch	C. H. Wright, M.E.I.C.
Cape Breton	A. L. Hay, M.E.I.C.
Saint John	J. N. Flood, A.M.E.I.C.
Moncton	L. H. Robinson, M.E.I.C.
Saguenay	C. N. Shanly, M.E.I.C.
Quebec	P. Méthé, A.M.E.I.C.
St. Maurice Valley	H. Dessaulles, A.M.E.I.C.
Montreal	J. G. Caron, A.M.E.I.C.
Ottawa	W. A. Rush, A.M.E.I.C.
Peterborough	A. L. Killaly, A.M.E.I.C.
Kingston	W. P. Wilgar, M.E.I.C.
Toronto	J. J. Traill, M.E.I.C.
Hamilton	J. A. McFarlane, M.E.I.C.
London	Frank C. Ball, A.M.E.I.C.
Niagara Peninsula	C. G. Moon, A.M.E.I.C.
Border Cities	J. E. Porter, A.M.E.I.C.
Sault Ste. Marie	J. W. LeB. Ross, M.E.I.C.
Lakehead	F. C. Graham, A.M.E.I.C.
Winnipeg	J. N. Finlayson, M.E.I.C.
Saskatchewan	M. B. Weekes, M.E.I.C.
Lethbridge	C. Raley, A.M.E.I.C.
Edmonton	R. W. Boyle, M.E.I.C.
Calgary	B. L. Thorne, M.E.I.C.
Vancouver	J. M. Begg, A.M.E.I.C.
Victoria	A. L. Carruthers, M.E.I.C.

Legislation and By-Laws Committee

The President and Council:

The amendments to the By-laws proposed last year were submitted to letter ballot of the membership and duly approved; these, applying to Sections 13 and 38, accordingly become effective in due course.

During the year 1927, amendments have been proposed by Council to the following Sections of the By-laws:—Nos. 9, 10, 18, 24, 52, 53, 68, 69, 70, 74 and 76.

An amendment to Section 29, dealing with the method of election of members by letter ballot of Council, has also been proposed by twenty corporate members of the Moncton Branch.

All these proposals have been circulated to the membership and will come up for discussion at the Annual General Meeting prior to their submission to a letter ballot vote of the members. In the opinion of your Committee, three of these proposals are of special importance; namely that amending Section 29, as mentioned above, that amending Section 35, regarding the amount of the annual fees of Members, and that amending Section 76, involving a change in the procedure to be followed in amending the By-laws.

Your Committee would express the hope that in considering all these proposals, and particularly the three just named, members will realize the complexity of the questions raised, and the unsatisfactory and sometimes unforeseen results which are apt to follow the adoption of suggestions or changes in wording which have not received adequate and reasoned discussion.

The views of your Committee on these matters have already been presented to Council in reports submitted during the year.

Respectfully submitted,

Geo. R. MacLeod, M.E.I.C.,
Chairman.

Papers Committee

The President and Council:

In view of the Papers Committee being spread from coast to coast, it has not been possible to prepare a report of the committee as a whole. As a substitute, this is a report by the chairman of the Committee.

The same policy as last year, of appointing an eastern and western vice-chairman of the Committee was followed out. W. J. Johnston, A.M.E.I.C., of St. John acted for the Maritimes, and E. A. Wheatley, A.M.E.I.C., represented the western Branches.

An attempt was made to carry out the recommendations made at the last Annual Meeting to the effect that each Branch should appoint a special representative to this Committee. This, however, did not work out entirely satisfactorily in practice. The general secretary requested every Branch to appoint a representative to this Committee but only half of the Branches took any action in this regard. It therefore looks as though many Branches feel that they have no use for the Papers Committee of the Institute, and do not desire to co-operate with other Branches in this feature of the activities of the Institute.

Through the activities, however, of the vice-chairman for Maritime provinces, arrangements were made, similar to last year, for one speaker to make a comprehensive tour, visiting all the Branches in the Maritimes.

One cannot write with any degree of enthusiasm of the work of this Committee because of the lack of co-operation. There is a cry from many Branches that they have difficulty in getting speakers, and yet they do not take advantage of the possibility of being assisted through the Papers Committee of Headquarters.

Respectfully submitted,

J. L. Busfield, M.E.I.C., *Chairman.*

Publications Committee

The President and Council:

I have much pleasure in reporting that the Publications Committee has had no business which necessitated its being called together during the year 1927. On one or two occasions its chairman has been consulted by the General Secretary regarding notices in the Journal, with mutually satisfactory results, but not even this would afford justification for describing the duties of the Committee as onerous.

Respectfully submitted,

P. L. Pratley, M.E.I.C., *Chairman.*

Board of Examiners and Education

The President and Council:

During the past year, your Board of Examiners has examined fifteen candidates for admission to The Institute, with results as set forth in the table below:

Subjects	Passed	Failed
Schedule "B"	1	3
Mechanical Engineering	1	0
Railway Engineering	5	1
Structural Engineering	0	4
Totals	7	8

The figures of the above table would suggest that candidates are perhaps disposed to regard the Institute examinations largely as formalities, and this is borne out by the papers submitted. Many of these are so poor as to indicate that the candidate has little knowledge of the subject upon which he is writing. In conducting its examinations, the Board tries to maintain a standard approximately equal to that of the Canadian universities, a fact of which candidates should take due notice.

During the year, the Board has recommended to Council, (1) that the Dominion Land Surveyors' certificate should not be accepted as exempting the holder from examination for admission, and (2) that a degree in forestry, or forestry engineering, should not be considered as equivalent to a degree in those branches of engineering already recognized by the Institute, but that the holder of such a degree might be admitted without examination provided his experience had been of satisfactory engineering character.

The syllabus of examinations is being revised, as there were many features of the old syllabus giving rise to difficulty. The proposed new syllabus will, it is hoped, obviate these troubles.

The consideration of the revised syllabus, and of the Institute's relations to the various provincial examining boards are matters which should receive the early attention of your Board of Examiners to be appointed by the incoming Council.

In closing, the Board would like to express its appreciation of the co-operation received from the Secretary and his staff, without which its efficient functioning would have been difficult, if not impossible.

Respectfully submitted,

R. DeL. French, m.e.i.c., *Chairman.*

Committee on Engineering Education

The President and Council:

The Committee on Engineering Education has been holding itself in readiness to co-operate with the Society for the Promotion of Engineering Education, but no specific problems have been presented to your Committee.

Respectfully submitted,

Frederick B. Brown, m.e.i.c., *Chairman.*

Gzowski Medal and Students' Prizes Committee

The President and Council:

Your Committee has studied carefully the papers presented during the year ending June 1st, 1927. The papers reviewed covered a wide range of topics, including reports of original research, records of natural resources and descriptions of recently completed engineering projects. Some of the papers were the work of two or more authors, and those dealing with original research appeared to be progress reports rather than papers dealing broadly with the subjects under investigation.

There was a marked difference of opinion as to the order of merit of the papers reviewed, but a general agreement that none of them could be ranked as forming a sufficiently valuable contribution to engineering literature and professional knowledge to warrant the award of the Gzowski Medal.

Your Committee, therefore, recommends that no medal be awarded this year.

The Committee recommends that a Student's Prize be awarded in the electrical section, to W. T. Fanjoy, s.e.i.c., for his excellent paper on the "Control of Common Types of A. C. Motors."

Respectfully submitted,

C. V. Christie, m.e.i.c., *Chairman.*

Leonard Medal Committee

The President and Council:

On behalf of the Leonard Medal Committee of The Institute, I beg to report that we have carefully considered the eligible papers and it is our unanimous opinion that in this instance the award be made to Sir Stopford Brunton, a.m.e.i.c., for his paper on "The Gold Deposits of Nova Scotia." We are of the opinion that on the question of originality, and composition combined with appropriateness it fulfils the idea of the founder.

Respectfully submitted,

Geo. D. Macdougall, m.e.i.c., *Chairman.*

Plummer Medal Committee

The President and Council:

Your Committee has carefully examined the various papers which they feel come within the scope of the Plummer Medal.

These papers are as follows:—

"The Characteristics and Utilization of Nova Scotia Coals," by W. S. Wilson, a.m.e.i.c., and M. W. Booth, a.m.e.i.c.

"Alternating Current Electrolysis," by J. W. Shipley and Chas. F. Goodeve.

"The Wood Consuming Industries of Canada," by John Stadler, m.e.i.c.

"The Expansion of Portland Cement Mortar Bars During Disintegration in Sulphate Solutions," by T. Thorvaldson, R. K. Larmour and V. A. Vigfusson.

"Bearing Metal Bronzes," by Harold J. Roast, and Fred Newell, m.e.i.c.

"Oil Paints and Their Application," by A. K. Light.

In judging these papers your Committee felt that originality of work should be one of the primary factors in their decision and should have consideration over mere statements of already known facts or compilations of other authors' works.

Following the consideration of subject matter, consideration was given to English, style and method of handling the subject.

Taking all these points into consideration, it is the majority opinion of your Committee that the paper as presented in the January 1927 number of the Journal entitled "Alternating Current Electrolysis," by J. W. Shipley and Charles F. Goodeve, should receive the Plummer Medal for the period under review.

Respectfully submitted,

J. R. Donald, m.e.i.c., *Chairman.*

Committee on Biographies

The President and Council:

During the year the work of the Committee on Biographies has consisted largely of correspondence conducted with actual and potential authors of memoirs of deceased engineers. Twelve biographies of varying length have already been compiled, six others are in progress, and six additional ones have been assigned to authors.

The work of the Committee is continuing as opportunity offers, but has been somewhat delayed by the illness of the chairman, who desires to express his appreciation of the work of his colleagues on the Committee.

Respectfully submitted,

Peter Gillespie, m.e.i.c., *Chairman.*

Library and House Committee

The President and Council:

The work of recataloguing the library was completed early in the year, with the exception of the files of periodicals, transactions and reports, the work on the latter being at present well advanced. As a result of this work greater facilities are afforded the members of the Institute in the use of the library and there has been an appreciable increase in the number of members who have availed themselves of the library facilities during the past year.

A record of library service for the past eight months shows that 141 books were borrowed of which 28 were loaned to members living outside of Montreal. This figure does not include the large number of books borrowed for reference within the Headquarters building.

Requests are constantly received at Headquarters for information which might be classed under the heading of "library reference service." These requests involved the search for articles on specified subjects in periodicals, transactions, reports, etc.; the listing of text books or articles dealing with a particular subject, and numerous other services. These services are most valuable to members residing in places where they have not access to technical libraries, and it is hoped that as the demand increases greater facilities will be provided to carry on this work.

In connection with this some 525 separate references were requested during the eight months period mentioned above.

While various regulations governing the operation of the library had been formulated and approved from time to time it was deemed advisable that these should be collated and amended so as to establish an authorized set of rules and regulations for the library, and with this in view your Committee submitted the regulations as printed on page 468 of the October issue of the Engineering Journal, which were approved by Council at the meeting held on September 27th, 1927.

During the year some 70 new technical books were added to the library in addition to various technical periodicals, transactions of other societies, and reports of numerous organizations. The majority of the technical books received were presented by the publishers for review in the Engineering Journal. Each month there has appeared in the Journal a list of books, etc., which have been received and added to the library. These lists may be found on pages 58, 236, 325, 440, 471, 506 and 542 of volume X, of the Journal.

Your Committee wishes to acknowledge with thanks the books, reports and other publications which were presented to the library by a number of individuals and organizations, and also to record the appreciation of the Institute of the service rendered by a number of members and others in reviewing books presented by publishers.

During the year there was presented to The Institute, by Mrs. William McNab, a large view of the original Victoria Tubular Bridge over the St. Lawrence River at Montreal, with the construction of which the late Mr. McNab was connected.

The expenditure on the library during the year amounted to one thousand, six hundred and six dollars and fifty-five cents, which includes the cost of the new books, expenses relative to the work of recataloguing, and the salary of the librarian.

At the meeting of Council held on June 21st, 1927, it was proposed that certain repairs should be made to the Headquarters building, and at the request of Council your Committee examined the building and found it badly in need of renovation and approved of the following work, which was subsequently carried out:

Office—Repairing plaster; tinting ceiling; painting walls, woodwork, partitions, etc.; installation of new lighting system to replace old library lights in the general office.

Lecture Hall—Washing and retinting ceiling, repapering walls, and painting woodwork.

Technical Reading Room—Repairing plaster, tinting ceiling, repapering walls and painting woodwork.

Repairs in connection with the Headquarters building entailed the expenditure of six hundred and sixty-four dollars and thirty-five cents, of which five hundred and fifty-one dollars and sixty-eight cents is accounted for by the repairs mentioned above.

Respectfully submitted,

W. C. Adams, M.E.I.C., *Chairman.*

Committee on International Co-operation

The President and Council:

The Institute's Committee on International Co-operation was not called into official action last year.

Italy, however, in 1927, in commemoration of the one hundredth anniversary of the death of Alessandro Volta invited the International Electrotechnical Commission, the World Power Conference, the Illuminating Engineers, the Meteorologists, the Physicists and the Telephonists and Telegraphers of the world to visit the Exhibition at Como (the old city where Volta had worked and died), to hold separate conventions around Lake Como and to join in a grand demonstration in honour of the "father of electricity," from whose name the word "volt" was derived. The writer was fortunate in being able to attend the meetings and functions of the two first mentioned organizations above, as an official delegate from Canada, and with pleasure takes advantage of this opportunity to tell the members of the Institute something about them, because national pride and "international co-operation" were the keynotes of all the proceedings.

Great Britain sent forty delegates to Italy; the United States sent twenty-one, France sent seventeen, and Germany fifteen, delegates to the plenary meetings of the International Electrotechnical Commission. Were it not for the fact that the Board of Railway Commissioners for Canada, (with the concurrence of the officials of the Department of Railways and Canals), took a special interest in the work relating to safety rules and regulations for electric power transmission systems, Canada would not have been represented at all at those great Italian gatherings, and this, in the writer's opinion, would have been most regrettable. Twenty countries were represented; many sent large delegations. Australia and Canada were the only countries represented by a single delegate and even far-off Japan sent two delegates.

Canada, in common with other countries, has National Committees of the International Electrotechnical Commission and of the World Power Conference,—both of which bodies have their head offices in London, England. Those National or home committees continuously carry out such work as is assigned to them at the plenary meetings or conventions of the parent bodies and their reports are considered and amended or approved at plenary meetings like those recently held in Italy. Lists of the subjects handled appear on pages 541 and 542 of the December issue of The Engineering Journal. The Illuminating Engineers handled the following matters:—Automobile lighting, factory lighting, photometric methods, and international definitions, while committees were appointed to deal with diffusing glassware, signal lenses, daylight motion pictures, street lighting, and glare research.

Although greatly handicapped by being alone while three concurrent committee meetings were being held at Bellagio, and, for several days, while another meeting was under way at the same time at Cernobbio, twenty miles away, the writer had abundant evidence to show that the presence of even one Canadian delegate at those International gatherings was greatly appreciated by the Italians and by the representatives of the other countries, who have spent much money and a great amount of time and energy in their efforts to develop international standardization.

The Italian committees had the hearty approval and active support of Premier Mussolini and his whole administration. They know Italy is well worth visiting and they gave us a great welcome. We could not help being much impressed by the abundant evidences of peace and progress on every hand while we were being taken to Milan, Venice, Florence, Rome, Pisa, Genoa and Turin on a special complimentary train and shown the treasures of science, art and history with which every step of the way is filled. In each city the Podesta extended the freedom of his district. At Rome the Governor and Premier Mussolini gave receptions in our honour and most of the delegates had an audience with His Holiness Pope Pius XI.

Visitors to Europe cannot fail to comment on the thousands of miles of main line electrified railways—in operation and in course of reconstruction. France, Switzerland and Italy seem to be vying with each other in their attempts to speedily electrify all their railways. In those three countries the American—and Canadian—contention, that the cost of railway electrification makes it prohibitive, has been side-tracked by the European conclusion that the value of the better electrical service and the comfort of the traveller are of more importance than the first cost of the change.

When invitations to International and other meetings are received, instead of asking ourselves:—"What is there in this for me?" would it not be well for those receiving them to say: "Can we help the other fellows if we attend?" Even though time, energy and money must be spent in connection with such affairs, the net gain to all concerned is, in the writer's opinion, very great. It does every human being a lot of good when he does something for some one else. That is true of family affairs, of Institute affairs and of International affairs.

Respectfully submitted,

John Murphy, M.E.I.C., *Chairman.*

Canadian National Committee of the International Electrotechnical Commission

The President and Council:

The Secretary regrets to report the untimely death on May 1st, 1927, of Mr. James Kynoch, chairman of the Canadian National Committee of the International Electrotechnical Commission, and chief engineer of the Canadian General Electric Company. Mr. Kynoch had been ill for a short time and was resting at his summer home at Lake Simcoe when he unexpectedly expired. He had taken a great interest in the work of the Committee and had planned many schemes for its extension and usefulness. He had taken a special interest in sending a Canadian representative to Italy to take part in the Volta Centennial Celebrations and did much towards making it possible for our representative to attend.

At a meeting of the Committee on July 11th, John Murphy, M.E.I.C., vice-chairman, was elected to succeed Mr. Kynoch as chairman. As our new chairman's attendance at the Italian meeting has, I am informed, been reported under the head of the International Co-operation Committee, there is no necessity to repeat it here.

A subject greatly to the fore at present is the question of co-ordinating the work of the International Electrotechnical Commission and that of the recently formed International Standards Association, and it is sincerely hoped that a universally satisfactory solution may be found as soon as possible.

In the meantime the International Electrotechnical Commission is vigorously carrying on its programme.

Respectfully submitted,

H. A. Dupré, M.E.I.C., *Secretary.*

Honour Roll and War Trophies Committee

The President and Council:

The task of compiling and checking the nominal rolls of members who fell or served in the Great War has occupied a considerable portion of the time of the staff of the Institute during the year 1927.

The list of members who fell has been checked by National Defence Headquarters, but identification is still required for a considerable number of members who either served in the Imperial Forces or in the Allied Armies.

The nominal roll of members who served has now been sent to National Defence Headquarters for confirmation and checking, and your Committee has been informed by the Director of Records that it will not be possible to undertake the work in connection with this roll for some months, owing to the vast number of similar rolls for various institutions throughout Canada and the United States, which have priority over our list, on account of their earlier date of receipt.

The sum necessary for the completion of the Memorial and the Record in Bronze has been collected. When the checking of the nominal rolls has been finally completed the work of erection will be put in hand by your committee.

Respectfully submitted,

Charles J. Armstrong, M.E.I.C., *Chairman.*

Committee on the Deterioration of Concrete in Alkali Soils

The President and Council:

In submitting our annual report this year we wish to set forth in detail the result of six years' exposure of the field specimens, and it is desired to call attention to certain phases of the chemical research which bear on the interpretation of the field tests.

Financial

As shown in detail in another part of this report, we have collected and spent on our investigation to date the sum of $47,821.93, contributed by the parties and in the amounts shown. Our Committee funds became practically exhausted about April of this year, but the chemical research has been continued on other funds in order to conclude certain work which will enable us to make a final report on behalf of our Committee.

Chemical Research

Much important work has been done during the year on the chemical research. One paper entitled, "The Expansion of Portland Cement Mortar Bars During Disintegration in Sulphate Solution," by Thorvaldson, Larmour and Vigfusson was printed in the Engineering Journal, April, 1927. This paper presents the method developed and used to measure quantitatively the progress of disintegration in mortar subjected to sulphate solutions. A paper, "The Effect of Steam Treatment of Portland Cement Mortars on their Resistance to Sulphate Solutions," by Thorvaldson and Vigfusson, is being presented at this annual meeting and is a contribution to engineering. A paper entitled "Action of Sulphates on the Components of Portland Cement" by Thorvaldson, Vigfusson and Larmour was presented to the Royal Society of Canada in May and appears in the 1927 Proceedings of that Society. This paper deals with the action of sulphates on the supposed constituents of Portland cement, and of the action on a synthetic cement made from the pure compounds, and presents some interesting and significant observations. A fourth paper on "The Action of Sulphate Solutions on High Alumina Cements" by Thorvaldson and Wolochow is ready for publication.

Up to the present eleven scientific papers have been prepared on various aspects of the chemical research, besides many reports similar to that now presented, which have been made to the annual meetings of the Institute and Branch meetings. In all we have published through the agency of this Committee some twenty-five papers, reports and articles on both the physical and chemical work since we started this work.

Field Work

When organizing the investigational work to be undertaken by this Committee in 1921, the members agreed that previous investigations, notably those of the Bureau of Standards, Washington, as well as the tests of several of the members of this Committee, had established certain facts regarding the disintegration of concrete by so-called alkali waters as follows:—

(1) That normal Portland cement concrete will be disintegrated if subjected to an "alkali" solution of sufficient concentration.

(2) That the better the concrete (i.e. the richer in cement content, the stronger, the more impermeable) the greater its resistance to alkali action.

(3) That none of the so-called alkali-proofing compounds either of the integral or surface type gave immunity.

(4) That the concentration and composition of ground waters in the field varied widely within a comparatively short radius and over periods of time.

(5) That in the absence of any real understanding of the nature of the reactions and in the light of the above facts *that conclusions based on small differences in rate of decay of field specimens over a limited period of years must be accepted with reservations.*

The Committee then decided that there was nothing to be gained by undertaking extensive field tests at that time, and that it was wise to allocate the major portion of the funds to a fundamental chemical research, in an attempt to ascertain the real reason of the decay and to search for possible methods of preventing such action. It was decided, however, to undertake a limited programme of field tests in order to corroborate previous findings and try out new materials submitted.

Our experience gained during the past six years has only confirmed us in our previous judgment, and we feel that the results obtained from the chemical research have even now justified our programme, as the many valuable findings made by Dr. Thorvaldson and his assistants have given us sound scientific facts to support our original contention that the results of field tests must be interpreted with care to avoid arriving at false conclusions. Besides the contributions made to the general understanding of the chemistry of cements and its decay, all of which will be reported in full at a future date, we desire to mention here a few findings which have a bearing on the interpretation of the field tests.

(1) It was found that contrary to general opinion, the actions of $MgSO_4$ and $NaSO_4$ solutions on cements were fundamentally different, and that certain cements which were highly resistant to one of these solutions decayed rapidly in the other. This has explained many apparently contradictory tests under what were thought to be similar alkali conditions.

(2) It was found that changes in concentration of the sulphate solutions had very different effects on different brands of Portland cement of standard specification.

(3) It was found that the conditions under which the concrete was cured bear on the resistance to sulphate action.

(4) It was found that two cements might have equal resistance to a sulphate solution when exposed in 1-10 mortar bars but very different relative resistances to the same solution when 1-3 mortar bars were used.

(5) It has been found that Portland cements, all of which meet standard specifications, often vary greatly in their "resistance" to sulphate action. Mention should be made in this connection of the corroborative work of Mr. D. G. Miller* of the United States Department of Agriculture, who found with concrete cylinders of high strength (over 4,000 pounds per square inch) but made of different brands of cement, that after exposure for two years in alkali waters some of the cylinders were practically unaffected, while others were completely disintegrated.

(6) A development of an analytical method of distinguishing between "alkali action," "acid action" and "frost action" has made it possible to eliminate considerable uncertainties in field observations.

(7) Data gathered on the high concentrations sometimes obtained by means of capillary action and subsequent evaporation has shown that often an analysis of the water does not give a measure of the real exposure conditions.

(8) It has been found that neat Portland cement blocks fail, in a most extraordinary manner, when subjected to sulphate solutions, and are less resistant than rich concrete blocks.

We feel that if unwarranted and erroneous conclusions from our field tests are to be avoided, they must be properly interpreted.

Two appendices† to this report have therefore been prepared, and are now submitted herewith as separate papers.

In the first, (Appendix A), Dr. Thorvaldson discusses those portions of his chemical findings which bear upon the interpretation of the field tests, and the second, (Appendix B), gives in detail the results of the field tests as observed up to December 1927.

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*Miller, Journal Am. Soc. Agr. Engrs., Feb. 1927.

†To be presented at the Technical Sessions of the General Professional Meeting.

Financial Statement

The following summary of expenditures and receipts as to December 1st, 1927, is submitted; a detail statement of expenditures from December 1st, 1925 to December 1st, 1926, is being sent to the financial supporters of the research.

It will be noted that our funds became exhausted early in the year.

Expenditures During Year Dec. 1st, 1926—Dec. 1st, 1927

General—Reprints of paper in Journal	$ 60.84	
Chemical—Salaries research assistants	1,182.50	
Research—Materials	1,238.51	
		$ 2,481.85

Total Expenditures to December 1st, 1927

General—Committee meetings, travelling expenses	$1,836.56	
Misc. telegrams, office expenses	414.69	
		$ 2,251.25
Physical Tests—Travelling allowance and expenses	$1,123.66	
Material, labour and equipment	1,745.67	
Freight and cartage	353.09	
		$ 3,222.42
Chemical Research—Travelling Expenses	$ 340.81	
Salaries research assistants	33,842.35	
Materials	8,165.10	
		$42,348.26
Total		$47,821.93

Total Receipts to December 1st, 1927

	1921	1922	1923	1924	1925	1926	1927	Total
Research Council	$5,000	$5,000	$5,000	......	......	$5,000	......	$20,000.00
Can. Cement Co.	3,000	3,000	3,000	......	2,997	......	......	11,997.00
Saskatchewan	3,000	3,000	3,000	......	......	......	......	9,000.00
Alberta	1,000	1,000	......	......	......	......	......	2,000.00
Can. Pac. Ry.	1,000	1,000	1,000	......	......	......	......	3,000.00
Winnipeg	200	200	300	......	......	......	......	700.00
Interest on Bank Account			139.41	422.14	190.65	193.71	179.02	1,124.93
Total receipts								$47,821.93

It will be noted that of the total money spent, over 70 per cent has been paid in salaries to laboratory assistants, which does not include any salary to the Director, who contributed his services, and that less than 5 per cent has been expended in overhead, including Committee meetings, etc., and considering the size of the Committee this seems quite small. We feel, therefore, that it may be justly claimed that the funds contributed have been well and efficiently used.

Respectfully submitted.

C. J. Mackenzie, 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's nominees on the Main Committee of the Canadian Engineering Standards Association are now as follows:—

Prof. C. M. McKergow, m.e.i.c. Retires March, 1928 (Renominated for three years)
Dean C. J. Mackenzie, m.e.i.c. " " 1929
Frederick B. Brown, m.e.i.c. " " 1930

The total number of active working committees and panels now stands at sixty-seven.

The arrangement with the National Research Council has been continued, whereby the Main Committee of the Association operates as an Associate Committee on Engineering Standards of the National Research Council. Under the understanding with the Research Council, a campaign for financial support was inaugurated and the sum of $5,171 was subscribed by various industrial firms who are interested or who have been associated with the work of the Association. This somewhat exceeds the amount set by the Research Council of $5,000.

The year has been marked by a great awakening of interest on the part of industry in the work of standardization and simplification, and technical papers and the press have co-operated in giving much valuable publicity to the work.

The first year-book of the Association was published in February, and has been very useful in promoting knowledge of the Association and its method of work. A quarterly bulletin was also inaugurated, the first issue appearing on March 31st. This serves as the official organ of the Association, and gives detailed information on the progress made by committees, the activities of the secretary, and a report on publicity and contact with industrial associations. It has been found very useful in the work, and many requests have been received for current copies as issued.

Publications Issued During 1927

A5-1927. Standard Specification for Portland Cement

A second edition of this specification was published during the summer, the only revision being an increase in the required minimum tensile strength for mortar briquettes. This has been increased from 200 to 225 pounds per square inch for seven-day tests, and from 300 to 325 for twenty-eight-day tests.

A20-1927. Standard Specification for Movable Bridges

This was published in October, 1927, and is an amplification of the section on movable bridges which appeared in the first specification for Steel Railway Bridges in 1920. It covers requirements for movable bridges of all types, such as special stresses, materials, attachments and operating equipment. It does not contain general specifications for bridges, but references to the Canadian Engineering Standards Association specifications for Steel Railway and Highway bridges are made in proper places.

C21-1927. Standard Specifications for Control Cable for Electrical Power Plant Equipment

This is a brief specification covering construction of control cable, and includes a colour code by means of which fifteen different conductors may be identified by the use of not more than two colours in the braid at any one time, and one standard design for the weave. This project was suggested by practical construction and operating men and the specification has already been used on several cable orders.

C22-1927. Canadian Electrical Code—Part I; Essential Requirements and Minimum Standards for Electrical Installations in, on or over Buildings Using Potentials of from 0-5000 Volts

This has been issued with the object of promoting uniform wiring regulations throughout Canada, as at the present time there is a great confusion between the rules now in operation in the different provinces. The Association has been working on this project since 1920, and the publication of the Code has been an outstanding event in the electrical field in Canada. It is a combined fire and personal safety code, and in this respect is unique; it has been based on the National Electrical Code, the National Electrical Safety Code, the Rules and Regulations of the Hydro-Electric Power Commission of Ontario, and many other provincial or municipal regulations. It has been very favourably received, and prospects for adoption in the different provinces are bright, for it has already been adopted in the province of Ontario and will shortly be adopted in the provinces of British Columbia and Quebec. Committees are now at work to promote the adoption of the Code in the Provinces of Alberta, Saskatchewan and Nova Scotia.

A complete list of the publications issued by the Association to date is as follows:—

A 1—1922	Standard Specifications for Steel Railway Bridges.
A1a—1922	Material Specifications, Steel Railway Bridges (reprint).
C 2—1920	Standard Requirements for Distribution Type Transformers.
C 3—1924	Standard Specification for Galvanized Telegraph and Telephone Wire.
B 4—1921	Standard Specification for Wire Rope for Mining, Dredging and Steam Shovel Purposes.
A 5—1927	Standard Specification for Portland Cement.
A 6—1922	Standard Specification for Steel Highway Bridges.
D 7—1922	Standard Specification for Flexible Steel Wire Rope and Strand for Aircraft Purposes.
G 8—1923	Standard General Specifications for Commercial Bar Steels.
A 9—1923	Standard Specifications for Reinforcing Materials for Concrete.
C10—1923	Standard Specification for Tungsten Incandescent Lamps.
D11—1924	Interim Report on the manufacture, Testing and Use of Gasoline.
B12—1924	Standard General Specification for Galvanized Steel Wire Strand.
E13—1924	Standard Specification for Railway Wire-Fencing and Gates.
C14—1924	Standard Specification for Reinforced Concrete Poles. .
C15—1924	Standard Specification for Eastern Cedar Poles.
A16—1924	Standard Specification for Steel Structures for Buildings.
C17—1925	Standard Requirements for A.C. Watthour Meters.
B18—1925	Standard Specifications for Stove Bolts.
A19—1926	Standard Classification of Items of Highway Expenditure.
A20—1927	Standard Specification for Movable Bridges.
C21—1927	Standard Specification for Control Cable.
C22—1927	Canadian Electrical Code—Part I.

Work in Progress

Civil Engineering and Construction

Concrete and Reinforced Concrete. Reports have been received from all the panels of this committee, and the first draft specification has now been prepared and will be considered by the committee at an early date.

Reinforcing Materials for Concrete. A list of recommended bars has been added to specification No. A9-1923.

Road Materials and Construction. Owing to pressure of other work, there has been no change in the status of the different specifications under this heading during the year, but it is hoped to take them up actively again this year.

Steel Railway Bridges. Final revisions to the specification for Steel Railway Bridges were considered by the committee on December 8th, and have been approved by letter ballot. Approval of the Sectional Committee and the Main Committee will now be obtained and copy for the revised specification is now being prepared. It has been decided to omit the specification for bridge paint until such time as a satisfactory arrangement can be made with the paint manufacturers.

Steel Highway Bridges. Revisions to the specification for Steel Highway Bridges are now being considered, and a new edition will be published during the coming year.

Steel Structures for Buildings. It will be necessary to issue a revised edition of this specification shortly, and the raising of the allowable unit stress from 16,000 to 18,000 pounds per square inch will be one of the features.

Mechanical Engineering

Machine Screws. A committee is now considering data sheets giving a reasonable list of machine screws for all practical purposes. The original list presented by the panel showed forty-three generally used machine screws on the market in Canada, but after discussion by the committee this has been reduced to eighteen, and it is probable that this revised list will be approved by the Committee.

Sheet Metal Gauges. Nothing further has been done on this project, but the Sheet Metal Exchange have sent out a circular to the trade, asking for approval of the adoption of a standard gauge for Canada. Nothing can be done until this approval has been received.

Cast Iron Pipe. The first draft specification was considered by the Committee on May 3rd, 1927, and revisions decided upon have been sent out to the committee again for comment. Arrangements are being made to carry out certain physical tests, from which it is expected to obtain data which can be used in the specification.

Electrical Engineering

Rating and Testing of Electrical Machinery. Reports have now been received from all three panels of this committee, and have been summarized and sent out to the members of the committee for comment. A meeting of the committee will be held to consider these reports on January 18th in Toronto.

Automotive Work

Traffic Signals for Highways. This project has been held up owing to a difference of opinion on colours for signals, and arrangements have been made for co-operation with the Canadian Good Roads Association at a conference in Quebec in January, when it is hoped to come to some satisfactory agreement on this question.

Ferrous Metals

Steel Castings. A report from the panel appointed to prepare a specification was reviewed by the committee at a meeting in Montreal on November 18th, and it has been proposed to follow the latest American Society for Testing Materials specification, but to add a section dealing with castings subject to heavy duty such as rotating parts of machines, housings, etc. A complete draft specification has now been prepared and is before the members of the committee for their comment.

Sampling for Check Analysis. Forging Quality of Bar and Billet Steel. A committee has been working jointly on these two projects, and has held two meetings during the year in Toronto, as a result of which a final draft specification is now before the members of the committee for comment. It is hoped to issue these specifications shortly.

Co-operation

Co-operation with other standardizing bodies has been fairly active, especially with the British Engineering Standards Association and the American Engineering Standards Committee. The support received from industry during the year has been very encouraging, especially in the obtaining of the objective set by the 1927 budget. Many requests have been received for representation on working committees, and enquiries for copies of the Year Book and the Bulletin and orders for publications have been particularly numerous towards the end of the year.

The Association is deeply indebted to those who have voluntarily given their time and experience in the work of the various committees and in the preparation of the specifications published during the year.

Respectfully submitted,

C. M. McKergow, M.E.I.C.
C. J. Mackenzie, M.E.I.C.
Frederick B. Brown, M.E.I.C.

Branch Reports

Border Cities Branch

The President and Council,—

There were seven regular meetings throughout the year, with an average attendance of 20 members, this figure includes members who may not have attended the dinner but who came only to the address. I am sure this attendance record is not a source of pride or gratification, since last year the average attendance was reported as 31, with a total membership of 130, whereas this year our membership totals 135.

The credit balance of the branch has increased from $101.92 on December 16th, 1926, to $201.17 at the present time; representing an increase of $99.25, which includes rebates, branch dues, etc., to the end of the year.

Meetings

Papers and addresses of the year are as follows:—

Jan. 14.—"**Street Car and Bus Transportation,**" by W. R. Robertson, general superintendent of railways, Hydro-Electric Power Commission of Ontario.

Feb. 11.—Charles F. Craig, of the American Brass Co., of Detroit, who presented the Anaconda film "**From Mine to Consumer.**"

Mar. 11.—The U.S. Steel Products Co. presented the film "**The Story of Steel.**"

Apr. 22.—"**The Manufacture of Modern Newsprint,**" by T. L. Crossley, A.M.E.I.C.

May 20.—"**Accident Prevention,**" by W. H. Cox, secretary of Essex and Kent Division of the Accident Prevention Association.

Oct. 14.—Col. H. C. Boyden, of Celite Products of Los Angeles.

Nov. 11.—"**The Evolution of Brickmaking,**" by E. C. Glenn, of Cooksville Brick Co.

Committees

The branch activities for the year were in the hands of the following committees:—

Papers	E. G. Ryley, A.M.E.I.C. (Chairman)
	E. A. Stone, M.E.I.C.
	O. Rolfson, A.M.E.I.C.
Entertainment	R. J. Desmarais, A.M.E.I.C. (Chairman)
	W. B. Pennock, Jr.E.I.C.
	R. C. Leslie, Jr.E.I.C.
	W. A. Messenger, S.E.I.C.
	J. H. Bradley, A.M.E.I.C.
Membership	A. E. West, A.M.E.I.C. (Chairman)
	Fred. Stevens, A.M.E.I.C.
	G. V. Davies, A.M.E.I.C.
	H. J. Coulter, Jr.E.I.C.
By-laws	Harvey Thorne, M.E.I.C.
Publicity	J. Clark Keith, A.M.E.I.C.
Nominating	M. E. Brian, A.M.E.I.C.
Assistant Secretary	A. W. Hammersley, A.M.E.I.C.

The thanks of the secretary are gratefully tendered to the chairmen and all the committees, and especially to Mr. Hammersley, who assisted in the sending out of the cards during the spring term.

Financial Statement

Receipts

Balance in bank, Dec. 15, 1926	$101.92	
Headquarters	232.48	
Meals at meetings	167.75	
Rebates due from Headquarters	3.00	
		$505.15

Expenditures

Meals at meetings	$196.75	
Printing notices	32.63	
Entertainment	19.85	
Cigars	22.50	
Lantern operator and tips to steward	26.50	
Postage, telegram, typing, etc.	5.75	
Balance on hand	198.17	
Rebates due from Headquarters	3.00	
		$505.15

Respectfully submitted,

C. G. R. Armstrong, A.M.E.I.C., *Secretary-Treasurer.*

Calgary Branch

The President and Council,—

On behalf of the Executive Committee, we beg to submit the following report on the activities of the Calgary Branch for the year ending December 31st, 1927:—

Officers

The slate of officers elected on March 13th, 1926, held office until March 12th, 1927. The following is a list of the officers elected on March 12th, 1927, for the branch year 1927-1928:—

Chairman	F. K. Beach, A.M.E.I.C.
Vice-Chairman	Thos. Lees, A.M.E.I.C.
Secretary-Treasurer	H. R. Carscallen, A.M.E.I.C.
Committee	J. H. Ross, A.M.E.I.C., Past-Chairman
	F. J. Robertson, A.M.E.I.C.
	J. J. Hanna, A.M.E.I.C.
	F. M. Steel, M.E.I.C.
Ex-officio	S. G. Porter, M.E.I.C.
	A. L. Ford, M.E.I.C.
Auditors	O. H. Hoover, A.M.E.I.C.
	J. C. Milligan, A.M.E.I.C.
Branch Editor	W. St. J. Miller, A.M.E.I.C.

Membership

The membership of the branch is as follows:—

	Resident	Non-Resident	Total as at Dec. 31, 1927	Total at end previous year
Members	20	6	26	25
Associate Members	47	23	70	66
Juniors	3	1	4	6
Students	1	1	2	3
Branch Affiliates	14	..	14	16
Totals	85	31	116	116

Meetings

Seven executive meetings were held during the year in taking care of the business of the branch.

General meetings, dinners, inspections, trips, etc., were as follows:—

Jan. 5.—Annual dinner.

Jan. 20.—"**Mining at Kimberly and Smelting Operations at Trail,**" by B. L. Thorne, M.E.I.C., Coal Mines Branch, Canadian Pacific Railways, Department of Natural Resources, Calgary.

Feb. 4.—"**The Coming Biological Age,**" by Dr. R. W. Boyle, F.R.S.C., M.E.I.C., Dean of the Faculty of Applied Science, University of Alberta.

Feb. 17.—"**Forest Conservation and Timber Preservation,**" by A. S. Dawson, M.E.I.C., chief engineer, Canadian Pacific Railway, Department of Natural Resources.

Mar. 3.—"**The Development of the Art of Communication,**" by A. M. Mitchell, auditor, Alberta Government Telephones, Edmonton.

Mar. 12.—Annual meeting.

June 4.—Inspection of the new plant of the Riverside Ironworks, Limited, Calgary.

June 25.—Inspection of local exchanges of the Alberta Government Telephone System.

Aug. 20.—Picnic to Calgary Power Company's plants, Seebe, Alberta.

Sept. 3.—Dinner and special meeting to discuss items on the proposed agenda of the Plenary Meeting of Council in Montreal, October 10, 11 and 12. Representatives from the Edmonton and Lethbridge Branches attended.

Oct. 27.—Dance at the Palliser hotel.

Nov. 16.—"**The Manufacture of Cement,**" by W. D. Armstrong, A.M.E.I.C., superintendent of Canada Cement Company, Exshaw, Alta.

Dec. 8.—"**The Geology of the Foothills in Relation to Petroleum,**" by Dr. John A. Allan, Professor of Geology, University of Alberta.

The average attendance at the above meetings was 52.

Financial Statement

(For year ending December 31, 1927)

Assets and Liabilities

Assets

Cash in bank	$510.49	
Value of bonds (net)	781.55	
Fees collectable from Branch Affiliates	12.00	
Rebates as per wire from Headquarters, 31/12/27	16.20	
		$1,320.24
Liabilities		Nil
Net value of assets at Dec. 31, 1926		$1,406.95
Decrease in value of assets		$86.71

Revenue and Expenditure

Revenue

Interest on bonds and savings	$ 61.47	
Proceeds from maturity of 3 Dom. of Canada bonds @ $100	300.00	
Rebates	270.00	
Branch news	32.13	
Branch Affiliates	30.00	
		$693.60

Expenditure

Expenses for meeting and speakers	$303.62	
Stenographic services	50.50	
Printing and miscellaneous expenditures	125.54	
		$479.66
		$213.94
Bank balance at Dec. 31, 1927	$510.49	
Rebates as per wire from Headquarters, 31/12/27	16.20	
	$526.69	
Bank balance at Dec. 31, 1926	312.75	
		$213.94

Audited and found correct,

J. C. Milligan, A.M.E.I.C. }
O. H. Hoover, A.M.E.I.C. } Auditors.

Respectfully submitted,

H. R. Carscallen, A.M.E.I.C., *Secretary-Treasurer.*
F. K. Beach, A.M.E.I.C., *Chairman.*

Cape Breton Branch

The President and Council,—

The Executive Committee of the Cape Breton Branch submits the following report of the branch activities for the year 1927:—

The annual dinner was held December 6th, 1927, and W. E. Clarke, M.E.I.C., was appointed chairman.

The following compose the Executive Committee:—

Chairman	W. E. Clarke, M.E.I.C.
Vice-Chairman	M. Dwyer, A.M.E.I.C.
Secretary-Treasurer	E. L. Ganter, A.M.E.I.C.
Executive	S. C. Mifflen, A.M.E.I.C.
	W. J. Ripley, M.E.I.C.
Ex-officio	W. S. Wilson, A.M.E.I.C.
	W. C. Risley, M.E.I.C.

The number of resident branch members last year was 36; it is now 37.

The following meetings were held during the year:—

Jan. 31.—"**Welland Ship Canal,**" by Alex. J. Grant, M.E.I.C., Department of Railways and Canals.

Feb. 8.—"**Sidelights of Radio Broadcasting,**" by F. W. Johnson, Northern Electric Company, Halifax.

Mar. 8.—"**Telephone Transmission,**" by W. E. Jefferson, Maritime Telephone and Telegraph Company, Halifax.

May 17.—"**Electric Motors for Various Applications,**" by C. H. Wright, M.E.I.C., Canadian General Electric Company, Halifax.

"**Industrial Motor Control,**" by A. G. Turnbull, Canadian General Electric Company.

Dec. 15.—"**Motion Pictures on Wireless and Transformer Construction.**"

On September 10th the Second Triennial Congress paid a visit to Sydney, and our Institute, combined with the Mining Society of Nova Scotia, conducted the party on an inspection trip of the Dominion Iron and Steel Company's plant and the coal mines of the Dominion Coal Company.

Financial Statement

On hand, April 26, 1927	$152.91	
Receipts		
Rebates from Headquarters for dues	$ 88.80	
Sale of dinner tickets	38.50	
Branch dues	97.10	
		$377.31
Expenditures		
Rent to Nov. 1, 1927	$135.00	
Expenses, presentation and dinner, D. W. J. Brown, Jr.E.I.C.	69.50	
Expenses, annual dinner	60.15	
Expenses, Mining Society meeting	15.00	
Printing	4.58	
Postage, stationery, telegrams	3.78	
Presentations and entertaining	10.00	
		$298.01
Leaving a balance on hand of		$79.30

Respectfully submitted,

W. S. Wilson, 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 herewith the following report on the activities of the branch during the year 1927.

Officers

The branch officers, elected on April 16th and approved by Council on May 20th, for the branch year 1927-28, were as follows:—

Chairman	A. I. Payne, M.E.I.C.
Vice-Chairman	W. R. Mount, A.M.E.I.C.
Secretary-Treasurer	H. R. Webb, Jr.E.I.C.
Committee	C. A. Robb, M.E.I.C.
	H. P. Keith, A.M.E.I.C.
	R. W. Ross, A.M.E.I.C.
	W. J. Cunningham, A.M.E.I.C.
Ex-officio	T. W. White, A.M.E.I.C.
	R. W. Boyle, M.E.I.C.

Meetings

Four Executive Committee meetings were held during the year. A programme committee consisting of C. A. Robb, M.E.I.C., R. W. Ross, A.M.E.I.C., and H. R. Webb, Jr.E.I.C., was appointed to develop the programme of meetings for the winter season, 1927-28.

Lectures and papers given before the branch were as follows:—

Mar. 14.—"**Forest Conservation and Timber Preservation,**" by A. S. Dawson, M.E.I.C., chief engineer, Department of Natural Resources, Canadian Pacific Railway, Calgary, Alberta. Attendance, 45.

Oct. 17.—"**Timber Conservation,**" by R. W. Ross, A.M.E.I.C., division engineer, Canadian National Railways, Edmonton, Alberta. Attendance, 20.

Nov. 21.—"**The St. Lawrence Waterway,**" by Dr. D. A. MacGibbon, professor of political economy at the University of Alberta, Edmonton. Attendance, 40.

Dec. 19.—"**Fuel vs. Water Power for the Generation of Electrical Power.**" This was the subject of an open discussion. The discussion was led by N. C. Pitcher, professor of mining engineering at the University of Alberta, and W. J. Cunningham, A.M.E.I.C., superintendent of the city power plant and street railway department, Edmonton. It was expected that R. A. Brown and G. H. Thompson, A.M.E.I.C., of Calgary, would help lead the discussion, but they were unable to attend. Attendance, 55.

A special meeting was held on July 18th on the occasion of the visit of R. J. Durley, M.E.I.C., general secretary. Mr. Durley addressed the meeting on the forthcoming Plenary Council Meeting in October, and his remarks were much appreciated by all.

All except the March meeting were preceded by branch dinners.

We would like to mention that special co-operation between the Northern Alberta branch of the Canadian Institute of Mining and Metallurgy and the Edmonton Branch of The Engineering Institute of Canada is bringing good results in stimulating interest and attendance. Meetings of the two branches alternate on the first and third Mondays of each month. A common programme was printed and distributed to members of both bodies and members of both Institutes are invited to all meetings. The December meeting mentioned above was arranged as a joint meeting.

MEMBERSHIP

The branch membership now stands as follows:—

	Resident	Non-resident
Members	16	3
Associate Members	28	6
Juniors	3	2
Students	9	1
Branch Affiliates	2	0
Total	70	

Increased interest in branch activities on the part of engineering students at the University of Alberta has been quite apparent this season.

FINANCIAL STATEMENT

Receipts

Balance on hand, Jan. 1, 1927	$147.53	
May 7, dues, Branch Affiliate	5.00	
June 15, rebates from Headquarters	91.50	
Oct. 25, " " "	12.90	
Dec. 20, " " "	18.90	
Dec. 31, rebates due from Headquarters	2.40	
		$278.23

Expenditures

Expenses, meetings and speakers	$ 37.85	
Stenographic services	11.35	
Printing, postage, miscellaneous	28.29	
Expenses, three delegates to Calgary	63.55	
Balance on hand, Dec. 31, 1927	137.19	
		$278.23

Respectfully submitted,

A. I. PAYNE, M.E.I.C., *Chairman.*
H. R. WEBB, JR.E.I.C., *Secretary-Treasurer.*

Halifax Branch

The President and Council,—

During the year 1927 the Halifax Branch held six meetings; five regular monthly meetings and the annual meeting and dinner, as follows:—

Jan. 6.—"**The Life of Sir Sanford Fleming,**" by Capt. The Hon. J. F. Cahan, A.M.E.I.C. Attendance, 46.

Jan. 27.—"**Welland Ship Canal,**" by Alex. J. Grant, M.E.I.C. Attendance, 50.

Mar. 4.—"**Maintenance of Gravel Roads,**" by Lieut.-Col. J. M. Miller; "**Construction of Gravel Roads,**" by A. B. Blanchard, M.E.I.C.; "**Highway Bridges,**" by J. E. Belliveau, A.M.E.I.C.; "**Prevention of Dust,**" by H. F. Laurence, M.E.I.C. Attendance, 35.

Oct. 20.—"**Engineering Education,**" by Prof. F. R. Faulkner, M.E.I.C. Attendance, 38.

Nov. 24.—"**Canadian History,**" by H. F. Munro, Ph.D. Attendance, 27.

Dec. 22.—Annual meeting and dinner. "**Subjects for Engineering Research,**" by Hon. Mr. Justice Mellish. Attendance, 73.

FINANCIAL STATEMENT

Cash on hand, Jan. 1, 1927:		
at Halifax	$33.41	
at Montreal	23.87	
		$57.28
Receipts		
Rebates	$205.00	
Branch news	23.31	
Meetings	42.60	
Interest on bank deposit	2.15	
		$273.06
		$330.34
Expenditures		
Printing, 1926	$ 64.00	
" 1927	44.10	
Postage	15.50	
Meetings	149.36	
Miscellaneous	4.90	
		$277.86
Cash on hand, Dec. 31, 1927:		
at Halifax	$28.23	
at Montreal	24.25	
		$52.48

Audited, January 6th, 1928.

W. J. DEWOLFE, A.M.E.I.C.
W. B. MACKAY, A.M.E.I.C.

Respectfully submitted,

C. A. FOWLER, M.E.I.C., *Chairman.*
K. L. DAWSON, A.M.E.I.C., *Secretary-Treasurer.*

Hamilton Branch

The President and Council,—

The Executive Committee of the Hamilton Branch submit the following report for the year 1927:—

OFFICERS

The branch year dates from June 1st, but this year the same executive exists for each half-year.

Chairman	L. W. Gill, M.E.I.C.	
Vice-Chairman	W. L. McFaul, M.E.I.C.	
Secretary-Treasurer and Councillor	W. F. McLaren, M.E.I.C.	
Members	H. A. Lumsden, M.E.I.C.	(1 yr.)
	G. R. Marston, A.M.E.I.C.	(1 yr.)
	F. P. Adams, A.M.E.I.C.	(2 yrs.)
	A. H. Munson, A.M.E.I.C.	(2 yrs.)
Branch News Editor	J. R. Dunbar, A.M.E.I.C.	
Past Chairman	C. J. Nicholson, A.M.E.I.C.	
Past Secretary-Treasurer	H. B. Stuart, A.M.E.I.C.	

MEETINGS

The following meetings were held:—

Jan. 7.—"**Arc Welding of Structural Steel Buildings,**" by A. M. Candy, of the Westinghouse Company, Pittsburgh, Pa. Attendance, 200.

Jan. 26.—"**Engineering Works and Traffic on the Great Lakes,**" by Lieut.-Col. H. J. Lamb, D.S.O., M.E.I.C. Attendance, 50.

Feb. 16.—"**Electric Control of Bridges,**" by J. P. Fraser; "**Street Illumination,**" by G. F. Mudgett; "**The Manufacture of Pig Iron,**" by H. G. Girvin; "**Traffic Signals,**" by A. R. Hannaford, A.M.E.I.C. Attendance, 45.

Mar. 16.—"**The Determination of the Strength of Concrete,**" by A. M. Jackson, A.M.E.I.C.; "**The Sewage Disposal Plant at Kitchener,**" by Stanley Shupe, M.E.I.C.; "**Caterpillar Tractors,**" by W. H. Mackie. Attendance, 30.

Apr. 22.—"**A Mechanical Analogy of Transmission Line Characteristics,**" by R. C. Bergvall, of the Westinghouse Company, Pittsburgh. This was the annual joint meeting with the Toronto Branch of the A.I.E.E., held in the Westinghouse auditorium. Attendance, 187.

Sept. 19, 21 and 22.—"**The Design and Control of Concrete Mixtures,**" by Rufus S. Phillips, of the Lewis Institute, Chicago. Attendance, 50.

Oct. 28.—Inspection trip to Welland Ship Canal under the auspices of the Niagara Peninsula Branch, followed by dinner at the Welland House, St. Catharines, and a meeting afterwards at the Collegiate Institute, where addresses were given as follows:—
"**The Welland Ship Canal,**" by A. J. Grant, M.E.I.C.
"**Conserving Niagara Falls,**" by F. D. Corey.
"**St. Lawrence Power,**" by H. G. Acres, M.E.I.C.
"**The Peace Bridge,**" by Mr. Lupfer.

Dec. 12.—"**Aviation,**" by Major-Gen. J. H. MacBrien, C.B., C.M.G., D.S.O. Attendance, 50.
About 35 were present from the Hamilton Branch.

MEMBERSHIP

	Dec. 31st, 1926 Res.	Non.-res.	Total	Dec. 31st, 1927 Res.	Non.-res.	Total
Members	18	6	24	16	8	24
Associate Members	40	10	50	41	19	60
Juniors	8	4	12	7	4	11
Students	24	13	37	31	14	45
Branch Affiliates	29	0	29	28	0	28
			152			168

FINANCIAL STATEMENT

Receipts

Brought forward	$601.38	
Rebates	192.60	
Branch news	50.81	
Branch Affiliate fees	121.50	
Journal subscriptions	14.00	
		$980.29

Expenditures

Printing and postage	$ 80.44	
Rent of halls	29.00	
Refreshments	40.10	
Sundry expenses	6.30	
Stenographer	50.00	
Delegate to Quebec	50.00	
Journal subscriptions	14.00	
Balance	710.45	
		$980.29

Respectfully submitted,

W. F. McLaren, M.E.I.C., *Secretary-Treasurer.*

Kingston Branch

The President and Council,—

The Executive Committee of the Kingston Branch begs to submit the following report for the year 1927.

During the year five papers were presented to the branch, as follows:—

Feb. 1.—"**Petroleum, With Particular Reference to Western Canada,**" by Dr. Bruce Rose, of the geology department, Queen's University.

Mar. 11.—"**The Lighthouse Service of Canada,**" by J. G. Macphail, M.E.I.C., commissioner of lights in the Department of Marine and Fisheries, Dominion Government, Ottawa.

Mar. 23.—"**Long Span Bridges,**" by Prof. C. R. Young, M.E.I.C., of the department of civil engineering, University of Toronto.

Oct. 18.—"**The Differential Vacuum System of Steam Heating,**" by Mr. M. W. Shears, heating engineer of the C. A. Dunham Company, Limited, Toronto.

Dec. 6.—"**Ice Engineering,**" by Professor Howard T. Barnes, M.E.I.C., of the physics department of McGill University.

Membership

Honorary Member	1
Members	14
Associate Members	14
Junior Members	3
Student Members	8
Affiliate	1
Total	41

This is a reduction of one from the previous year.

Executive Committee

January to October		October to December
Prof. L. T. Rutledge, M.E.I.C.	Chairman	Prof. D. S. Ellis, A.M.E.I.C.
Prof. D. S. Ellis, A.M.E.I.C.	Vice-Chair.	Prof. W. L. Malcolm, M.E.I.C.
G. J. Smith, A.M.E.I.C.	Sec.-Treas.	D. G. Geiger, S.E.I.C.
J. M. Campbell, M.E.I.C.	Executive	Major LeR. F. Grant, M.E.I.C.
Dr. L. F. Goodwin, M.E.I.C.		A. G. MacLachlan, JR.E.I.C.
Prof. A. Jackson, A.M.E.I.C.		Dr. L. F. Goodwin, M.E.I.C.
R. J. McClelland, A.M.E.I.C.	*Ex-officio*	Prof. L. T. Rutledge, M.E.I.C.
Major LeR. F. Grant, M.E.I.C.		Major LeR. F. Grant, M.E.I.C.
	Programme Committee	Prof. W. L. Malcolm, M.E.I.C.
		Prof. A. Jackson, A.M.E.I.C.
		G. J. Smith, A.M.E.I.C.

Financial Statement

Receipts

Balance brought forward		$101.79	
Rebates on fees		58.80	
Branch news		40.75	
Dinner, March 30		16.00	
Bank interest		2.55	
Receivables		7.80	
			$227.69

Expenditures

Printing and postage		$ 13.06	
Advertising		9.00	
Rental of halls		10.50	
Expenses of lecturers		23.30	
Dinner, March 30		34.80	
Secretary		50.00	
Balance carried forward:			
Bank	$76.75		
Cash	2.48		
Receivables	7.80		
		87.03	
			$227.69

Respectfully submitted,

Prof. D. S. Ellis, M.E.I.C., *Chairman.*

D. G. Geiger, S.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, 1927, there were 36 corporate members and 8 non-corporate members, and on December 31st, 1927, there were 39 corporate members and 13 non-corporate members, showing a gain during the year of 3 corporate and 5 non-corporate members.

Meetings

Two meetings were held during the year, due to the fact that there was a big boom in construction work in the district, which kept our members very busy, and also, the Lakehead Branch, taking in the two cities of Port Arthur and Fort William, each with its separate service clubs and other organizations, is a difficult branch at which to find a night suitable to the members of both cities.

May 18.—A business meeting of the branch was held, after which the members joined the Port Arthur Chamber of Commerce at a luncheon at the Prince Arthur hotel, at which Prof. Wallace, of Manitoba University, gave a most interesting talk on "**Northland Development.**"

July 11.—Our General Secretary, R. J. Durley, M.E.I.C., arrived. Some of our members took him around the harbour in a yacht and later entertained him at luncheon.

Officers

The officers for the past year were as follows:—

Chairman	C. B. Symes, A.M.E.I.C.
Vice-Chairman	D. G. Calvert, A.M.E.I.C.
Secretary-Treasurer	Geo. P. Brophy, A.M.E.I.C.
Executive Committee	D. C. Chisholm, M.E.I.C.
	J. C. Meader, A.M.E.I.C.
	W. H. Souba, M.E.I.C.
	G. R. Duncan, A.M.E.I.C.

Financial Statement

Receipts

Balance in bank, Dec. 31, 1926	$130.96	
Rebates on fees	69.90	
" due and not deposited	8.40	
Interest	3.19	
		$212.45

Expenditures

Telegrams	$ 2.19	
Postage	3.00	
Printing	1.60	
Sundries	30.89	
Balance in bank, Dec. 31, 1927	174.77	
		$212.45

The following members were nominated in connection with the annual elections of The Institute for Councillors to represent the Lakehead Branch on the Council of The Institute:—

R. B. Chandler, M.E.I.C., Port Arthur.
G. R. Duncan, A.M.E.I.C., Fort William.

Respectfully submitted,

Geo. P. Brophy, A.M.E.I.C., *Secretary-Treasurer.*

Lethbridge Branch

The President and Council,—

On behalf of the Executive Committee of the Lethbridge Branch, the following report for the year ending December 31st, 1927, is submitted:—

The annual meeting of the branch was held on March 19th, 1927, at the conclusion of a most interesting and instructive season.

Officers

In the selection of new officers for the year 1927-28, the following gentlemen were elected:—

Chairman	Geo. S. Brown, A.M.E.I.C.
Vice-Chairman	N. Marshall, M.E.I.C.
Secretary-Treasurer	Wm. Meldrum, A.M.E.I.C.
Executive	N. H. Bradley, A.M.E.I.C.
	C. S. Clendening, A.M.E.I.C.
	J. B. deHart, M.E.I.C.
Ex-officio	J. T. Watson, A.M.E.I.C.
	R. Livingstone, M.E.I.C.
Auditors	C. S. Clendening, A.M.E.I.C.
	W. L. McKenzie, A.M.E.I.C.

During the year the branch lost the support of one of our most active members, J. T. Watson, A.M.E.I.C., who was chairman during the previous year, he having accepted the position of superintendent of the steam power plant of the East Kootenay Electric Light and Power Company.

MEETINGS

Five executive meetings were held during the year and ten regular meetings, with an average attendance at the latter of 35.

Jan 8.—"**Field Control of Strength of Concrete by Water Cement Ratio,**" by K. MacKenzie, service engineer, Canada Cement Company, Winnipeg.

Jan. 22.—"**Water Power Development in Canada,**" by A. L. Ford, M.E.I.C., district chief engineer, Water Power Branch, Department of the Interior, Calgary.

Feb. 5.—"**Irrigation Possibilities of Southern Alberta,**" by B. Russell, M.E.I.C., reclamation engineer, Department of the Interior, Calgary.

Feb. 19.—"**Artillery Development in the Late War,**" by Brig.-Gen. J. S. Stewart, D.S.O., Lethbridge.

Mar. 5.—"**Mine Timber Tests,**" by Prof. R. S. L. Wilson, M.E.I.C., University of Alberta, Edmonton.

Mar. 19.—Annual meeting.

Oct. 15.—"**Explosives,**" by C. E. Wood, Canadian Giant, Limited, Calgary.

Oct. 29.—"**Power Plant and Combustion Problems,**" by J. G. Hall, A.M.E.I.C., Combustion Engineering Corporation, Winnipeg.

Nov. 12.—"**Methods of Printing, Past and Present,**" by F. T. Robins, Robins Printing Company, Lethbridge.

Dec. 10.—"**Highway Construction and Maintenance,**" by N. H. Bradley, A.M.E.I.C., district engineer, Department of Public Works, Alberta Government, Lethbridge.

MEMBERSHIP

The membership of the branch is as follows:—

	Residents	Non-residents	Total
Members	8	0	8
Associate Members	24	6	30
Juniors	0	2	2
Students	0	1	1
Institute Affiliates	0	0	0
Branch Affiliates	25	0	25
	57	9	66

FINANCIAL STATEMENT

Receipts

Cash in bank, Dec. 31, 1926		$163.64	
Rebates from Headquarters		99.30	
" due from Headquarters, as per telegram		7.80	
Branch Affiliate fees		100.00	
Headquarters payment for branch news		19.87	
Bank interest		3.65	
			$394.26

Expenditures

Headquarters, Affiliates' Journal fees		$ 36.15	
Printing notices and cards		43.35	
Speakers' expenses		63.90	
Music and complimentary meals		39.75	
Telegrams, stenographers, express charges and stamps		31.61	
			214.76
Cash in bank, Dec. 31, 1927	$171.70		
Rebate due from Headquarters	7.80		
		179.50	
			$394.26
Accounts payable		nil	

We have examined the vouchers, papers and 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. } Auditors.
C. S. CLENDENING, A.M.E.I.C.

Respectfully submitted,

GEORGE S. BROWN, A.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 report for the year ending December 31st, 1927:—

During the year there were eight executive meetings, nine general meetings, a smoker and social, an inspection trip and a course of three lectures on concrete.

The year's activities began with the annual dinner meeting, held at the Blue Dragon Tea Room. Brig.-Gen. C. J. Armstrong, M.E.I.C., was the speaker and his subject was "**Some Military Engineering in the Great War.**" Solos were rendered during the meeting and the members joined in songs from The Institute's Song Sheet.

On February 23rd the members and friends gathered at the Armouries Annex for a smoker and social evening, as the guests of the 7th Field Company, Canadian Engineers. Entertainment and lunch proved an excellent means of promoting comradeship and good feeling among the members and of stimulating interest in the local branch.

A regular meeting was held in the board room of the Public Utilities Commission on March 16th. A very interesting paper on "**Recent Progress in Electric Welding**" was given by R. E. Smythies, M.E.I.C., of the Lincoln Electric Company. The paper was illustrated with lantern slides.

A special meeting was held in the city engineer's office on March 30th, at which Mr. Mackie, of the Best and Holt Caterpillar Tractor Company, showed moving pictures of tractors on various engineering jobs.

The April meeting, held on April 23rd, included an inspection trip to two of London's sewage disposal plants,—the South End plant and the East End plant,—where W. M. Veitch, A.M.E.I.C., engineer of sewage disposal for London, acted as guide. Following the visit to the plants, Mr. Veitch read a paper on "**The Principles of Sewage Disposal.**" At 6.00 o'clock lunch was served at the Armouries Annex.

The regular May meeting, on May 16th, was held in the Board of Education room in the Public Utilities Building. The branch was honoured by the presence of General Secretary R. J. Durley, M.E.I.C., who addressed the members on Headquarters' matters. E. Viens, M.E.I.C., director of testing laboratories, Department of Public Works of Canada, gave a paper on "**The Principles Involved in the Making of Economically Durable Concrete.**" The results of tests under Mr. Viens' direction proved very interesting.

An inspection trip was conducted on May 19th, when members of the branch were allowed to inspect the new Hotel London and the London Life building, both in course of construction. This inspection was made possible through the courtesy of the architects, John M. Moore and Company.

For the annual inspection trip the members of the branch motored to the New Peace bridge and the Horton Steel Works. The trip was arranged for August 6th and 7th to include the official opening of the bridge. The cars left London Saturday morning and returned Sunday evening.

On September 27th, 28th and 29th a course of three lectures on "**The Design and Control of Concrete Mixtures**" was given at the London Technical School. These lectures were given by arrangement with the Portland Cement Association by their lecturer, Mr. R. S. Phillips.

The October meeting was combined with an inspection trip to the quarries of the Beachville White Lime Company on Saturday, October 15th. The party motored to Beachville for the inspection and then to Woodstock, where supper was served at the Hotel Oxford and a paper by Mr. Bruce Matson, of the Beachville White Lime Company, on "**Limestone and Its Derivatives**" was read.

An address by D. M. Bright, A.M.E.I.C., on "**Electric Steam Generation**" was given at the regular meeting on November 23rd. The members were also interested in a full report of the recent Plenary Session of Council, given by W. C. Miller, A.M.E.I.C., the branch representative on Council.

The last meeting of the year was held in the Public Utilities board room on December 28th. Jas A. Vance, A.M.E.I.C., vice-chairman of the branch, gave an interesting talk on highway and bridge contracts with which he had been connected during fifteen years of engineering and contracting. The address was illustrated with photographs showing various phases of the work on these jobs. During a social hour at the end of the meeting, light refreshments were served.

The average attendance at meetings during the year showed an increase of fifteen over the previous year. It has been the policy of the branch to invite to its meetings many contractors, architects and others who might be interested in the subjects to be discussed.

MEMBERSHIP

The membership of the London Branch is as follows:—

	1926	1927
Members	12	13
Associate Members	30	31
Juniors	6	5
Students	10	12
Affiliates	..	1
Total	58	62

FINANCIAL STATEMENT

(For year ending December 31st, 1927)

Receipts

Balance in bank, Jan. 1, 1927	$181.79	
Collections from members at dinners	38.00	
Rebates from Headquarters:		
Dues	91.50	
Branch news	25.15	
From Chairman and Secretary for Christmas gifts	1.50	
		$337.94
Rebates due from Headquarters		.90
Total receipts		$338.84

Expenditures

Notices, printing	$ 13.44	
Postage	9.00	
Cigars for dinners and smoker	12.75	
Telegrams and long-distance calls	.98	
Annual dinner—Jan. 19	24.00	
Entertaining dinner guests and speakers' expenses	11.50	
Janitor services	13.00	
Entertaining, catering and lunches	82.25	
Wedding and Christmas gifts	25.25	
Flowers	6.00	
Bank balance, Dec. 31, 1927	139.77	
Rebates due from Headquarters	.90	
Total expenditures		$338.84

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. R. SMITH, A.M.E.I.C. }
R. W. GARRETT, A.M.E.I.C. } Auditors.

Respectfully submitted,

JNO. R. ROSTRON, 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 eighth annual report of the Moncton Branch.

The Executive Committee held nine meetings during the year. There were ten meetings of the branch held, seven of which were supper-meetings, and one was open to the public. One meeting was held at Sackville for the benefit of the engineering students of Mount Allison University.

Our membership at present consists of 54 members, as follows:—

	Resident	Non-resident
Members	8	2
Associate Members	23	6
Juniors	3	2
Students	6	3
Affiliates	1	..
Totals	41	13

The annual meeting of the branch was held on May 19th, 1927. The following officers were elected for 1927-28:—

Chairman	G. C. Torrens, A.M.E.I.C.
Vice-Chairman	H. J. Crudge, 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.
	M. J. Murphy, A.M.E.I.C.
	H. B. Titus, A.M.E.I.C.

The members of the executive committee in addition to the above are as follows:—

Jas. Pullar, A.M.E.I.C.
G. E. Smith, A.M.E.I.C.
F. L. West, M.E.I.C.
A. S. Gunn, A.M.E.I.C. (*Ex-officio*)
H. W. McKiel, M.E.I.C. (*Ex-officio*)

FINANCIAL STATEMENT

The financial statement for the year ending December 31st, 1927, is as follows:—

Revenue

Balance in bank, Jan. 1, 1927	$ 59.38	
Cash on hand	7.33	
Rebates on dues and branch news	110.35	
Tickets sold for supper-meetings	158.00	
Bank interest	2.03	
Rebates due from Headquarters	5.40	
		$342.49

Expenditures

Expenses of meetings	$163.25	
Postage	5.00	
Printing and advertising	31.05	
Telegrams and telephones	3.95	
Express charges	6.72	
Miscellaneous	10.22	
Balance in bank	114.29	
Cash on hand	2.61	
Rebates due from Headquarters	5.40	
		$342.49

Respectfully submitted,

G. C. TORRENS, A.M.E.I.C., *Chairman.*
V. C. BLACKETT, A.M.E.I.C., *Secretary-Treasurer.*

Montreal Branch

The President and Council,—

On behalf of the Executive Committee, we beg to make the following report covering the activities of the Montreal Branch for the year 1927:—

The personnel of the Executive Committe was comprised as follows:—

C. V. Christie, M.E.I.C.	Chairman, 1927.	
F. C. Laberge, M.E.I.C.	Vice-Chairman, 1927.	
A. Duperron, M.E.I.C.	Elected, 1926.	
A. R. Ketterson, A.M.E.I.C.	" "	
J. A. McCrory, M.E.I.C.	" "	
J. G. Caron, A.M.E.I.C.	" 1927.	
D. Hillman, M.E.I.C.	" "	
D. C. Tennant, M.E.I.C.	" "	
C. K. McLeod, A.M.E.I.C.	Secretary-Treasurer.	
J. M. R. Fairbairn, M.E.I.C.	*Ex-officio,* Past President, E.I.C.	
Arthur Surveyer, M.E.I.C.	" " " "	
C. J. Desbaillets, M.E.I.C.	" " Branch Chairman.	
W. C. Adams, M.E.I.C.	" Councillor, E.I.C.	
J. L. Busfield, M.E.I.C.	" " "	
J. T. Farmer, M.E.I.C.	" " "	
J. H. Hunter, M.E.I.C.	" " "	
Geo. R. MacLeod, M.E.I.C.	" " "	
C. M. McKergow, M.E.I.C.	" " "	
P. L. Pratley, M.E.I.C.	" " "	

The Executive Committee met nine times during the year, and the attendance at all meetings was good, the average attendance being 10. R. J. Durley, M.E.I.C., attended several of these meetings throughout the year.

PAPERS AND MEETINGS COMMITTEE

The Papers and Meetings Committee consisted of a chairman, vice-chairman, together with the chairman and vice-chairman of the various sections of the branch. In order to co-relate the activities of the Papers and Meetings Committee with the Executive Committee, the chairman was chosen from the Executive of the branch. The following is the personnel of this Committee:—

Chairman — A. Duperron, M.E.I.C.
Vice-Chairman — G. A. Wallace, A.M.E.I.C.

Civil Section	J. S. Hall, A.M.E.I.C.	Chairman
	H. Massue, A.M.E.I.C.	Vice-Chairman
Electrical Section	L. A. Kenyon, A.M.E.I.C.	Chairman
	N. L. Morgan, A.M.E.I.C.	Vice-Chairman

Mechanical Section	F. S. B. Heward, A.M.E.I.C.	Chairman
	G. H. Dickson, A.M.E.I.C.	Vice-Chairman
Municipal Section	J. F. Brett, A.M.E.I.C.	Chairman
	J. A. Jette, M.E.I.C.	Vice-Chairman
Railway Section	J. A. Ellis, A.M.E.I.C.	Chairman
	J. H. Forbes, A.M.E.I.C.	Vice-Chairman
Students' Section	A. N. Budden, Jr.E.I.C.	Chairman
	Marc Boyer, S.E.I.C.	Vice-Chairman

The meetings for the first half of the year were arranged by the 1926 committee. The meetings from October 1st to April 26th have been arranged by Mr. Duperron's committee.

The complete list of all these meetings with the details of the papers and the names of the authors is appended.

The general attendance at these meetings has not been very large, and it would seem that a concentrated effort should be made by the more active members to arouse the interest of other members, and to encourage attendance.

This matter is given fuller attention in the report of the Reception Committee, an extract of which is as follows:—

"There has been a gradual falling-off in attendance during the past two years, the average total attendance for 1925 being 110, for 1926, 98, and for 1927, 92. This would appear to be entirely out of keeping with the total resident membership of the branch and with the quality of the papers presented.

"Out of a total resident membership numbering approximately 1,000, 475 have not registered attendance at a single meeting in the last two years, and a further 415 have not registered at more than five meetings in the same period. It would therefore appear that only about ten per cent of the membership can be considered as being active."

Membership

The membership of the branch is given in the following table, and shows no appreciable change from last year except a slight increase in the number of resident Associate Members:—

		1924	1925	1926	1927
Honorary Member	Resident	1	1	1	1
Members	Resident	205	212	217	224
	Non-resident	16	15	8	9
Associate Members	Resident	410	406	399	413
	Non-resident	46	48	24	25
Juniors	Resident	70	65	76	79
	Non-resident	13	12	8	8
Students	Resident	285	280	249	212
	Non-resident	30	35	7	11
Affiliates	Institute	10	11	14	17
	Branch	28	20	19	22
	Total	1,114	1,105	1,022	1,021

Membership Committee

A Membership Committee was appointed under the chairmanship of D. C. Tennant, M.E.I.C., and their efforts have met with considerable success. There is an increase of seven in the resident members and of fourteen in the number of resident associate members, the total membership of the branch standing at 1,021, as against 1,023 reported a year ago. Due to the policy of Headquarters of removing from the lists those members who have been constantly in arrears in the payment of dues, there has been a large number of names dropped from the roll. Therefore, the fact that there is no appreciable decrease in the membership shows that the Membership Committee has done good work.

It is with deepest regret that we have to record the loss to the branch, by death, during the past year of the following members:—

B. J. Forrest, M.E.I.C.
W. L. Scott, M.E.I.C.
G. C. Read, A.M.E.I.C.
R. C. Forbes, S.E.I.C.

Reception Committee

The Reception Committee, under the chairmanship of H. G. Thompson, Jr.E.I.C., was composed of the following members:—

A. B. Rogers, A.M.E.I.C.
E. T. Harbert, S.E.I.C.
J. B. O. Saint-Laurent, A.M.E.I.C.
D. K. Addie, Jr.E.I.C.
T. M. Dechene, A.M.E.I.C.
W. V. Cheshire, S.E.I.C.

Members of this committee have been on hand at every meeting of the branch, and have added materially to the sociability of the meetings. It is recommended that members bringing in visitors or other members not acquainted with the membership as a whole should make use of this committee on Thursday evenings.

In addition, this committee has kept a record of the attendance at the meetings, the results of which are remarked upon in more detail above.

Publicity Committee

The Publicity Committee, composed of two members,—H. W. B. Swabey, M.E.I.C., and Wm. McG. Gardner, A.M.E.I.C.,—has devoted its attention mainly to reporting particulars of the meetings for the Journal, including a synopsis of the papers presented. They have also been active in securing the co-operation of the daily papers in giving publicity to the meetings of the branch.

During the year over seven pages of Branch News have been published in the Journal, bringing in a revenue of $79.68 to the branch funds.

The proper functioning of this committee in its publicity work was made much more difficult by the fact that in many cases copies of the papers to be read were not available before the meeting.

Special Committees

Throughout the year, in addition to the Membership Committee other special committees were appointed when required. Amongst those might be specially mentioned:—

(1) A committee to study the best method of co-operating with the Board of Trade in case where such co-operation might seem advisable. In this connection, members of the branch were appointed to confer with a committee of the Board of Trade in a study of the best methods of Smoke Abatement. C. M. McKergow, M.E.I.C., R. DeL. French, M.E.I.C., and F. A. Combe, M.E.I.C., have given a considerable amount of time to this important study.

(2) A committee under the chairmanship of J. A. McCrory, M.E.I.C., was appointed to arrange the details of a trip to inspect the new hydro-electric developments on the Gatineau river, as the guests of the Gatineau Power Company. The great success of this trip was in large measure due to the untiring efforts of the chairman and J. L. Busfield, M.E.I.C., and the secretary.

(3) A committee, under the chairmanship of J. L. Busfield, M.E.I.C., is making all arrangements for the Annual General and Professional Meeting, which is to be held in Montreal on February 14th, 15th and 16th.

Nominating Committee

Following the requirements of the By-laws, a Nominating Committee was appointed to make nominations for the 1928 Executive Committee. Three members, F. A. Combe, M.E.I.C., G. E. Templeman, M.E.I.C., and F. S. B. Heward, A.M.E.I.C., were appointed at the special general meeting of the branch held on November 3rd, while J. G. Caron, A.M.E.I.C., and C. K. McLeod, A.M.E.I.C., were later appointed by the Executive Committee. This committee made the nominations which were placed before the membership for ballot.

This committee, in accordance with By-laws, also acted as scrutineers, and the results of elections for the year 1928 are as follows:—

Chairman	F. C. Laberge, M.E.I.C.
Vice-Chairman	J. A. McCrory, M.E.I.C.
Member of Executive	R. DeL. French, M.E.I.C.
" " "	H. Massue, A.M.E.I.C.
" " "	E. A. Ryan, M.E.I.C.

Meetings Held During 1927

Jan. 6.—"**Recent Development in Boiler Furnaces,**" by B. N. Broido. Attendance, 87.

Jan. 13.—"**Mercury-Arc Rectifiers,**" by Othmar K. Marti. Attendance, 114.

Jan. 20.—"**Power Film.**" Attendance, 143.

Jan. 27.—"**Railway Lands—Titles, Surveys, Leases and Taxes,**" by Frank Taylor, M.E.I.C. Attendance, 57.

Feb. 3.—"**Traffic Regulations by Automatic Signals,**" by K. W. Mackall. Attendance, 73.

Feb. 10.—"**Radium Experiments,**" by J. E. Gendreau, M.D. Attendance, 142.

Feb. 15-17.—Annual General and Professional Meeting at Quebec.

Feb. 24.—"**Aerial Surveying,**" by F. G. Wait. Attendance, 53.

Mar. 3.—"**The Scientific Method in Industry,**" by G. Percy Cole, M.E.I.C.. Attendance, 69.

Mar. 10.—"**The Purification of Water for Boiler Feed Purposes,**" by T. R. Duggan, Ph.D. Attendance, 47.

Mar. 17.—"**Locomotive Feed Water Heating,**" by W. C. Hamm. Attendance, 45.

Mar. 24.—"**General Geological Features of the District of Montreal,**" by A. Mailhot. Attendance, 76.

Apr. 7.—"**The Theory of Telephony Made Visible,**" by L. St. J. Haskill. Attendance, 133.

Apr. 14.—"**Manufacture and Uses of Carbon-Dioxide,**" by J. R. Donald, M.E.I.C. Attendance, 43.

Apr. 21.—"**Vallee Street Substation,**" by H. Milliken, M.E.I.C. Attendance, 82.

Apr. 28.—"**Gatineau Power Development,**" by W. E. Blue, A.M.E.I.C. Attendance, 120.

Oct. 6.—"**The Arc Welding of Structural Steel,**" by A. M. Candy. Attendance, 101.

Oct. 13.—"**Induction Regulators,**" by N. D. Seaton, A.M.E.I.C. Attendance, 64.

Oct. 20.—"**The Substructure of the Buctouche River Bridge,**" by Major C. S. G. Rogers, A.M.E.I.C. Attendance, 78.

Oct. 27.—"**Manufacture of Ball and Roller Bearings,**" by Gordon Janes, M.E.I.C. Attendance, 97.

Nov. 3.—"**Manufacture of High-Pressure Boilers,**" by J. O. Twinberrow, A.M.E.I.C. Attendance, 78.

Nov. 10.—"**Tramways System of Montreal,**" by Judge St. Cyr. Attendance, 142.

Nov. 17.—"**Target Shooting with the Short Lee-Enfield Rifle,**" by J. M. Pope. Attendance, 16.

Nov. 24.—"**Capacitors,**" by M. C. Lowe, S.E.I.C. Attendance, 60.

Dec. 1.—"**Vacuum Process of Paper Manufacturing,**" by Ogden Minton. Attendance, 138.

Dec. 8.—"**Montreal Harbour Bridge,**" by P. L. Pratley, M.E.I.C. Attendance, 240.

Dec. 15.—Annual meeting of the branch.

Financial Statement

The financial statement shows that the branch has been looking forward to the necessity of underwriting a considerable portion of the expenses of the professional meeting to be held in conjunction with the annual meeting next February. The members of the branch will be gratified to learn that for the first time in the history of the branch it will be possible to hold the Professional Meeting without making a special collection from the members for entertainment.

The Executive Committee desires that every member of the branch should realize that it is his duty to promote the welfare of the branch in every way possible. If members will not contribute papers, or take part in the discussions, the least they can do is to attend the meetings and so encourage those who are spending their time and energy in maintaining the prestige of The Institute.

Financial Statement

Ordinary Revenue		
Branch news	$ 79.68	
" Affiliate dues	133.00	
Rebates from Headquarters for dues to Dec. 1	1,779.33	
Interest on savings account	41.89	
		$2,033.90
Extraordinary Revenue		
Balance on hand, Jan. 1, 1927	$1,533.54	
Rebate, Gatineau trip	119.13	
		$1,652.67
Total revenue		$3,686.57
Expenditures		
Weekly postcards and notices	$ 667.08	
Miscellaneous printing	143.59	
Stationery and stamps	25.15	
Secretary's honorarium	300.00	
Clerical assistance	121.40	
Telephones and telegrams	63.19	
Moving picture machine, slides, etc.	22.59	
Subscription to Journal for Affiliates	40.00	
Miscellaneous	153.55	
Total disbursements		$1,536.55
Balance, savings account	$1,753.63	
" current "	396.39	
		$2,150.02
		$3,686.57

Respectfully submitted,

C. V. Christie, M.E.I.C., *Chairman.*
C. K. McLeod, A.M.E.I.C., *Secretary-Treasurer.*

Niagara Peninsula Branch

The President and Council,—

On behalf of the Executive Committee of the Niagara Peninsula Branch, we take pleasure in presenting the annual report of the branch for the calendar year 1927.

As the branch by-laws provide that the term of office of the Executive Committee shall start on June 1st of each year, in the hope that more continuity may exist throughout the winter or programme season, the Executive Committees for the calendar year 1927 were as follows:—

Jan. 1 to May 31, 1927		June 1 to Dec. 31, 1927
A. Milne, A.M.E.I.C.	Chairman	C. H. Scheman, M.E.I.C.
T. S. Scott, M.E.I.C.	Vice-Chair	E. G. Cameron, A.M.E.I.C.
R. W. Downie, A.M.E.I.C.	Sec.-Treas	Walter Jackson, M.E.I.C.
E. G. Cameron, A.M.E.I.C.		R. W. Downie, A.M.E.I.C.
L. L. Gisborne, A.M.E.I.C.		L. L. Gisborne, A.M.E.I.C.
J. C. Street, M.E.I.C.		R. H. Harcourt, A.M.E.I.C.
W. S. Orr, A.M.E.I.C.		C. G. Moon, A.M.E.I.C.
H. L. Bucke, M.E.I.C.	*Ex-officio*	A. Milne, A.M.E.I.C.
		E. P. Johnson, A.M.E.I.C.

Membership

The membership of the branch, except for the class of Student, has been practically constant. Because of the completion of the Queenston-Chippawa hydro-electric development at Niagara Falls and the increased activities on the Welland ship canal there has been a marked removal of members from the territory of the former and an increase in membership in the territory of the latter work. The decrease in Student membership can be accounted for by the "age limit" in existence f[illegible] class and by their advance to higher classes.

Following is a statement [illegible]ection with this subject which will give at a glance our sta[illegible]en compared with the previous report.

	At end of year 1926	At end of year 1927	Loss	Gain
Members	24	23	1	..
Associate Members	78	77	1	..
Juniors	15	16	..	1
Students	30	15	15	..
Affiliate	0	1	..	1
Branch Affiliates	15	14	1	..
Net loss			16	

Meetings

It has been the policy of the Executive Committee to have meetings at least once a month. Generally speaking, these meetings include a trip in the afternoon, a dinner at a convenient point and a programme in the evening. The trip is usually over some part of a construction work in progress or through some plant in the vicinity, and the programme includes a speaker to describe the work just visited.

During the past year this arrangement has worked very well, but perhaps our branch territory is more favourably situated for it.

Following is a table giving details of our meetings:—

Jan. 25.—Dinner and meeting at Hotel Reeta, Welland. "**Dredges and Dredging,**" by W. E. Bonn, A.M.E.I.C. Meeting well attended, but number not recorded.

Feb. 28.—Dinner and meeting at Welland hotel, St. Catharines. "**Recent Progress in Electric Arc Welding,**" by R. E. Smythies, M.E.I.C. Meeting well attended, but number not recorded.

Apr. 27.—Trip, dinner and meeting at Dexter House, Welland. "**Welland Ship Canal,**" by Alex. J. Grant, M.E.I.C. Attendance, 67.

May 18.—Dinner and annual meeting of branch at Welland hotel, St. Catharines. "**Some Observations on Present Day Life in America,**" by Principal Hutton and R. J. Durley, M.E.I.C. Meeting well attended, but number not recorded.

June 16.—Trip, outing and dinner at Erie Downs club, Bridgeburg. No principal speaker, but trips through the Horton Steel Works and New Peace bridge. Attendance, 102.

July 23.—Trip, luncheon and meeting at new filtration plant at St. Catharines. "**Water Filtration,**" by A. Milne, A.M.E.I.C. Attendance practically nil because of weather and road conditions.

Oct. 1.—Trip, dinner and meeting at Port Colborne, Ont. "**Early History and Development of the Nickel Industry,**" by H. W. Walter. Attendance, 75.

Oct. 28.—Trip, dinner and meeting at Welland hotel, St. Catharines. "**Welland Ship Canal,**" by Alex. J. Grant, M.E.I.C. "**More Power from Niagara,**" by F. D. Corey. "**New Peace Bridge,**" by E. P. Lupfer. "**Power from St. Lawrence,**" by H. G. Acres, M.E.I.C. Attendance of 300 at dinner and 700 at meeting.

Nov. 9.—Business meeting at Engineers' club, Thorold. No principal speaker, but business was to consider a revision of by-laws. Attendance, 12.

Nov. 16.—Dinner and meeting at King Edward hotel, Niagara Falls. "**Automatic Traffic Control,**" by R. M. Love. Attendance, 28.

Dec. 8.—Trip to Buffalo, N.Y. Inspection of the plants of the Curtis Aeroplane and Motor Company and Consolidated Aircraft Corporation. Attendance marred by weather.

Expenditures

Telephone, telegraph, exchange, postage, incidentals	$ 17.32	
Meeting expenses, including payment for meals	416.50	
Notices of meetings	59.20	
Printing and envelopes, stamps, etc., re revisions of by-laws	10.83	
Printing and envelopes, stamps, etc., election of officers	18.25	
Secretary's honorarium—R. W. Downie	100.00	
Journal subscription to Branch Affiliates	28.00	
Cash on hand and in bank	264.78	
		$914.88

EXECUTIVE COMMITTEE MEETINGS DURING YEAR 1927

Date 1927	*Place*	*Business*	*Attendance*
Feb. 28	Welland Hotel, St. Catharines	General business and planning for future meetings.	6
Apr. 4	Engineers' Club, Thorold	General business and receiving the report of the Nominating Committee	7
May 31	Engineers' Club, Thorold	New Executive—Appointment of Standing Committees	8
Aug. 29	Offices of Ontario Power Company, Niagara Falls	General business and planning for future meetings.	5
Oct. 5	Hotel Reeta, Welland	Receiving of report of the By-laws Committee and review of agenda for plenary Council Meeting of October 10 to 12	9 (100%)
Oct. 21	Refectory at Niagara Falls	Amending draught on revision to the By-laws for presentation to general business meeting	8

[illegible]ERSHIP

Meetings requiring specia[illegible]n were those of June 16th, October 1st and October 28th. [illegible] June 16th was the first under the present Executive Committ[illegible] the outing and dinner consisted of a golf tournament and [illegible]n dinner at the Erie Downs Golf Club, at Fort Erie, through [illegible] courtesy of the Horton Steel Works. The meeting of October 1st was at Port Colborne, and the trip was through the International Nickel Company and over the harbour works. The dinner was provided through the courtesy of the C. S. Boone Dredging Company. The meeting of October 28th consisted of a trip over the Welland ship canal in process of construction, a dinner at St. Catharines, and a joint meeting with the local sections of the American Institute of Electrical Engineers. On this trip, which took all day, and at the dinner at St. Catharines were visting members of The Engineering Institute of Canada from neighbouring branches, who were entertained by this branch to the number of 123. Transportation was mostly by automobile, but a construction train provided by the Welland ship canal authorities was made available for those requiring it, and a tug and scow was fitted up by the C. S. Boone Dredging Company for the trip over the Port Colborne end.

COMMITTEES

The branch's executive committee met at the call of the chairman as occasion required, and the above table gives a detail of the meetings.

By recommendation from the last to the present Executive Committee, the By-laws Committee was particularly active in framing a revision of the by-laws known as the Second Amendment, whereby the members will hereafter vote for members of an Executive Committee, and they will in turn elect from their members the chairman and vice-chairman and appoint from the branch membership the secretary-treasurer. Draught of these revisions has been accepted by the branch members at a general business meeting, approved by Council at Headquarters and letter ballots mailed to each member.

FINANCIAL STATEMENT

Financially, the branch is in fair condition, having on hand a balance which is in excess of last year's balance by over $60.00. This is due to added economies throughout the year. Details of the receipts and disbursements follow:—

(For period of January 1, 1927, to December 31, 1927)

Receipts

Balance brought forward	$203.70	
Proceeds from meetings	351.26	
Rebate on members' fees paid to Headquarters	247.50	
Branch Affiliates' fees	77.20	
Branch news	33.06	
Bank interest	2.16	
		$914.88

The members of our branch, on the occasion of their annual meeting held on May 18, 1927, appreciated a visit to them by the General Secretary and his wife, Mr. and Mrs. R. J. Durley.

Respectfully submitted,

C. H. SCHEMAN, M.E.I.C., *Chairman.*
WALTER JACKSON, 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 1927:—

During the year the Managing Committee held eight meetings. In addition, the branch held eight evening meetings and eight luncheons. In August, the Empire Mining and Metallurgical Congress held a session in Ottawa. The branch co-operated with the Rotary, Kiwanis and Lions clubs and with the Canadian Mining and Metallurgical Institute in providing entertainment for the delegates to the Congress during their stay in the city.

The annual ball was held at the Chateau Laurier, and, as usual, was a great success. Every year this function is becoming more and more of a social event in Ottawa.

The balance sheets show a very successful year financially. Our assets have increased by $158.16, so that our working capital is now $1,862.62.

It is with deep regret that we report the loss through death of five members, namely, W. P. Anderson, M.E.I.C., A. W. Campbell, M.E.I.C., G. A. Mountain, M.E.I.C., A. d'Orsonnens, A.M.E.I.C., and F. H. Wrong, A.M.E.I.C.

MEETINGS

During the year eight luncheons and eight evening meetings were held and a visit was made to the Canadian International Paper Company's plant at Gatineau, Que. The meetings were as follows:—

Jan. 13.—"**Celestial Engineering,**" by R. Meldrum Stewart, M.E.I.C.; luncheon meeting at Chateau Laurier.

Jan. 13.—Annual meeting—Daffodil Tea Rooms.

Feb. 10.—"**Engineering Development in Fighting Ships,**" by Engineer Commander T. C. Phillips, R.C.W., M.E.I.C.; luncheon meeting at Chateau Laurier.

Feb. 17.—"**Surveying in the Mountains,**" by M. P. Bridgland, M.E.I.C.; evening meeting in the Palm Room, Chateau Laurier.

Feb. 25.—"**The Bituminous Sands of Northern Alberta,**" by S. C. Ells, M.E.I.C.; evening meeting in the Palm Room, Chateau Laurier.

Mar. 1.—Joint luncheon meeting with the Canadian Institute of Mining and Metallurgy at the Chateau Laurier; address by Dr. D. A. Lyon, chief metallurgist of the Bureau of Mines, Washington.

Mar. 4.—"**Operation and Construction of Water Tube Boilers,**" by J. O. Twinberrow, A.M.E.I.C.; evening meeting at the Victoria Memorial Museum.

Mar. 24.—"**Sidelights on Northern Canada,**" by G. H. Blanchet, F.R.G.S., A.M.E.I.C., and Major L. T. Burwash, M.E., F.R.G.S., M.E.I.C.; evening meeting in the Palm Room, Chateau Laurier.

Mar. 31.—"**Commercial Aviation in Canada,**" by Ellwood Wilson, M.E.I.C., president of the Fairchild Aerial Surveys Company of Canada; luncheon meeting at the Chateau Laurier.

Apr. 7.—"**Some Practical Notes on Oil Paints and Their Application,**" by A. K. Light, chemist, Department of Public Works; evening meeting in the Palm Room, Chateau Laurier.

Oct. 15.—Visit to Canadian International Paper Company's plant at Gatineau, Que.

Oct. 27.—"**Recent Power Developments in Ottawa Vicinity,**" by W. E. Blue, A.M.E.I.C., of the Gatineau Power Company; luncheon meeting at the Chateau Laurier.

Nov. 8.—"**Workability in Concrete, with Particular Reference to the Use of Diatomaceous Silica,**" by Col. H. C. Boyden; evening meeting at the University Club.

Nov. 17.—"**My Trip to Italy,**" by John Murphy, M.E.I.C.; luncheon meeting at the Chateau Laurier.

Nov. 24.—"**Experiences as a Military Adviser to the Chinese Government,**" by Gen. F. A. Sutton, M.C.; luncheon meeting at the Chateau Laurier.

Dec. 1.—"**National Parks Idealism,**" by J. B. Harkin, Commissioner of Canadian National Parks; luncheon meeting at the Chateau Laurier.

Dec. 8.—"**Psychoanalysis and Mental Health,**" by Professor J. W. Bridges, PH.D.; evening meeting in the Palm Room, Chateau Laurier.

The attendance at the luncheons averaged over 100, the largest attendance being at the luncheon address by Gen. Sutton. While engineering subjects were discussed to some extent, the policy was to have addresses with a popular appeal.

Membership

During the year several members were lost through death, transfers, etc. A number of new members were gained, however, so that the total membership of the branch shows a net increase of five. 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 1925, 1926 and 1927:—

	1925	1926	1927
Honorary Members	1	0	1
Members	113	112	110
Associate Members	244	213	212
Juniors	35	26	28
Students	34	22	22
Affiliates of Institute	8	7	8
Branch Affiliates	37	37	41
Totals	472	417	422

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 that have previously prevailed.

Finances

The attached statements of assets and liabilities and of receipts and expenditures show the financial position of the branch to be a very satisfactory one. Our bank balance is approximately $160.00 more than last year and our assets have increased approximately the same amount.

The year was closed with a balance of $616.00 in the bank, $5.12 cash on hand and $1,000 in Victory bonds, a total balance of $1,621.22. In addition to this balance the branch has assets of $22.50 in rebates due from Headquarters, $17.90 for advertising in the Journal for the year and $201.00 in furniture, equipment, etc., making a total balance of $1,862.62. The accompanying chart shows the financial standing of the branch from 1910 to date.

The income for the past two years was:—for 1926, $1,043.81, and for 1927, $893.42; the expenditure for 1926, $1,146.41, and for 1927, $734.46. An annual income of $52.50 is derived from Victory bonds.

Officers for 1927

The annual meeting of the branch will be held in Ottawa on January 12th, when the officers and members of the Managing Committee for 1928 will be elected.

Financial Statement

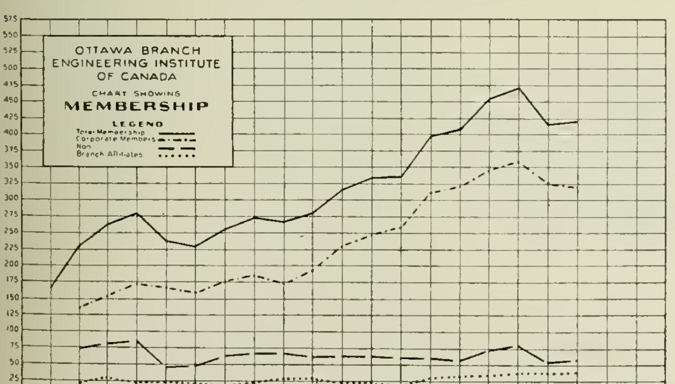
(For the year ending December 31, 1927)

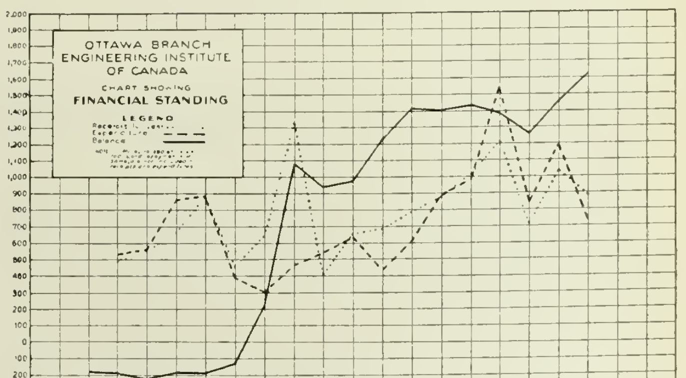
Receipts

Balance in bank, Jan. 1, 1927	$452.90	
Cash on hand, Jan. 1, 1927	9.36	
Interest on Victory bonds	52.50	
Bank interest	12.04	
Rebates from Headquarters, Nov. and Dec. 1926	41.20	
" " " Jan. to April, 1927	473.00	
" " " May to Aug. 1927	80.60	
" " " Sept. to Nov., 1927	41.90	
" " " Branch news, Jan. to May, 1927	46.73	
" " " Branch news, Nov. and Dec., 1927	6.19	
Branch Affiliate fees	90.00	
Proceeds from ball	59.26	
Proceeds from sale of luncheon tickets	592.05	
Refund from Mining Congress	9.00	
Adjustment in petty cash account	.09	
		$1,966.82

Expenditures

Chateau Laurier—luncheons and room rent	$940.00	
Daffodil Tea Rooms	32.50	
Printing, stationery, etc.	28.61	
Advertising	44.80	
Insurance	2.00	
Subscriptions to the Engineering Journal	6.00	
Subscriptions to Engineering News-Record	10.00	
Advance to Ball Committee	10.00	
Scrim's, for flowers	41.00	
University Club, room, etc.	32.00	
Board of Trade Membership fee	25.00	
Sundries, lecture expenses, entertainment, etc.	34.75	
Petty cash, postage, etc.	138.94	
Balance in bank, Dec. 31, 1927	616.10	
Balance cash on hand	5.12	
		$1,966.82





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 1926 fees	22.50	
" " " " " Advertising, 1927	17.90	
Victory bonds, due November 1, 1934	500.00	
" " " October 15, 1943	500.00	
Cash in bank	616.10	
Cash on hand	5.12	
		$1,862.62

Liabilities

Surplus	$1,862.62	
		$1,862.62

Audited and found correct,

K. M. Cameron, M.E.I.C.

Respectfully submitted,

N. Cauchon, A.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 Committee of the Peterborough Branch, we beg to submit to you the following report to cover the activities of the branch for the calendar year 1927:—

Meetings and Papers

Jan. 13.—"**The Manufacture of Carbon Products,**" by the late J. C. Webster, M.E.I.C., Canadian National Carbon Company, Limited.

Jan. 27.—"**The Hemmings Falls Development,**" by J. S. H. Wurtele, M.E.I.C.

Feb. 10.—*Students' Night.*
"**Full Voltage Starting of Induction Motors,**" by S. O. Shields, S.E.I.C.
"**Control of A.C. Motors,**" by W. T. Fanjoy, S.E.I.C.
"**Some Interesting Facts About Northern Alberta,**" by F. J. Stewart, S.E.I.C.

Feb. 24.—"**With Canadian Engineers in Palestine,**" by Prof. J. Roy Cockburn, M.E.I.C.

Mar. 10.—"**Ancient Engineering,**" by F. H. Dobbin.

Mar. 31.—"**Recent Progress in Electric Welding,**" by R. E. Smythies, M.E.I.C., Lincoln Electric Company, Limited.

Apr. 14.—"**Long Span Bridges,**" by Prof. C. R. Young, M.E.I.C.

Apr. 28.—"**Ice Engineering,**" by Dr. Howard T. Barnes, M.E.I.C.

Oct. 27.—"**Electrical Equipment of International Paper Company's Gatineau Mill,**" joint paper by A. B. Gates, A.M.E.I.C., B. Ottewell, A.M.E.I.C., W. E. Ross, A.M.E.I.C.

Dec. 8.—"**Modernizing of Old Radio Sets and Use of B Eliminators,**" by J. H. Thomson, Ferranti Electric, Limited.

Special Meetings

May 17.—Annual general business meeting and election.

Aug. 30.—Special dinner-meeting and presentation to Paul Manning, A.M.E.I.C.

Nov. 22.—Annual banquet.

The average attendance of the membership at the regular meetings has been very gratifying, and, in addition, these meetings, in accordance with the policy of the branch, have been given notices in the local press inviting the general public.

A general invitation was extended by the committee in charge of arrangements for the celebrations of the Confederation Jubilee in the city of Peterborough to all organizations to assist in the preparations. The Peterborough Branch offered to erect a decorative arch, and in order to carry out this project it was decided to forego the usual summer outing and devote the time to the construction and erection of the arch.

This work was carried out by a party of the members working evenings and Saturday afternoons and resulted in the erection of an arch which took the form of a scale model of the Quebec bridge, which occupied a prominent position on the main thoroughfare of the city during the celebration. The arch was later presented to the Peterborough Exhibition Board, who have had it erected in the exhibition grounds.

Membership

The membership now stands as follows:—

Members	19
Associate Members	37
Juniors	10
Students	18
Affiliates and Branch Affiliates	15
Total	99

During the year the branch suffered the loss of one of its most esteemed and prominent members, the late R. B. Rogers, M.E.I.C., a Life Member of The Institute and past chairman of the Peterborough Branch.

There is a slight loss in the membership due to transfers and one resignation. In the case of Students a loss is shown, but this is due to the fact that the Peterborough Branch is peculiarly situated in this respect, the total in this grade being susceptible to change from month to month due to transfers of student engineers to and from the Canadian General Electric Company's works.

Executive Committee

Ten meetings of the Executive Committee have been held during the year, at which routine and special business has been transacted.

The members of the Executive Committee are:—

Chairman	A. E. Caddy, M.E.I.C.
Secretary	W. E. Ross, A.M.E.I.C.
Treasurer	A. B. Gates, A.M.E.I.C.
	B. L. Barns, A.M.E.I.C.
	G. H. Burchill, JR.E.I.C.
	W. M. Cruthers, A.M.E.I.C.
Councillor	R. L. Dobbin, M.E.I.C.
	R. C. Flitton, A.M.E.I.C.
	J. A. G. Goulet, M.E.I.C.
	B. Ottewell, A.M.E.I.C.

Student Activities

In order to further the interest of the Students in Institute affairs, a Student Section has been formed, which section appoints a chairman, who is invited to attend meetings of the Branch Executive Committee.

The results to date have been gratifying, and it is hoped to develop this section still further in the near future.

Financial Statement

(For the year ending December 31st, 1927)

Receipts

Bank balance, Jan. 1, 1927	$ 40.01	
Rebates on fees	169.80	
Journal news	46.25	
Annual dinner receipts	150.00	
Affiliate fees and Journal subscriptions	32.00	
Bank interest	3.19	
		$441.25

Expenditures

Rent	$ 50.00	
Journal subscriptions	16.00	
Speakers and meetings	45.64	
Printing	75.50	
Secretarial expenses	8.94	
Annual dinner expenses	130.50	
Confederation celebration	14.63	
Sundries	7.38	
Balance in bank	92.66	
		$441.25

Archie B. Gates, A.M.E.I.C., *Treasurer.*

Respectfully submitted,

A. E. Caddy, M.E.I.C., *Chairman.*
W. E. Ross, A.M.E.I.C., *Secretary.*

Quebec Branch

The President and Council,—

The Executive Committee of the Quebec Branch begs to present the following annual report on the work of the branch during the year 1927:—

MEMBERSHIP

	Resident	Non-resident	Total
Honorary Member	1	..	1
Members	17	1	18
Associate Members	66	11	77
Juniors	11	3	14
Students	11	3	14
Affiliates	1	..	1
			125

ANNUAL MEETING

The annual meeting of the Quebec Branch was held on May 30th, 1927, under the chairmanship of A. B. Normandin, A.M.E.I.C. The following officers were elected for the year 1927-28:—

Honorary Chairman for Life.........
A. R. Décary, D.A.SC., M.E.I.C., President of The Institute.
Chairman ....A. B. Normandin, A.M.E.I.C.
Vice-Chairman ....S. L. de Carteret, M.E.I.C.
Secretary-Treasurer ....Philippe Méthé, A.M.E.I.C.
Committeemen ....Alex. Larivière, A.M.E.I.C.
L. C. Dupuis, A.M.E.I.C.
Hector Cimon, A.M.E.I.C.
T. J. F. King, A.M.E.I.C.
Ex-officio ....W. G. Mitchell, M.E.I.C.
" ....Louis Beaudry, A.M.E.I.C.

MEETINGS

The executive of the Quebec Branch held its meetings regularly during the year 1927. The two outstanding events of the year were the Annual General and General Professional Meeting of The Institute, held in the old city of Quebec, February 15th to 17th, 1927, and the election to the presidency of The Institute of A. R. Décary, D.A.SC., M.E.I.C., one of the most distinguished members of the engineering profession in Canada and an active member of the Quebec Branch.

During the general meeting, many engineers from all parts of the country, and also prominent men in governmental, industrial, commercial, economical, intellectual and administrative spheres, honoured the Quebec Branch by their presence and took an active part in the discussion of papers presented at the various sessions of the meeting.

Our membership increased from 112 to 125.

All questions submitted by the Council of The Institute have been studied, discussed and transacted.

Our branch has followed with interest the deliberations on The Institute, and has 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 has followed closely, studied seriously and made as complete reports as possible on all applications for membership which have been referred to this branch, and the necessary recommendations have been made to the Council of The Institute, who has kindly taken them into consideration.

ADDRESSES

The following addresses were given at our different luncheons and evening meetings:—

"**The Montreal Harbour Bridge,**" by P. L. Pratley, M.E.I.C., consulting engineer, Montreal.

"**Workability in Concrete, with Special Reference to the Use of Diatomaceous Silica,**" by Col. H. C. Boyden.

"**Economical and Industrial Evolution,**" by Hon. Frank Carrel, Member of the Legislative Council of Quebec.

FINANCIAL STATEMENT

Revenue

Cash in bank, Jan. 1, 1927	$110.49	
Bank interest	5.10	
Rebates from Headquarters:		
Members' fees	229.50	
Branch news	4.48	
		$349.57

Expenditures

Printing stamps, etc.	$33.35	
Expenditures for meetings	30.50	
Postal box	8.00	
		$71.85
Balance on hand, Jan. 1, 1928		$277.72

Respectfully submitted,

A. B. NORMANDIN, A.M.E.I.C., *Chairman.*
PHILIPPE MÉTHÉ, A.M.E.I.C., *Secretary-Treasurer.*

RAPPORT ANNUEL DE LA SECTION DE QUÉBEC POUR L'ANNÉE 1927

Au président et aux membres de l'Institut des Ingénieurs du Canada.

Le conseil de la Section de Québec a l'honneur de vous soumettre son rapport annuel pour l'année 1927, comme suit:—

ROLE DES MEMBRES

	Résidents	Non-résidents	Total
Membres Honoraires	1	..	1
Membres	17	1	18
Membres Associés	66	11	77
Membres Juniors	11	3	14
Membres étudiants	11	3	14
Membres Affiliés	1	..	1

ASSEMBLÉE ANNUELLE

L'assemblée annuelle de la Section de Québec a été tenue le 30 mai 1927, sous la présidence de Monsieur A. B. Normandin, A.M.E.I.C., et les Officiers dont les noms suivent ont été élus pour l'année 1927-28:—

Président Honoraire, à vie ....M. A. R. Décary, D.A.SC., M.E.I.C.
Président ....M. A. B. Normandin, A.M.E.I.C.
Vice-Président ....M. S. L. de Carteret, M.E.I.C.
Secrétaire-Trésorier ....M. Philippe Méthé, A.M.E.I.C.
Conseillers ....M. Alex. Larivière, A.M.E.I.C.
M. L. C. Dupuis, A.M.E.I.C.
M. Hector Cimon, A.M.E.I.C.
M. J. T. F. King, A.M.E.I.C.
Ex-officio ....M. W. G. Mitchell, M.E.I.C.
" ....M. Louis Beaudry, A.M.E.I.C.

ASSEMBLÉES

Le Conseil de la Section de Québec a tenu ses assemblées regulièrement durant l'année 1927.

Deux évènements mémorables ont marqué l'année écoulée: la tenue de l'Assemblée annuelle de l'Institut dans la vieille Cité de Champlain, et le choix de Monsieur A. R. Décary, D.A.SC., l'un des membres les plus distingués de la profession d'ingénieur au Canada, et membre dévoué de la Section de Quebec, comme Président général de l'Institut.

A l'occasion de l'assemblée générale, un grand nombre d'ingénieurs venus de toutes les parties du pays, et des personnages marquants de toutes les sphères, gouvernementale, industrielle, commercialle, économique, intellectuelle et administrative ont bien voulu nous honorer de leur visite, et prendre part aux travaux présentés à l'assemblée.

Le nombre de nos membres s'est accru de 112 à 125.

Toutes les questions soumises par le Conseil général à la Section de Québec ont été étudiées, discutées 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 sérieuse, de faire un rapport aussi complet que possible sur toutes les demandes d'admission qui lui ont été référées, et les recommandations nécessaires ont été faites au Conseil général de l'Institut qui a bien voulu en tenir compte.

CAUSERIES

Les causeries suivantes ont été donnés à nos différentes réunions.

"**Le Pont Montréal-Longueuil,**" par P. L. Pratley, M.E.I.C., ingénieur conseil de Montréal.

"**La plasticité du béton et les effets de l'emploi de silice 'diatomacée',**" par Col. H. C. Boyden, B.SC., I.C.

"**L'évolution économique et industrielle,**" L'hon. Frank Carrel, conseiller législatif.

Etat Financier pour l'Année 1927

Revenus

Montant en banque au 1er janvier 1927	$110.49	
Intérêts sur dépot	5.10	
Remises du Bureau chef:		
Cotisations des membres	229.50	
Nouvelles de la Section	4.48	
		$349.57

Dépenses

Impression, timbres, etc.	$33.35
Dépenses pour assemblées	30.50
Boite postale	8.00
	$71.85

A. B. Normandin, a.m.e.i.c., *Président.*
Philippe Méthé, a.m.e.i.c., *Secrétaire-trésorier.*

Saguenay Branch

The President and Council,—

On behalf of the Executive Committee, we take pleasure in submitting the following report for the year 1927.

The year 1927 was a very quiet one for our branch. Owing to certain changes in the policy of one of the large paper companies, several of our oldest and most capable members were either removed from our branch by being transferred to Quebec or elsewhere out of our territory or else stationed at various places about lake St. John, thus decentralizing an important group of our members, to the great disadvantage of the branch.

Several attempts at executive and other meetings were made, but owing to the greater difficulty in assembling the scattered members it was almost impossible to reach a quorum, the disadvantage of a scattered membership being thus plainly brought to light.

It has been agreed that the best way to obviate this will be, for any given year, to elect officers from among those living in a certain centre, thus giving a greater chance of successful meetings. The centre would, of course, vary every year, thus allowing everyone an equal opportunity for election. This policy, without being made a definite by-law of the Saguenay Branch, will nevertheless be considered as an accepted custom and will be tried out at the coming spring elections. We hope thereby to get a satisfactory means of holding meetings and reviving the former activities of the branch.

Officers

The officers of the branch are as follows:—

Chairman	Edouard Lavoie, m.e.i.c.
Secretary-Treasurer	Burroughs Pelletier, a.m.e.i.c.
Executive	J. L. Delisle, a.m.e.i.c.
	C. C. Lindsay, a.m.e.i.c.
	G. F. Layne, a.m.e.i.c.

Membership

The membership of the branch is as follows:—

Members	4
Associate Members	25
Juniors	10
Students	11
	50

Financial Statement

(As at January 1st, 1928)

Receipts

Balance on hand from previous report	$ 73.82	
Remittances from headquarters (Jan.)	10.65	
" " " (Aug.)	69.30	
" " " (Oct.)	14.10	
		$167.87

Expenditures

Stationery, postage, incidentals	$ 6.75	
Balance on hand	161.12	
		$167.87

Respectfully submitted,

Edouard Lavoie, m.e.i.c., *Chairman.*
Burroughs Pelletier, a.m.e.i.c., *Secretary-Treasurer.*

Saint John Branch

The President and Council,—

The Saint John Branch of The Engineering Institute of Canada records the end of another calendar year by submitting its tenth annual report.

The executive has transacted business of the branch by meeting nine times during the year. Seven branch meetings were held in Saint John, at which addresses were given, in addition to the joint dinner with the Association of Professional Engineers of the province of New Brunswick in January and the annual meeting and dinner in May. The branch maintained its interest in the engineering college within its branch territory by holding a joint meeting with the Engineering Society of the University of New Brunswick in Fredericton during March; this trip is eagerly looked forward to by our members and proves very enjoyable.

A motor trip was made during Labour Day week-end to Grand Falls, distant about 200 miles from Saint John, to inspect the hydro-electric construction works. This trip gave our branch members, resident and branch district, a chance to become better acquainted. Thanks are due to A. C. D. Blanchard, m.e.i.c., for excellent arrangements provided at Grand Falls, and to the Dominion Construction Company for courtesies extended there.

At branch meetings, various engineering subjects have been discussed. Good interest has been maintained in meetings. Committees continue to give efficient service in several features of branch endeavour.

This branch takes its place in the community by assisting in any worth-while work outside what may be regarded as strictly Institute affairs. It assisted in Fire Prevention Week, drew attention to need of adoption of town planning, worked in close harmony with the Board of Trade. Some branch members have become identified with Board of Trade work and done good service. Branch members have been active in local service clubs. In other words, Saint John Branch members are taking part in various features of civic community life.

Of interest to engineers in various activities within branch territory during the past year may be mentioned hydro-electric and pulp mill construction and some interest in mineral development. The transfer of the harbour of Saint John to the control of a Harbour Commission during the past year is recorded.

This branch was represented at the Plenary Meeting of Council held at Montreal in October.

Membership

The nine western counties of New Brunswick are included in the territory of this branch. Statement of membership on December 31, 1927, is as follows:—

	Residents	Non-residents	Total
Members	14	7	21
Associate Members	28	16	44
Juniors	6	2	8
Students	3	5	8
Affiliates	2	..	2
Total	53	30	83

Total at end of 1926—79; total at end of 1927—83; net gain—4.

Meetings

Jan. 25.—Joint dinner with Association of Professional Engineers of New Brunswick.
"**Welland Ship Canal,**" by Alex. J. Grant, m.e.i.c.

Mch. 4.—Joint meeting with Engineering Society of University of New Brunswick, at Fredericton, N.B.
"**Railway Location,**" by A. S. Gunn, a.m.e.i.c.
"**Electrical Operation,**" by G. A. Vandervoort, a.m.e.i.c.
"**Some Features of the Saint John River Power Company's Developments at Grand Falls, N.B.,**" by A. C. D. Blanchard, m.e.i.c.

Mch. 31.—"**Town Planning for Saint John,**" by W. F. Burditt.

Apr. 7.—"**Maritime Harbours, How Treated and What They Mean to Us,**" by Thos. J. Locke.

Apr. 21.—"**Engineering in Contracting,**" by J. N. Flood, a.m.e.i.c.

May 4.—Annual meeting.

Sept. 3-5.—Summer excursion to Grand Falls, N.B.

Oct. 28.—"**Sanitary Drainage,**" by G. G. Murdoch, m.e.i.c.

Nov. 17.—"**Passamaquoddy Bay Tidal Development,**" by Dexter P. Cooper.

Dec. 9.—"**Filtration,**" by J. L. Feeney, a.m.e.i.c.

Financial Statement

Receipts

Balance in bank, Dec. 31, 1926	$122.31	
Rebates of members' fees	165.60	
Branch news	32.39	
Branch Affiliate, dues and Journal subscriptions	6.00	
		$326.30

Expenditures

Expenses incurred by secretary in 1926	$ 37.96	
Hall and meeting	46.01	
Printing	46.86	
Stenography	12.00	
Postage	6.05	
Telegrams and telephone	5.22	
Branch Affiliate, Journal subscription	2.00	
Miscellaneous	5.60	
Balance in bank, Dec. 31, 1927	164.60	
		$326.30

Assets

Balance in bank, Dec. 31, 1927	$164.60	
Rebates of members' fees outstanding	6.30	
		$170.90

Liabilities

Outstanding accounts	$ 32.02	
Surplus on Dec. 31, 1927	138.88	
		$170.90

Respectfully submitted,

S. R. Weston, M.E.I.C., *Chairman.*
W. J. Johnston, A.M.E.I.C., *Secretary-Treasurer.*

Saskatchewan Branch

The President and Council,—

On behalf of the Executive Committee, we beg to submit the following report concerning the activities of the Saskatchewan Branch for the calendar year 1927.

Membership

The membership of the branch has shown a gain of 8 with the usual fluctuations due to transfers, etc.

The present membership of the branch is:—

	Residents	Non-residents	Total
Members	6	13	19
Associate Members	39	30	69
Juniors	3	5	8
Students	3	8	11
Affiliates	1	1	2
Branch Affiliates	5	0	5
Total	57	57	114

Executive Committee

The present executive was elected on March 8th at the branch annual meeting, and with those continuing in office is as follows:—

Chairman ....M. B. Weekes, M.E.I.C., Regina, Sask.
Vice-Chairman ......A. M. Macgillivray, A.M.E.I.C., Saskatoon, Sask.
Secretary-Treasurer ..R. W. E. Loucks, A.M.E.I.C., Regina, Sask.
Executive (2 years)...D. A. R. McCannel, A.M.E.I.C., Regina, Sask.
W. R. Warren, A.M.E.I.C., Regina, Sask.
W. G. Worcester, M.E.I.C., Saskatoon, Sask.
(1 year)...J. W. D. Farrell, A.M.E.I.C., Regina, Sask.
P. C. Perry, A.M.E.I.C., Regina, Sask.
W. H. Greene, M.E.I.C., Moose Jaw, Sask. (past-chairman).
H. R. MacKenzie, A.M.E.I.C., Regina, Sask. (councillor).
Auditors ....D. H. Lunam, BR. AFFIL., Regina, Sask.
G. G. Fitzgerald, A.M.E.I.C., Regina, Sask.

Committees

Chairmen of the standing committees are:—

Papers and Library ....D. A. R. McCannel, A.M.E.I.C.
Legislation ....R. N. Blackburn, M.E.I.C.
Nominating ....J. R. C. Macredie, M.E.I.C.
Attendance ....J. G. Schaeffer, S.E.I.C.
D. C. M. Davies, A.M.E.I.C.
Publicity ....R. W. E. Loucks, A.M.E.I.C.
Meetings ....W. T. E. Smith, Br. Affil.

The Saskatchewan Branch representative on the Nominating Committee of The Institute is M. B. Weekes, M.E.I.C.

Meetings

The executive held six meetings for the transaction of branch affairs. There were five regular meetings of the branch and two special meetings. In January a very pleasant social evening was spent at the home of H. N. Macpherson, A.M.E.I.C., at which the ladies were present, and in August a basket picnic was held at River Park, in the town of Lumsden. R. J. Durley, M.E.I.C., general secretary of The Institute, was scheduled to attend the picnic and to meet the members at an informal dinner on the following day. Owing to sudden news of illness in his family, Mr. Durley was unfortunately unable to be with us on this occasion.

The regular meetings have been well attended and considerable interest and enthusiasm shown by the officers and members. They were in each case preceded by a dinner. At the present time the meetings are being held in the Saskatchewan hotel, Regina.

Meetings

The programme for the year was as follows:—

Jan. 7.—Ladies' night. Social evening at the home of H. N. Macpherson, A.M.E.I.C.

Jan. 27.—"**The Engineer and the Immigration Problem,**" by A. G. Dalzell, M.E.I.C., consulting engineer, Toronto, Ont.

Feb. 18.—"**The Construction of the Canadian Pacific Railway (Saskatchewan) Hotel at Regina,**" by H. S. Bare, A.M.E.I.C., resident engineer, Canadian Pacific Railway.
"**The Management of the Hotel,**" by Mr. T. E. Chester, manager.
"**Mining Claims and Mineral Prospects in the Mineral Belt North of The Pas, Manitoba,**" by Wm. T. Thompson, M.E.I.C.
Personal inspection of the Canadian Pacific Railway hotel during the afternoon by members of the branch, conducted by H. S. Bare, A.M.E.I.C.

Mar. 8.—Tenth annual meeting. Reports of committees, election of officers, banquet, toast list and other entertainment.
Address by Prof. A. R. Greig, M.E.I.C., on his recent tour of Europe, from an engineering standpoint.

Aug. 24.—Basket picnic at River Park, Lumsden; sports, games, refreshments, etc.

Nov. 18.—Addresses on "**Departmental Activities for the Past Season,**" by J. W. D. Farrell, A.M.E.I.C., superintendent, water works, Regina; R. H. Murray, A.M.E.I.C., sanitary engineer, Saskatchewan Department of Public Health, and S. T. Lewis, division engineer, Canadian Pacific Railway.

Dec. 19.—Address on "Conventions" by:—H. N. Macpherson, A.M.E.I.C., "**Benefits to Be Derived from Conventions.**"
T. A. McGuinness, A.M.E.I.C., "**Electrical Railway Convention.**"
C. W. Doody, traffic superintendent, Saskatchewan Department of Telephones, "**Canadian Telephone Association Convention.**"
H. S. Carpenter, M.E.I.C., "**Canadian Good Roads Convention.**"
D. A. R. McCannel, A.M.E.I.C., "**Canadian Good Roads Convention.**"

Scholarship

The annual scholarship of $50.00 offered by the branch to the most deserving student in the graduating class in engineering of the University of Saskatchewan, was awarded to Mr. L. W. Llewellyn.

Financial Statement

Revenue

Balance from 1926	$190.17	
Headquarters rebates	208.50	
Branch dues	57.00	
Sundries, branch news, etc.	30.50	
		$486.17

Expenditure

Meetings	$104.89	
Stationery, notices, etc.	47.12	
Scholarship	50.00	
Honorarium	100.00	
Sundries	21.50	
Balance—Cash in bank	143.76	
Cash on hand	18.90	
		$486.17

Respectfully submitted,

M. B. Weekes, M.E.I.C., *Chairman.*
R. W. E. Loucks, A.M.E.I.C., *Secretary-Treasurer.*

Sault Ste. Marie Branch

The President and Council,—

The attendance at the meetings for the year averaged thirty-five, and nearly all the meetings were held at the Y.W.C.A. rooms following a dinner. The attendance this year has been about the same as in 1926, averaging over 50 per cent of our resident members. The number of guests were larger this year, as we held two public meetings, one in St. Luke's hall on April 29th and one in the Y.M.C.A. on October 28th.

The Papers and Publicity Committee and the Entertainment Committee are to be congratulated upon the splendid papers and meetings that they arranged for and carried out. On account of our geographical location the arranging for outside speakers is a problem and requires considerable effort on the part of the Papers Committee to keep up a good programme.

The entertaining of R. J. Durley, M.E.I.C., general secretary of The Institute, on July 8th and the dinner and inspection trip through the Union Carbide plant, Sault Ste. Marie, Michigan, were two very interesting events during the year.

Meetings

The regular meetings were held on the last Friday of each month, except the special meetings held in April and July, and the papers given and the inspection trips made were as follows:—

Jan. 28.—An inspection trip through the local plant of the Spanish River Pulp and Paper Company, under the guidance of company's officials.

Feb. 25.—"**Economy in Steam Generation,**" by E. V. Ahara, JR.E.I.C., of the Combustion Engineering Corporation of Montreal.

Apr. 15.—An inspection trip through the calcining plant of the Union Carbide Company, Sault Ste. Marie, Mich., following a dinner given by the officials of the Carbide Company.

Apr. 29.—"**Radio and the Wizardy of Wireless,**" by Mr. Richardson, of the Canadian General Electric Company, of Toronto.

May 27.—"**The Army Water Supply in France,**" by B. M. Owen, of Babcock-Wilcox and Goldie-McCulloch, Limited, of Galt, Ont.

July 8.—A special dinner meeting was held to welcome R. J. Durley, M.E.I.C., the general secretary of The Institute.

Sept. 30.—Lecture and slides prepared by C. H. Speer, M.E.I.C., on "**The Steel Industry**" for use in the Provincial Schools under the Department of Education supervision.

Oct. 28.—"**The Construction and Operation of Modern High Pressure Boilers,**" by J. O. Twinberrow, A.M.E.I.C., chief engineer of boiler department of Babcock-Wilcox and Goldie-McCulloch, Limited, of Galt, Ont.

Nov. 14.—Special meeting to discuss the engineering features of the proposed hydro-electrical development of the St. Mary's river rapids.

Dec. 16.—Annual meeting. Reports of all committees. Election of officers for 1928. Address by retiring chairman, G. H. Kohl, M.E.I.C.

Membership

	Residents	Non-residents	Total
Members	12	13	25
Associate Members	11	42	53
Juniors	6	7	13
Students	2	12	14
Affiliate	1	..	1
Branch Affiliates	15	..	15
Total			121

This is an increase of four members as shown by the 1926 report. Conditions are somewhat better industrially throughout this district this year. At present we have four or five elections and transfers pending.

Financial Statement

Receipts

Balance from 1926	$ 87.04	
Income from Headquarters, rebates	193.50	
Income from Headquarters, advertising	30.00	
Income from Headquarters, branch news	29.61	
Affiliate fees	47.00	
Journal subscriptions	18.00	
Meetings, dinners and entertainment	45.30	
		$450.45

Expenditures

Postage and stationery	$ 24.00	
Printing and advertising	58.32	
Gratuities and donations	62.00	
Stenographer	25.00	
Telegrams	1.39	
Secretary's honorarium, 1927	25.00	
Meetings, dinners and entertainment	100.52	
Journal subscriptions	18.15	
Sundries	1.45	
		$315.83
Balance in current account		134.62
Balance in savings account		108.23
Total balance		$242.85

Outstanding Affiliate fees, $17.00.

Respectfully submitted,

GEO. H. KOHL, M.E.I.C., *Chairman.*
A. H. RUSSELL, A.M.E.I.C., *Secretary-Treasurer.*

St. Maurice Valley Branch

The President and Council,—

We have the honour to submit to you the annual report of the St. Maurice Valley Branch of The Institute for the year 1927:—

The branch was established in 1926, and the first meeting was held on the 27th of November, 1926.

Officers

The first executive was as follows:—

President	Ellwood Wilson, M.E.I.C.
Councillor (one year)	Bruno Grand Mont, A.M.E.I.C.
" (two years)	Henri Dessaulles, A.M.E.I.C.
" (three years)	S. W. Slater, A.M.E.I.C.
Secretary-Treasurer	Romeo Morrissette, A.M.E.I.C.

The same executive was maintained in office for 1927.

Meetings

The by-laws of the branch were adopted, and the meetings of the branch in 1927 were held as follows:—

Jan. 15.—At the Chateau de Blois, in Three Rivers; "**Municipal Finances,**" by Romeo Morrissette, A.M.E.I.C.

Mar. 19.—"**Aerial Surveys,**" by Ellwood Wilson, M.E.I.C.

May 7.—At Grand'Mere; speaker, Mr. E. B. Wardle, of the Laurentide Company, Limited, who gave an address followed by a visit to the mill.

Oct. 22.—At Shawinigan Falls; "**The Role of the Engineer,**" by Julian C. Smith, M.E.I.C.

Nov. 24.—At Three Rivers; general discussion.

Dec. 13.—Annual election of officers, resulting as follows:—Ellwood Wilson, M.E.I.C., was re-elected chairman for 1928. Bruno Grand Mont, A.M.E.I.C., member of Executive Committee, and Romeo Morrissette, A.M.E.I.C., *secretary-treasurer.*

Financial Statement

Receipts for 1927	$169.67
Expenses for 1927	91.51
Balance on hand	$78.16

Respectfully submitted,

ELLWOOD WILSON, M.E.I.C., *Chairman.*
ROMEO MORRISSETTE, A.M.E.I.C., *Secretary-Treasurer.*

Toronto Branch

The President and Council,—

The Executive Committee of the Toronto Branch respectfully submit the following report for the calendar year of 1927:—

The Executive Committee holding office during this period are as follows, the present members being elected at the branch annual meeting on March 24th.

Executive Committee

January to March 1927		March to December 1927
J. G. R. Wainwright, A.M.E.I.C.	Chairman	R. B. Young, M.E.I.C.
R. B. Young, M.E.I.C.	Vice-Chair.	J. A. Knight, A.M.E.I.C.
J. W. Falkner, A.M.E.I.C.	Sec.-Treas.	W. B. Dunbar, A.M.E.I.C.
A. E. K. Bunnell, M.E.I.C.	Executive	C. S. L. Hertzberg, M.E.I.C.

H. W. Tate, A.M.E.I.C.		J. J. Traill, M.E.I.C.
L. W. Wynne-Roberts, A.M.E.I.C.		T. Taylor, M.E.I.C.
A. T. C. McMaster, M.E.I.C.		A. E. K. Bunnell, M.E.I.C.
I. H. Nevitt, M.E.I.C.		H. W. Tate, A.M.E.I.C.
J. A. Knight, A.M.E.I.C.		L. W. Wynne-Roberts, A.M.E.I.C.
T. R. Loudon, M.E.I.C.	*Ex-officio*.	T. R. Loudon, M.E.I.C.
E. G. Hewson, M.E.I.C.	"	J. M. Oxley, M.E.I.C.
J. M. Oxley, M.E.I.C.	"	*H. K. Wicksteed, M.E.I.C.
H. K. Wicksteed, M.E.I.C.	"	J. G. R. Wainwright, A.M.E.I.C.
C. B. Ferris, A.M.E.I.C.	"	J. W. Falkner, A.M.E.I.C.
		P. Gillespie, M.E.I.C.

* *Deceased.*

Standing Committees

The following standing committees with the chairman of each were appointed by the executive:—

January to March		April to December
J. G. R. Wainwright, A.M.E.I.C.	Papers (Programme)	R. B. Young, M.E.I.C.
R. B. Young, M.E.I.C.	Finance	J. A. Knight, A.M.E.I.C.
J. Hyslop, M.E.I.C.	Publicity	J. W. Falkner, A.M.E.I.C.
E. T. J. Brandon, A.M.E.I.C.	Membership	L. W. Wynne-Roberts, A.M.E.I.C.
L. W. Wynne-Roberts, A.M.E.I.C.	Meetings (Attendance)	T. Taylor, M.E.I.C.
A. T. C. McMaster, M.E.I.C.	Library	C. S. L. Hertzberg, M.E.I.C.
W. B. Dunbar, A.M.E.I.C.	Student Relations	W. B. Dunbar, A.M.E.I.C.

The Executive Committee of the branch held fifteen meetings throughout the year for the transaction of branch business and eleven general meetings, of which one was a luncheon meeting.

A feature of the activities of the branch this year has been its co-operation with other engineering bodies. On October 28th there was a trip over the new Welland ship canal. The party was composed of members of the following societies:—The American Institute of Electrical Engineers of Hamilton, Niagara Peninsula and Toronto Branches; The Engineering Institute of Canada of the Niagara Peninsula and Toronto Branches; The Engineering Society of Buffalo, N.Y.

In the evening dinner was served in the Welland Inn, St. Catharines, at which the visiting members of The Engineering Institute of Canada were the guests of the Niagara Peninsula Branch. A joint meeting in the auditorium of the Collegiate Institute at night was addressed by Mr. E. P. Lupfer, chief engineer of the Peace Bridge, A. J. Grant, M.E.I.C., engineer-in-charge of the Welland ship canal, and H. G. Acres, M.E.I.C., consulting engineer, of Niagara Falls, who spoke on the "**St. Lawrence Development.**"

Twenty-seven members of our branch spent a very enjoyable and profitable day.

A luncheon meeting was held on December 1st at the King Edward hotel jointly with the Toronto Sections of the A.I.E.E. and A.S.M.E., to honour Professor Peter Gillespie, M.E.I.C., who, in addition to being a respected member of our branch, is also a vice-president of The Institute. This meeting was attended by 150 members.

The regular evening meetings were arranged to cover as far as possible the various subdivisions of the engineering profession. During the early part of the year the papers were mostly by local men, whereas the latter papers were mostly by out-of-town men.

A policy which has turned out very successful is that of welcoming the out-of-town speakers at an informal dinner attended by members of the executive and those who purpose taking part in the discussion of the paper.

After the meeting on the evening of January 27th the members were the guests of the staff in Applied Mechanics of the Faculty of Applied Science and Engineering, University of Toronto, at the inauguration of their new 200-ton Riehle testing machine. An opportunity was also given those present to investigate the facilities of the laboratory for testing various structural and highway materials. Lunch was served at the close of the demonstration.

The attendance at the meetings has been in general good, with an average of 100. At the meeting addressed by Dr. Howard T. Barnes, M.E.I.C., of Montreal, the room capacity was sorely taxed with an attendance of 325.

The programme for the year was as follows:—

Jan. 13.—"**Recent Progress in Electric Arc Welding,**" by R. E. Smythies, M.E.I.C., vice-president, Lincoln Electric Company.

Jan. 27.—"**Some Dredging Problems,**" by W. E. Bonn, A.M.E.I.C., Toronto Harbour Commission.

Feb. 10.—"**Quality Concrete,**" by R. B. Young, M.E.I.C., laboratory engineer, Hydro-Electric Power Commission of Ontario.

Feb. 24.—"**The Contribution of the Engineer to the Immigration Problem,**" by A. G. Dalzell, M.E.I.C.

Mar. 10.—"**Valuation Work from the Engineer's Standpoint,**" by J. Hole, A.M.E.I.C.

Mar. 24.—Branch annual meeting.

Oct. 20.—"**Ice Engineering,**" by Dr. Howard T. Barnes, M.E.I.C., McGill University.

Nov. 3.—"**Non-bituminous Highway Materials and Their Uses,**" by A. T. Goldbeck, National Crushed Rock Association.

Nov. 17.—"**Grand Falls Power Development,**" by A. C. D. Blanchard, M.E.I.C., resident engineer for H. G. Acres and Company.

Dec. 1.—Luncheon meeting in honour of Prof. P. Gillespie, M.E.I.C., Vice-President of The Institute.

Dec. 15.—"**Recent Developments in Highway Construction,**" by R. M. Smith, A.M.E.I.C., acting deputy minister, Department of Highways, Ontario.

The membership of the branch shows a healthy condition. While subject to the normal fluctuations, the total shows an increase of 38 over the preceding year.

We regret to report the loss by death during the year of three valued members:—H. K. Wicksteed, M.E.I.C., C. H. Rust, M.E.I.C., and E. A. James, M.E.I.C.

Membership

The membership on December 31st, 1927, was as follows:—

	Residents	Non-residents	Total
Members	131	4	135
Associate Members	259	19	278
Juniors	52	5	57
Students	79	6	85
Affiliates	4	..	4
Branch Affiliates	2	..	2
Total	527	34	561
1926 total	496	27	523
Increase over 1926	31	7	38

Financial Statement

(For the calendar year of 1927)

Revenue

Bank balance on Jan. 1st, 1927	$1,002.12	
Rebates and branch news	672.72	
Branch Affiliate fees	20.00	
Receipts on dinner accounts	43.00	
Bank interest	22.70	
		$1,760.54

Expenditures

Advertising and printing	$ 232.78	
Room rental	63.50	
Lecturers' expenses	14.45	
Flowers, H. K. Wicksteed's funeral	10.00	
Library	16.41	
Insurance	13.93	
Affiliate Journal fees	4.30	
Expenses of dinners	43.00	
Stenographer and postage, etc.	49.56	
Secretary's honorarium and expenses	162.08	
		$ 610.01
Cheques outstanding on Jan. 1, 1927		112.22
Bank balance on Dec. 31, 1927		1,038.31
		$1,760.54

Respectfully submitted,

R. B. Young, M.E.I.C., *Chairman.*
W. B. Dunbar, A.M.E.I.C., *Secretary-Treasurer*

Vancouver Branch

The President and Council,—

I have the honour to report on the affairs of the Vancouver Branch for the year 1927, as follows:—

In pursuance of the policy adopted during 1926, a programme of weekly meetings was continued during the months of January, February, March and April, 1927. To these meetings the Vancouver Section of the American Institute of Electrical Engineers, and the B.C. Division of the Canadian Institute of Mining and Metallurgy were invited; and throughout the year the closest co-operation has existed between the branch and the Association of Professional Engineers of British Columbia, many of the meetings being held jointly, and personal notices sent to members of both organizations. The Vancouver Branch of the Town Planning Institute of Canada and of the Royal Military College Club were also visitors at meetings which were of special interest to their members. The average attendance at all meetings throughout the year was 56.

Meetings

The following meetings were held by the branch during the year:—

Jan. 5.—"**The Development of an Engineer's Education,**" by E. E. Brydone-Jack, Ph.D., M.E.I.C.
Jan. 12.—"**Mountain Roads,**" by W. G. Swan, M.E.I.C.
Jan. 19.—"**Oscillographs,**" by H. Bickers, Ph.D.
Jan. 26.—"**The Mines of the Province,**" by J. D. Galloway.
Feb. 9.—"**Coast Range of British Columbia,**" by V. Dolmage, Ph.D.
Feb. 16.—"**Recent Developments in Oil Engines,**" by H. F. C. Letson, M.C., Ph.D.
Mar. 9.—"**Recent Advances in Metallurgy,**" by Prof. H. N. Thomson.
Mar. 16.—"**The Reading and Writing of an Engineer,**" by J. Porter.
Mar. 23.—"**The Work of the Vancouver and Districts Joint Sewerage and Drainage Board,**" by J. M. Begg, A.M.E.I.C.
Apr. 6.—"**The Engineering Profession and Its Relation to Engineering Education,**" by E. A. Wheatley, A.M.E.I.C.
Apr. 13.—"**B.C. Silver Mines,**" by C. A. Banks.
Apr. 27.—"**The Need for Wider Streets, as Developed by Investigation in Cities in America and Europe,**" by W. H. Tiedeman.
May 4.—"**Engineering Education,**" by Prof. W. E. Duckering.
May 11.—"**Britannia Mines,**" by C. P. Browning.
Nov. 9.—"**Kenya Colony and the Kenya and Uganda Railway,**" by Brig.-Gen. G. D. Rhodes, C.B.E., D.S.O., M.E.I.C.
Nov. 30.—"**The Reconstruction of the Ocean Falls Dam, 1922-1923,**" by A. K. Robertson, M.E.I.C.
Dec. 14.—Annual meeting.

Executive Committee

The Executive Committee held six regular meetings during 1927, the business of the branch being transacted by it. General meetings were confined strictly to a speaker and his subject, with the exception of the annual meeting. A special meeting of the executive was held on August 8th to meet R. J. Durley, M.E.I.C., general secretary of The Institute, when plans for the Western Professional Meeting to be held in Vancouver in June 1928 were discussed.

General Review of 1927 Business

Branch Elections:—Sixty-nine ballots were returned out of a total of 154 mailed, which is about the average.

Library:—Arrangements are now under way to arrange and index the library, to make it of more value to members.

Walter Moberly Memorial Prize:—The third award of this prize, consisting of eight books from the University Library, was made in May to G. W. Waddington, A.M.E.I.C., for the year 1927.

Royal Engineers Memorial Tablet:—In co-operation with the Association of Professional Engineers, a committee raised the necessary funds by subscriptions from members and erected at Alexandra bridge on the Cariboo road a cairn and bronze Memorial Tablet to the Royal Engineers who first constructed this historic highway. The tablet will be unveiled on July 1st, 1928, the dedication ceremony being conducted by Judge Howay.

Financial Statement

(December 15th, 1926, to December 14th, 1927)

Receipts

Cash on hand, Dec. 15, 1926	$150.52	
Rebates on fees, Aug. 1926-Aug. 1927	364.34	
Branch news	11.18	
Library, rent from Association of Professional Engineers	50.00	
Refund, Dr. Hill's paper	5.00	
Petty cash	.10	
		$581.14

Disbursements

Library, rent	$100.00		
Instalment on principal to Headquarters	25.00		
Subscription, Can. Engineer	3.00		
		$128.00	
Office rent		75.00	
Honorarium, secretary		50.00	
Printing and stationery		83.98	
Dr. Hill's paper reprints		5.00	
Lantern		20.94	
Stenographer		15.00	
Postage	$55.91		
Less paid by A.P.E.	34.50		
		21.41	
J. H. Kennedy wreath		7.00	
Sundries		4.75	
Balance on hand, in bank		148.06	
Balance on hand, cash		22.00	
			$581.14

Library Capital Account

(As at December 14th, 1927)

	Dr.	Cr.
To loan from Headquarters	$300.00	
By instalment repaid 1927		$ 25.00
Balance Dr.		275.00
	$300.00	$300.00

Walter Moberly Fund

(December 15th, 1926, to December 14th, 1927)

Receipts

Cash on hand, Dec. 15, 1926	$ 45.38	
City of Vancouver, bond interest, 1927	25.00	
Dominion of Canada, " " "	5.00	
Bank interest	1.77	
		$77.15

Disbursements

Prize awarded to G. W. Waddington, A.M.E.I.C., (8 books)	$ 25.00	
Cash on hand, Dec. 14, 1927	52.15	
		$77.15

Bonds held for Trust:—	
City of Vancouver Bond No. 663, 5%, 1964	$500.00
Dominion of Canada, No. T.A. 065189, 5%, 1943	100.00
	$600.00

Audited and found correct,
J. Hardie Young, C.A.

The balance of cash on hand, $170.06, shows a slight improvement over the previous year. This will, however, be offset at the close of the year by an expenditure to be met of a minimum of $25.00 for the arranging and indexing of the library.

One cheque was drawn on the Walter Moberly Memorial Fund for $25.00 to cover the prize to G. W. Waddington, A.M.E.I.C., the balance on hand in this account now being $52.15.

It will be noted that rebates to the branch in 1927 were approximately $80.00 less than in 1926, accounted for almost entirely by the non-payment of fees by members.

Membership

	Dec. 17, 1925	Dec. 17, 1926	Dec. 14, 1927
Branch Residents			
Members	60	56	59
Associate Members	90	73	85
Juniors	7	9	10
Students	42	28	44
Affiliates	0	0	0
	199	166	198
Branch Non-residents			
Members	20	15	17
Associate Members	59	51	37
Juniors	12	8	5
Students	9	7	7
Affiliates	1	0	0
	101	81	66

In the passing of Messrs. James H. Kennedy, M.E.I.C., and E. Dundas Todd, A.M.E.I.C., the branch has suffered the loss of two of its truest friends.

On August 11th, F. W. Alexander, M.E.I.C., tendered his resignation as chairman of the branch. This was necessitated by his transfer from Vancouver to Winnipeg in the employ of his company. Since then W. Brand Young, A.M.E.I.C., vice-chairman, has guided the affairs of the branch, Mr. Alexander's chairmanship running to the present date.

Respectfully submitted,

W. BRAND YOUNG, A.M.E.I.C., *Chairman.*
F. P. V. COWLEY, A.M.E.I.C., *Secretary-Treasurer.*

Victoria Branch

The President and Council,—

On behalf of the Executive Committee, we beg to submit the following report of the Victoria Branch for the year ending November 30th, 1927:—

Membership

Many changes have appeared in the membership during the year. Three new members have come from other parts of Canada to reside in the district, D. A. Livingstone, A.M.E.I.C., Engr.-Commander A. D. M. Curry, M.E.I.C., and W. A. Richardson, A.M.E.I.C., and have been added to the roll. Eight members have left the district or severed their connection with the branch. The executive particularly regrets the loss of two members by the removal of their names from The Institute roll for non-payment of dues. The executive also regrets to record the death of Lt.-Col. Charles O'C. Donnelly, M.E.I.C., of Nanaimo, B.C., who died on December 20th, 1926.

The numerical standing of the branch is now:—

	Resident	Non-resident
Members	26	2
Associate Members	23	5
Juniors	0	0
Students	3	0
Branch Affiliates	1	0
	53	7

The total membership is 60, as compared with a total of 68 last year.

Officers

The Branch Executive for the year has been:—

Chairman ....E. Davis, M.E.I.C.
Vice-Chairman ....R. F. Davy, A.M.E.I.C.
Secretary-Treasurer ....K. M. Chadwick, M.E.I.C.
Executive ....H. F. Bourne, A.M.E.I.C.
W. S. Drewry, A.M.E.I.C.
E. P. Girdwood, M.E.I.C.
Ex-officio ....J. N. Anderson, A.M.E.I.C.
Councillor and Past-Chairman.

The executive held eight meetings during the year at which branch business was conducted.

Committees

The conveners of committees were as follows:—

Papers ....F. L. Macpherson, M.E.I.C.
Social ....W. M. Everall, A.M.E.I.C.
Library ....F. W. Knewstubb, A.M.E.I.C.
Town Planning ....E. G. Marriott, A.M.E.I.C.
Publicity ....G. B. Mitchell, M.E.I.C.

The whole executive acted as Attendance, Legislative and Credentials Committees.

In connection with the library, F. W. Knewstubb, A.M.E.I.C., reported that there were no changes during the year.

Meetings

The branch was fortunate during the past year in having an excellent series of addresses, luncheons and outings, which were arranged as follows:—

Dec. 1.—Address on "**Some Experience of a Land Surveyor,**" by F. C. Green, M.E.I.C.

Dec. 15.—Address on "**The Manufacture of Sulphite Pulp,**" by W. L. Ketchen, M.E.I.C., manager, British Columbia Pulp and Paper Company, Port Alice, B.C.

Jan. 11.—Members invited to attend meeting of British Columbia Land Surveyors' Association, to hear address by H. L. Seymour, M.E.I.C., on "**Town Planning,**"

Jan. 13.—Luncheon meeting, at which Mayor C. Pendray was the guest of honour and addressed the members on the advantages of the West Coast business to Victoria. Major Geo. A. Walkem, M.E.I.C., president of The Institute, was present at this meeting.

Jan. 26.—Illustrated address on "**Palestine and Syria,**" by F. G. Aldous, A.M.E.I.C., Lieutenant of the Royal Engineers.

Feb. 25.—Address on "**Town Planning,**" by W. Brand Young, A.M.E.I.C.

Mar. 16.—Address on "**Engineering in Warfare,**" by Major N. C. Sherman, M.E.I.C.

Apr. 7.—Address on "**Alouette and Stave Lakes Development,**" by E. E. Carpenter, M.E.I.C., consulting engineer, British Columbia Electric Railway Company, and on the "**Electric Equipment,**" by C. W. Colvin, assistant electrical engineer, of the same company.

Apr. 22.—Visit to the lithographing department of the *Daily Colonist,* followed in the evening by an illustrated address on "**Rainfall and Run-off,**" by E. G. Marriott, A.M.E.I.C.

Apr. 29.—Visit to mill of Canadian Puget Sound Lumber Company.

July 1.—Official opening of Esquimalt drydock, to which members of the branch were invited by the Celebration Committee of the Diamond Jubilee of Confederation.

Aug. 4.—Luncheon meeting in honour of R. J. Durley, M.E.I.C., General Secretary of The Institute, at which Institute affairs were discussed.

Aug. 10.—Visit to Jordon river power plant of the British Columbia Electric Railway Company.

Oct. 26.—Address on "**Town Planning,**" by Mr. Doughty-Davies.

Nov. 11.—Visit to plant of Sidney Roofing and Paper Company, by invitation of Mr. R. Mayhew, manager.

Meetings of Vancouver Island Prospectors' Association, to which members of the branch were invited. At the first meeting moving pictures of China were given by Mr. Hutcheson, member of the Royal College of Mines, London. At the second meeting, on,—

Nov. 15.—Address on "**Finley River District and Its Mining Possibilities,**" by Mr. Victor Dolmage, of the Dominion Geological Survey Department.

Nov. 23.—Address on "**Water Powers of the Dominion,**" by E. Davis, M.E.I.C.

Financial Statement

(From December 1st, 1926, to November 30th, 1927)

Receipts		
Balance in hand, Dec. 1, 1926		$147.48
Branch dues, 1926	$ 3.00	
Branch dues, 1927	97.50	
Rebates from Headquarters	142.50	
Branch news in Institute Journal	20.14	
Key and use of lantern	1.50	
	$264.64	
		$412.12
Expenditures		
Rent of room 25 Brown building	$120.00	
Printing	20.40	
Electric light	3.38	
Insurance of books	4.10	
Rent of halls for lectures	9.50	
Magazines	17.30	
Wreath	3.50	
Lantern screen	6.30	
Cleaning room	3.00	
Postage for year	14.18	
Binding Engineering News (materials)	1.95	
Typewriter cleaning	5.00	
Honorarium	50.00	
Miscellaneous	1.65	
Entertainments	4.80	
		$265.06
Balance in the bank (Royal Bank)	$131.16	
in cash	15.90	
	$147.06	
		$412.12

Audited and found correct,—

F. GRAY ALDOUS, A.M.E.I.C. }
E. G. MARRIOTT, A.M.E.I.C. } Auditors.

Respectfully submitted,

R. F. DAVY, A.M.E.I.C., *Chairman.*
K. M. CHADWICK, M.E.I.C., *Secretary-Treasurer.*

Winnipeg Branch

The President and Council,—

On behalf of the Executive Committee, we beg to submit the following annual report of the Winnipeg Branch:—

The active membership on the books of the branch is 265, being as follows:—

Members	46
Associate Members	140
Juniors	21
Students	45
Local Affiliates	13
Total	265

Thirteen regular meetings were held in 1927 with an average attendance of 42. A special meeting, held jointly with the Association of Professional Engineers of the Province of Manitoba, was held in March. It took the form of a dinner-dance and entertainment in the Royal Alexandra hotel, Winnipeg. Some 250 members and guests attended this function. Another meeting deserving special mention was a complimentary luncheon tendered to the members of the Executive Committee and chairmen of standing and special committees by the chairman of the branch, Theo. Kipp, M.E.I.C. The luncheon was given in the Manitoba Club on March 8th. Its purpose was to provide an opportunity for the organization of the branch's activities for the year.

Following its custom, the branch presented prizes to four students of the University of Manitoba for the four best competitive papers. Two of the prizes went to the civil engineering section and two to the electrical engineering section. The winners in the civil section were: (1st) Harold Payne, S.E.I.C.; (2nd) A. Bain, S.E.I.C. The winners in the electrical section were: (1st) I. C. Ingimundson; (2nd) E. V. Hunt.

An event of the summer was the visit of General Secretary R. J. Durley, M.E.I.C.

The following is the financial report of the branch:—

Financial Statement

Receipts

Bank balance, Feb. 17, 1927	$1,148.08	
Cash balance	1.25	
Local dues (net)	346.50	
Rebate, dues	389.23	
" branch news	2.76	
" advertising	18.00	
Bank interest	29.68	
Bond interest	13.75	
Total net receipts		$1,949.25

Receipts for Adjustment

Institute Headquarters, J. A. Wright, Jr.E.I.C., account		5.00	
Local Affiliate Journal Account:—			
Reynolds	$2.00		
Stainton	2.00		
Schumacher	2.00		
		6.00	
			$ 11.00
Grand total receipts			$1,960.25

Expenditures

Printing and supplies	$ 171.27
Secretary-treasurer	180.00
Stenographer	120.00
Janitor	10.00
Students' prizes	80.00
Entertainment	250.00
Cash	23.18
Total net expenditures	$834.45

Expenditure for Adjustments

Local Affiliate Journals	$6.00		
J. A. Wright account	5.00		
Exchange, general	.30		
Exchange re McLeod	.15		
Cash balance	3.07		
		$ 14.52	
Grand total expenditures			$ 848.97
Excess receipts over expenditures			$1,111.28

Bank Reconciliation

Bank balance, Dec. 31, 1927	$1,129.08		
Outstanding cheques, deduct	63.80		
		$1,065.28	
Deposit, Jan.	$ 32.00		
Deposit, pending receipt of December rebates	14.00		
		$ 46.00	
			$1,111.28

Respectfully submitted,

Theo. Kipp, M.E.I.C., *Chairman.*
James Quail, A.M.E.I.C., *Secretary-Treasurer.*

THE

ENGINEERING JOURNAL

THE JOURNAL OF
THE ENGINEERING INSTITUTE
OF CANADA

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Report of Committee on Institute's Prizes and Medals

On page 284 of the May 1927 issue of The Engineering Journal there appears, under the column "Correspondence," the interim report of the Committee on The Institute's Prizes and Medals, in which the Committee outlined the situation with regard to the prizes and medals awarded by The Institute, and made certain recommendations with a view to revising the rules governing the award of Students' Prizes and the establishment of additional prizes. In the editorial column on page 278 of the same issue of the Journal there appeared a brief review of the report of this Committee.

Subsequently, at the Annual Meeting which has just taken place in Montreal, on February 14th, 1928, the Committee's final report was presented and adopted, and there are reproduced herewith, for the information of the membership at large, the rules governing the award of prizes to Students and Juniors; the rules governing the award of the Sir John Kennedy Medal and the rules governing the award of the Past-Presidents' Prize.

Rules Governing Award of 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.

Rules Governing Award of the Sir John Kennedy Medal

A gold medal, to be called the "Sir John Kennedy Medal," may be struck and awarded under the following rules, in commemoration of the great services rendered to the development of Canada, to engineering science and to the profession by the late Sir John Kennedy, Past-President of The Engineering Institute of Canada.

(1) The medal shall be awarded by the Council of The Institute, but only when the occasion warrants, as a recognition of outstanding merit in the profession or of noteworthy contribution to the science of engineering or to the benefit of The Institute.

(2) As a guide in making the award, the Council of The Institute shall take into consideration the life, activities and standing in the community and profession of the late Sir John Kennedy.

(3) Awards shall be limited to corporate members.

(4) At the beginning of each year, every branch of The Institute shall be asked for its recommendation, supported by reasons, for the award of the medal, which must be submitted to Council not later than May 1st. The Council of The Institute shall then give consideration to the recommendations, but will not necessarily adopt any of them. If, in the opinion of the Council, no corporate member of The Institute thus recommended is of sufficient merit or distinction, no award shall be made.

(5) The award shall be decided by letter ballot of the Council in a form to be prescribed by the Council. The ballot shall be mailed to each member of the Council and shall state the date of the Council meeting at which it is proposed to canvass the ballot, which shall not be less than twenty days after the issue of the ballot. At least twenty votes shall be cast to constitute an award. Three or more negative votes shall exclude from an award.

(6) Announcement of an award shall be made in The Engineering Journal and at the Annual Meeting, and, if possible, the presentation shall take place at that meeting.

Rules Governing Award of the Past-Presidents' Prize

In recognition of the fund established 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 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.

Meetings of Council

Meeting of February 10th, 1928

A meeting of Council was held at 8 o'clock p.m. on Friday, February 10th, 1928, at Headquarters: President A. R. Decary, M.E.I.C., in the chair and eight other members of Council being present.

The secretary presented a report regarding the expense involved in the holding of Plenary Meetings of Council, and the benefits to be derived from such meetings, and was directed to publish this in an early issue of the Journal for the information of members.

The membership of the Nominating Committee for the current year was announced, as contained in the Report of Council for 1927, and D. C. Tennant, M.E.I.C., was appointed Chairman.

The Report of Council and the reports of the various committees of Council were considered, and approved for presentation at the Annual General Meeting.

A letter was submitted from the Calgary Branch containing a resolution passed by that branch favouring the continuation of research work in connection with the deterioration of concrete in alkali soils, and the secretary was directed to communicate with the National Research Council drawing their attention to the desirability of appropriating funds for the continuation of this important work.

An announcement regarding a World Engineering Congress to be held in Tokio in October 1929 was noted, and the secretary was directed to forward information regarding this to all the branches of The Institute.

Five applications for reinstatement were considered and approved.

Six special cases were given consideration.

Ten resignations were accepted.

The following elections and transfers were effected:—

Elections	
Member	1
Associate Members	4
Juniors	4
Students	6
Affiliate	1

Transfers	
Associate Member to Member	1
Junior to Associate Member	4
Student to Associate Member	7
Student to Junior	3
Affiliate to Associate Member	1

The Council rose at 10.30 o'clock p.m.

Meeting of February 13th, 1928

A special meeting of Council was held at Headquarters on Monday, February 13th, 1928, at 8 o'clock p.m.: President A. R. Decary, M.E.I.C., in the chair and eight other members of Council being present.

At this special meeting, Council was occupied with the consideration of the proposals for the amendment of By-laws; particularly with the objection which had been raised by one of the branches to the proposed amendment to Section 76.

An opinion having been obtained from Council's legal adviser as to the legality of making such changes in the wording of this amendment as would meet the objection referred to, it was decided that this should be done before the amendment is presented for discussion at the Annual General Meeting.

Suggestions having been received from the Ottawa and Hamilton Branches regarding the possibility of holding the Annual Meeting for 1929 in those cities, the secretary was directed to place this matter on the agenda for the Annual General Meeting.

The Council rose at 9 o'clock p.m.

Meeting of February 14th, 1928

A meeting of Council was held at 5.20 o'clock p.m. at the Windsor Hotel, Montreal, on Tuesday, February 14th, 1928: President Julian C. Smith, M.E.I.C., in the chair and ten other members of Council being present.

R. J. Durley, M.E.I.C., was unanimously reappointed as Secretary.

F. P. Shearwood, M.E.I.C., was unanimously reappointed as Treasurer.

The chairmen of the standing committees of The Institute were unanimously appointed as follows:—

Finance Committee ....J. H. Hunter, M.E.I.C.
Library and House Committee .....W. C. Adams, M.E.I.C.
Publications Committee ....P. L. Pratley, M.E.I.C.
Legislation and By-laws Committee. O. O. Lefebvre, M.E.I.C.

The attention of Council was drawn to a communication received from Colonel E. G. M. Cape, M.E.I.C., regarding the development of a standard contract form governing engineering construction work. P. L. Pratley, M.E.I.C., was appointed chairman of a committee to discuss this matter with the Canadian Construction Association, the other members of his committee to be appointed at the next meeting of Council.

The Council rose at 6.15 o'clock p.m.

ELECTIONS AND TRANSFERS

At the meeting of Council held on February 10th, 1928, the following elections and transfers were effected:—

Member

ANGELIS, Marius Lewis de, B.Sc. and A.C.G.I., (London City and Guilds Engrg. College), asst. elect'l engr., Mtl. Tramways Co., Montreal, Que.

Associate Members

HEROUX, Joseph Edmond Napoleon, B.A.Sc., (Laval Univ.), asst. engr. with tech. service, city of Montreal, Montreal, Que.

LAURIAULT, Wilfred Eldige, chem. engr., (Univ. of Mtl.), engr., tech. service, city of Montreal, Montreal, Que.

PRUD'HOMME, Michael Alexander, ch. dftsman, design and constrn. of ry. freight cars of spec. constrn. with Hart-Otis Car Co., Montreal, Que.

STE. MARIE, Louis Alexandre, B.A.Sc., (Laval Univ.), asst. engr., tech. service, city of Montreal, Montreal, Que.

Juniors

CHVILIVITZKY, Jakov, 4th year student, dept. of C.E., Univ. of Toronto, Toronto, Ont.

JACKSON, Charles H., B.A.Sc., (Univ. of Toronto), asst. supt., constrn.), paper mill constrn., Price Bros. & Co., Ltd., Riverbend, Que.

MATHIESON, T. Stanley, B.Sc., (Queen's Univ.), dftsman, Can. Int. Paper Co., Temiskaming and Hawkesbury, Ont.

SCHONI, Willy, dipl. elect'l engrg., (Swiss Polytechnique Inst.), asst. engr., switchboard engrg. dept., C.G.E. Co., Peterborough, Ont.

Affiliate

CHAPPELL, Melbourne Russell, general mgr. and vice-president, Chappell Bros. & Co., Ltd., Sydney, N.S.

Transferred from the class of Associate Member to that of Member

McVEAN, Harold Gordon, B.A.Sc., (Univ. of Toronto), consultant re business and personal estate org., estate taxation, life ins., business and personal trusts, etc., Toronto, Ont.

Transferred from the class of Junior to that of Associate Member

LUCAS, Leslie, plant mgr., Northern Canada Power Ltd., Timmins, Ont.

ROSE, Alexander Andrew, B.A.Sc., (Univ. of Toronto), head of tech. dept., Sault Ste. Marie Tech. School, Sault Ste. Marie, Ont.

ROSE, John Thorborn, B.A.Sc., (Univ. of Toronto), asst. engr. on Int. Hydrographic Aerial Survey, Winnipeg, Man.

ZEALAND, Edward L., B.A.Sc., (Univ. of Toronto), constrn. engr. on plant constrn., Aluminum Co. of Canada, Arvida, Que.

Transferred from the class of Student to that of Associate Member

BEECROFT, George William, B.A.Sc,. (Univ. of Toronto), field engr., El Centro Tropical Oil Co., Colombia, S.A.; at present on vacation.

BONNEVILLE, Sydney, B.Sc., (McGill Univ.), protection engr., reporting to transmission engr., Bell Tel. Co., Montreal, Que.

CHALMERS, Andrew Edward, B.Sc., (Queen's Univ.), engr. and road supt., twp. of Bertie in Welland county, Ont.

FLEMING, John Murray, B.A.Sc., (Univ. of Man.), designing engr. with C. D. Howe &. Co., Port Arthur, Ont.

GWYTHER, Valentine Mackenzie William, B.A.Sc., (Univ. of B.C.), ch. of party on land survey work, North Vancouver, B.C.

MESSENGER, William Aubrey, B.Sc., (McGill Univ.), vice-president and engr. with G. H. Emery Constrn. Co., Windsor, Ont.

WHITE, Joseph James, B.E., (Univ. of Sask.), supt. of general constrn. work and design with Miners and Ball, Ltd., Saskatoon, Sask.

Transferred from the class of Student to that of Junior

HARLOW, George Hammond, B.A.Sc., (Univ. of Toronto), instructor in thermodynamics at Univ. of Toronto, Toronto, Ont.

MORGAN, Frederick Stewart, B.A.Sc., (Univ. of B.C.), designer of struct. steel and reinforced concrete in constrn. dept., Knickerbocker Ice Co., New York, N.Y.

WESTREN, J. Harvey, B.A.Sc., (Univ. of Toronto), asst. supt., mech. goods div., Dunlop Tire and Rubber Corp., Toronto, Ont.

Transferred from the class of Affiliate to that of Associate Member

NELSON, Maxwell Stuart, B.Sc., (McGill Univ.), i/c design, detail, manufacture and installation of architectural and bldg. constrn., ironwork and light structural steel, A. Faustin, Ltd., Montreal.

Institute's Prizes Awarded

The reports of the committees on the award of Institute prizes for the past year, as presented at the Annual Meeting in Montreal on February 14th, 1928, are published in this issue of the Journal and show the following awards:—

THE LEONARD MEDAL to Sir Stopford Brunton, A.M.E.I.C., for his paper on "The Gold Deposits of Nova Scotia," which was published in July 1926 issue of the Bulletin of the Canadian Institute of Mining and Metallurgy.

THE PLUMMER MEDAL to Professor J. W. Shipley and Mr. Chas. F. Goodeve for their paper entitled "Alternating Current Electrolysis," which was published in the January 1927 issue of The Engineering Journal.

A STUDENTS' PRIZE to W. T. Fanjoy, S.E.I.C., for his paper on "Control of Common Types of A.C. Motors."

Of interest to the members is the report of a special committee of Council, which, after a careful study of the existing rules and regulations regarding the award of The Institute's Prizes, has recommended a revision of the rules regarding the award of prizes to Students and Juniors, the establishment of a prize in the form of a gold medal to be known as the Sir John Kennedy Medal, and rules regarding the award of this medal, and also rules governing the award of the Past-Presidents' Prize. The report of this committee was presented at the Annual Meeting in Montreal on February 14th, 1928, and was adopted by the meeting, and the rules recommended by the committee are published on another page of this issue for the information of the membership at large.

OBITUARY

Malcolm Hugh MacLeod, M.E.I.C.

In the death of Malcolm Hugh MacLeod, M.E.I.C., which occurred at his home in Toronto, Ont., on February 9th, 1928, The Institute has lost another of its first members, whose election as a Member of The Canadian Society of Civil Engineers took place on June 9th, 1887.

The late Mr. MacLeod was born in Scotland in 1857 and came to America with his parents in 1862, receiving his education in the public and private schools of Franklin, Pa., and New York. His first engineering work was as rodman on the Victoria Railway in 1875, and in 1879 he was appointed assistant on construction of the Credit Valley Railway. The following year he was employed with the Ontario Pacific Junction Railway, first as leveller and later as transitman on location surveys. In 1881 he joined the Ontario and Sault Ste. Marie Railway as transitman, and the next year was appointed resident engineer on construction of the Toronto and Ottawa Railway.

During the next two years Mr. MacLeod was engaged as resident engineer on the construction of the Lake Superior Division of the Canadian Pacific Railway Company, and the following year was in charge of the location survey and construction of the Atlantic and Northwest Railway. Subsequently, he was appointed superintendent of operations for the Crow's Nest Pass Division of the Canadian Pacific Railway Company. In 1900 he left the Canadian Pacific to become chief engineer of the Canadian Northern Railways, and was appointed general manager and chief engineer in 1907. Previous to the amalgamation of the Grand Trunk Pacific and the Canadian Northern Railways in 1923, he was appointed vice-president in charge of construction and after the amalgamation he became advisory engineer to the executive, in which position he remained until the time of his death.

Mr. MacLeod took an active interest in the affairs of The Institute and served on the Council during the years 1906, 1918 and 1919.

PERSONALS

George C. Clarke, A.M.E.I.C., who has been on the staff of the Harbour Drydock Company, Inc., New York City, has accepted a position in Montreal with Fraser-Brace Engineering Company, Limited.

Philip Hughes, S.E.I.C., who graduated from McGill University with the degree of B.Sc. in 1926, has joined the staff of the Bureau of Tests of the International Paper Company at Glen Falls, N.Y.

W. H. Abbott, A.M.E.I.C., has joined the staff of Busfield, McLeod Limited, and is taking charge of their heavy oil engine department. Mr. Abbott is now spending some months in England visiting various plants and studying latest developments in the oil engine field.

F. E. Emery, A.M.E.I.C., formerly employed in the construction department of Swift and Company, Chicago, Ill., has joined the staff of the International Steel and Iron Company at Chicago. Prior to going to Chicago in 1925, Mr. Emery was Alberta representative of The Manitoba Bridge and Iron Works.

A. D. Huether, A.M.E.I.C., has recently joined the organization of Busfield, McLeod Limited, as manager for Ontario, and has taken charge of the Toronto office of this company. Mr. Huether has been for a number of years with the construction department of the Ontario Hydro-Electric Power Commission, and is also well-known in Ontario as a former member of the Argonaut football team.

G. B. Lomer, A.M.E.I.C., who for some time past was designing engineer for the Power Corporation of Canada, is now located in Georgetown, British Guiana, as acting manager of The Demerara Electric Company, Limited. Mr. Lomer is a graduate of McGill University, from which he received the degree of B.Sc. in 1910. Following graduation, he was for a number of years with the following companies: Canadian Pacific Railway Company, Canadian Explosives, Limited, and the Wayagamack Pulp and Paper Company, Limited. From 1919 to 1920 he was with Smitch, Hinchman and Grylls, engineers, Detroit, Mich., as designing engineer. The following two years he spent with the Riordon Pulp and Paper Company as combustion engineer and subsequently with the E. B. Eddy Company in the same capacity.

W. R. Pearce, M.E.I.C., Receives Appointment in South America

W. R. Pearce, M.E.I.C., chief engineer of the New Brunswick Telephone Company, Limited, has severed his connection with that concern to accept the position of general superintendent of plants for the International Telephone and Telegraph Corporation of South America, and will have his headquarters in Montevideo, Uruguay. Mr. Pearce first entered the telephone field in 1905, immediately following graduation from Queen's University, becoming engaged with the Western Electric Company as an electrical student. He was first sent to Chicago, where he remained for four years, then going to Alberta. In 1909 he accepted a position with the Alberta Government Telephones and in 1912 was placed in charge of engineering construction and maintenance of the plant, with headquarters at Edmonton, Alta. Subsequently, in 1914, in addition to the engineering and plant department, he was placed in charge of the entire system. On March 1st, 1921, he accepted the position of chief engineer of the New Brunswick Telephone Company, Limited.

Major Chas. A. Doherty, A.M.E.I.C., now Located in Malta

Major Chas. A. Doherty, A.M.E.I.C., formerly connected with the Air Ministry, England, is now located in Valletta, Malta, where he is engaged upon construction work and the installation of a pumping plant and sewage system.

Major Doherty is a native of Erin, Ont., and entered the Faculty of Applied Science at the University of Toronto in 1913, but on account of the war he did not complete his course. He began his engineering work in 1911 as chainman with the Grand Trunk Pacific Railway, and was later with a firm of building contractors at Toronto and Scarboro, and subsequently with another firm of contractors as assistant to the chief engineer, and later in charge of all excavation and concrete work on No. 2 section of the Welland ship canal.

In 1916, he proceeded overseas with the Canadian Field Artillery and in July 1917 was seconded to the Department of Fortifications and Works War Office on aerodrome construction, subsequently being appointed resident engineer in charge of the construction of the Rockford Aerodrome, Essex. The following year he held the same position in charge of the construction of Norwich Acceptance Park and two training schools. In September 1918 he was transferred to the Air Construction Service, Royal Air Force, and placed in charge of all engineering and works services on aerodromes in Eastern and Midland counties, which territory was afterwards enlarged to include Western and Northern counties. Following the reorganization of this service, he was appointed sub-area officer with the rank of Major in charge of new construction and maintenance of permanent air stations from London and Bristol as far north as Liverpool and Hull.

Julian Cleveland Smith, LL.D., M.E.I.C.

President of The Engineering Institute of Canada

Occupying a prominent position in the engineering, industrial and business life of the Dominion, and with personal characteristics differing greatly from those usually associated with the great captains of industry, the newly-elected President of The Institute, Julian C. Smith, LL.D., M.E.I.C., M.I.E.E., F.AM.I.E.E., brings to the Council of The Institute, as its presiding officer, the experience and understanding of one who has advanced from a very junior position in his chosen profession to the responsible duty of directing one of Canada's greatest engineering industrial organizations.

JULIAN CLEVELAND SMITH, LL.D., M.E.I.C.

Mr. Smith was born on October 7th, 1878, at Elmira, N.Y., receiving his early education at the Central High School, Buffalo, and his engineering training at Cornell University, from which he graduated, with the degree of M.E., in 1900.

He began his business career as a draughtsman with Wallace C. Johnston, at Niagara Falls, N.Y., and in 1902 joined the organization of the Shawinigan Water and Power Company as assistant engineer of the Company's plant at Shawinigan Falls, Que. In 1903, he was appointed superintendent of the plant, and gradually advanced to the position of general superintendent and chief engineer of the Company. The next change was in 1913, when he became vice-president of the Company, and this was followed by his appointment as vice-president and general manager in 1916. The phenomenal development of the Shawinigan Water and Power Company and its subsidiary and associated companies, is in no small measure due to the genius of Mr. Smith, for his has been the dominating personality responsible for the growth which has taken place during the twenty-six years of his association with the Company.

The Company of which he is vice-president and general manager, from a small beginning, has become one of the greatest power companies in the world, controlling extensive resources, and serving a very large part of the inhabited portion of the province of Quebec. Besides the positions which he holds with the Shawinigan Water and Power Company, Mr. Smith presides over the activities of its many subsidiary companies. He is president of the United Securities Limited; the Montreal Tramways Company; the Quebec Power Company; the North Shore Power Company, Limited; the Shawinigan Chemicals, Limited; and the St. Maurice Power Company, Limited, and is vice-president of the Dominion Engineering Works, Limited, and director of a large number of companies, including the Dominion Bridge Company, Limited.

Mr. Smith has been the recipient of many honours, and in 1922 the degree of Doctor of Laws was conferred upon him by Queen's University, in recognition of his high attainments.

In addition to a thorough technical training, enriched by wide experience, Mr. Smith possesses a keen memory and discernment far above the average. He is by nature generous and sympathetic and modest to a degree and enjoys to a remarkable extent the esteem and affection of his associates.

Mr. Smith is a member of various clubs in New York and Montreal, and of the leading technical associations in England and the United States. He joined The Institute before its change of name, being elected a Student on January 14th, 1904. He was transferred in April of the same year to the grade of Associate Member, and was elected a Member on April 8th, 1911.

The Forty-Second Annual General and General Professional Meeting

Convened at Headquarters, Montreal, January 19th, 1928, and Adjourned to the Windsor Hotel, Montreal, February 14th, 1928.

Annual General Meeting at Institute Headquarters

The Forty-Second Annual General Meeting of The Institute was held at Headquarters on Thursday, January nineteenth, nineteen hundred and twenty-eight, at eight o'clock p.m., with President A. R. Decary, M.E.I.C., in the chair.

The secretary having read the notice convening the meeting, the minutes of the Forty-First Annual General Meeting were submitted, and, on the motion of F. S. B. Heward, A.M.E.I.C., seconded by B. Grand Mont, A.M.E.I.C., were taken as read and confirmed.

Appointment of Scrutineers

On the motion of J. L. Busfield, M.E.I.C., seconded by J. G. Caron, A.M.E.I.C., John S. Brisbane, A.M.E.I.C., and A. I. Vallieres, A.M.E.I.C., were appointed scrutineers to report the result of the Officers' Ballot.

Appointment of Auditors

On the motion of Geo. R. MacLeod, M.E.I.C., seconded by J. T. Farmer, 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 K. B. Thornton, M.E.I.C., seconded by C. K. McLeod, A.M.E.I.C., that the meeting do adjourn to reconvene on Tuesday, February fourteenth, nineteen hundred and twenty-eight, at ten o'clock a.m., at the Windsor Hotel, Montreal.

The meeting accordingly adjourned at five minutes past eight o'clock p.m.

Meeting at Windsor Hotel, Montreal

The adjourned meeting was called to order by President A. R. Decary, M.E.I.C., in Windsor Hall, at the Windsor Hotel, at 10 o'clock a.m., on February fourteenth, nineteen hundred and twenty-eight.

The secretary having announced the messages of regret received from members and invited guests, the question of approval of the Prize Fund Regulations was considered. After a short discussion, the regulations, having already been approved by Council, were unanimously approved as governing the award of prizes to Students and Juniors, the award of the Sir John Kennedy Medal and the award of the Past-President's Prize.

As directed by Council, the secretary presented a statement which he had prepared regarding the Plenary Meeting of Council which was held in October last, giving information as to the cost and the benefits to be derived from such meetings. This memorandum was unanimously approved, the sense of the meeting being that the policy of holding Plenary Meetings should certainly be continued, and the hope being expressed that it might even be possible to hold two such meetings each year. This matter, however, was left for the decision of Council.

Reports of Council and Committees

On the motion of Geoffrey Stead, M.E.I.C., seconded by Geo. R. MacLeod, M.E.I.C., the report of Council for 1927, as published on page 193 of the March issue of the Journal, was taken as read and approved, and consideration of the reports of the various committees followed.

The chairman of the Finance Committee, in presenting its report, drew attention to the satisfactory condition of The Institute's finances, and particularly to the way in which the expenses of publishing the Journal had been met. On the motion of J. H. Hunter, M.E.I.C., seconded by J. L. Rannie, M.E.I.C., the report of the Finance Committee was adopted.

The report of the Nominating Committee for 1928 was presented by the secretary, and, on the motion of Brig.-Gen. C. H. Mitchell, M.E.I.C., seconded by Geoffrey Stead, M.E.I.C., was unanimously adopted. The chairman stated that the Council had appointed D. C. Tennant, M.E.I.C., as chairman of the Nominating Committee for 1928 and announced its membership as printed on page 197 of the March issue of the Journal.

The report of the Papers Committee, as published on page 197 of the March issue of the Journal, was taken as read and was unanimously adopted, on the motion of J. L. Rannie, M.E.I.C., seconded by F. T. Kaelin, M.E.I.C.

The report of the Publications Committee, as published on page 197 of the March issue of the Journal, was unanimously adopted on the motion of P. L. Pratley, M.E.I.C., seconded by Geo. R. MacLeod, M.E.I.C.

On the motion of C. K. McLeod, A.M.E.I.C., seconded by F. C. Laberge, M.E.I.C., the reports of the Board of Examiners and Education and of the Committee on Engineering Education, as published on pages 197 and 198 of the March issue of the Journal, were unanimously adopted.

The secretary read the reports of the committees dealing with the award of the Gzowski Medal, Leonard Medal, Plummer Medal and the Students' Prizes, as published on page 198 of the March issue of the Journal, and they were adopted on the motion of A. J. Grant, M.E.I.C., seconded by F. P. Shearwood, M.E.I.C.

The report of the Committee on Biographies, as published on page 198 of the March issue of the Journal, was adopted on the motion of Prof. P. Gillespie, M.E.I.C., seconded by Geo. R. MacLeod, M.E.I.C.

The report of the Library and House Committee, as published on page 199 of the March issue of the Journal, was adopted on the motion of W. C. Adams, M.E.I.C., seconded by C. K. McLeod, A.M.E.I.C.

The report of the Committee on International Co-operation, as published on page 199 of the March issue of the Journal, was presented by B. S. McKenzie, M.E.I.C., and, on his motion, seconded by J. H. Hunter, M.E.I.C., was adopted.

The report of the Canadian National Committee of the International Electrotechnical Commission, as published on page 200 of the March issue of the Journal, was adopted on the motion of L. W. Gill, M.E.I.C., seconded by F. C. Laberge, M.E.I.C.

The report of the Honour Roll and War Trophies Committee, as published on page 200 of the March issue of the Journal, was adopted on the motion of Brig.-Gen. C. H. Mitchell, M.E.I.C., seconded by Geo. R. MacLeod, M.E.I.C.

In presenting the report of the Committee on the

Deterioration of Concrete in Alkali Soils, as published on pages 200-202 of the March issue of the Journal, the secretary pointed out that this report should be read in connection with its two appendices, A and B, which, on account of the important technical information they contained, were being printed separately and presented at the General Professional Meeting on the 16th instant, these appendices giving respectively the complete history of the Committee's field specimens of concrete and the chemical findings which had been based on these field tests. C. J. Mackenzie, M.E.I.C., as chairman of the Committee, pointed out that the work of the Committee had involved the expenditure of over $40,000, a large proportion of which had been furnished by the National Research Council; that the Committee's funds had now been exhausted, and that it was very desirable to continue the investigations. He hoped that The Institute would approach the National Research Council with the request that they provide funds for the continuation of this work. Dean Mackenzie's views were supported by B. S. McKenzie, M.E.I.C., Brig.-Gen. C. H. Mitchell, M.E.I.C., and by Dean F. D. Adams, HON.M.E.I.C., and, on the motion of Geo. R. MacLeod, M.E.I.C., seconded by W. G. Mitchell, M.E.I.C., the Committee's report was adopted, on the understanding that a resolution would be drawn up and presented at a later period of the meeting, with the view of making representations to the National Research Council regarding the matter.

The report of The Institute's Members of the Main Committee of the Canadian Engineering Standards Association, as published on page 202 of the March issue of the Journal, was taken as read and adopted on the motion of F. P. Shearwood, M.E.I.C., seconded by K. L. Dawson, A.M.E.I.C.

Amendments to By-laws

In presenting for discussion the amendments proposed to the By-laws, the secretary pointed out that these were exceptionally numerous, that they had been published in the Journal for December 1927, page 532, and for January 1928, page 34, and that while the majority had been proposed by Council on the recommendation of the Legislation and By-laws Committee, a very important amendment affecting the method of electing members by letter ballot of the Council had been proposed by twenty corporate members of the Moncton Branch. The president pointed out that some of the proposed amendments involved merely minor changes in wording and could, perhaps, be dealt with first, and, after a brief discussion, on the motion of Geoffrey Stead, M.E.I.C., seconded by K. L. Dawson, A.M.E.I.C., it was resolved that the proposed amendments to Sections 68, 69 and 70 be submitted to the membership by letter ballot. Similar action followed in connection with the proposed amendments to Sections 9, 10, 18 and 24.

With regard to the proposed amendment to Section 35 dealing with the annual fees payable by members, the secretary drew attention to letters received regarding this matter from the Niagara Peninsula Branch, London Branch, Lethbridge Branch, Sault Ste. Marie Branch, Saskatchewan Branch, Peterborough Branch, Calgary Branch and Halifax Branch. Considerable discussion followed, during which W. J. Johnston, A.M.E.I.C., stated the views of the Saint John Branch, and it was pointed out that the proposal, which seeks to increase the fees of Members only, originated with the Plenary Meeting of Council in October last. The treasurer, Mr. Shearwood, drew attention to the difference in the expenditure per member for various purposes in the case of The Engineering Institute and the American Society of Civil Engineers, submitting figures showing that the expenditure on salaries, publications, travelling expenses and meetings is very much less per member in the case of The Engineering Institute, while the expenditure on local branches is much greater. W. G. Mitchell, M.E.I.C., pointed out that the progress and development of The Institute were dependent upon the provision of additional funds, and after prolonged discussion, the sense of the meeting appeared to be that while an increase in members' fees was desirable, the best method of allocating the increase between the various classes of membership was by no means clear. After further discussion, the chairman, in accordance with the provisions of Section 76 of the By-laws, appointed W. G. Mitchell, M.E.I.C., and K. L. Dawson, A.M.E.I.C., to state the reasons to be advanced in favour of the proposal, and O. O. Lefebvre, M.E.I.C., and C. H. Wright, M.E.I.C., to state the reasons for opposing the proposal, these statements to be sent out with the letter ballot.

The meeting adjourned at 12.45 p.m.

On re-assembling at 3 o'clock p.m., discussion was resumed on the report of the Committee on the Deterioration of Concrete in Alkali Soils, and, on the motion of Brig.-Gen. C. H. Mitchell, M.E.I.C., seconded by Professor C. M. McKergow, M.E.I.C., the following resolution was unanimously adopted.

> "This General Meeting of The Engineering Institute of Canada desires to place on record its great appreciation of the excellent work which has been done by the Committee on the Deterioration of Concrete in Alkali Soils, and realizes the enormous amount of time and attention which the Committee has devoted to the task involved in approaching and securing the funds for furthering its investigations.
>
> "The Meeting desires also to congratulate the Committee on its results.
>
> "This Annual Meeting, while desirous that the Committee be continued, recommend to the incoming Council that representations be made to the Research Council of Canada, which has so generously and sympathetically supported this useful work in the past, and urge that a further investigation into this subject be continued by them, believing that it is one of the most important subjects for research which they can undertake at this time.
>
> "Further, it recommends that if the Committee be continued the Council express to the Research Council that the past and future services of the Committee and the support of The Institute generally be available to the Research Council in this valuable work."

Discussion on the proposed amendments to the By-laws was then resumed, and the amendment proposed by Council to Section 52 was unanimously approved, without discussion, for inclusion in the letter ballot, as follows:—

> "In order to authorize the present practice in a number of branches, it is proposed to add to subsection (a) the words 'the secretary and treasurer may, as an alternative, be appointed by the Executive Committee instead of being elected by the members of the branch.'"

Similar action was taken as regards the proposed amendment to Section 53 which provides that in order to provide for the formation of Students' Sections in connection with branches, it is proposed to add to this Section an additional paragraph reading as follows:—

> "Students' Sections may likewise be established at the request of members of a branch, made in writing to the secretary of the branch, and approved by the Executive Committee. The rules for such Students' Sections shall be submitted to Council for approval."

The proposed amendment to Section 74 was also approved for inclusion in the letter ballot, reading as follows:—

> In order to authorize the present practice of not requiring subscriptions to the Journal from Honorary Members, Life Members and members who have compounded their fees, it is proposed to amend Section 74 as follows:—
>
> *Line 1*—Insert after the word "classes" the words "(except Honorary Members, Life Members and Members who have compounded their fees, who shall receive the Journal gratis)."
>
> *Line 2*—Delete the words "(form E in the appendix)."

Discussion followed on the amendment proposed by Council to Section 76, dealing with the procedure in amending By-laws, and the secretary explained the action which had been taken by Council to which exception had been taken by the Moncton Branch. A communication, comprising a preamble and resolution, forwarded by that branch under date of January 14th, 1928, was read to the meeting, together with subsequent correspondence between the secretary and the secretary-treasurer of the Moncton Branch.

The secretary then stated that subsequent to this correspondence, Council had taken legal advice as to whether, in order to meet the objections of the Moncton Branch, Council could legally change the wording but not the meaning or intent of its proposed amendments before submission to the Annual General Meeting for discussion, and also whether a proposal to amend a By-law could be withdrawn before submission to the Annual General Meeting. Counsel's reply to the first question was in the affirmative, provided that the modification is for clarity only and does not change the intent and purpose, and the reply to the second question was in the affirmative.

Having heard the explanation of Council's action on this matter, it was unanimously resolved, without further discussion, that the proposed amendment should go out to ballot in the revised form submitted by Council, as follows:—

It is proposed to change the second paragraph of Sectoin 76 so as to read:—

> "All proposals shall be submitted for discussion at the Annual Meeting; the members there present may propose an amendment or amendments thereto, and all proposals made with any such amendment or amendments shall be printed on the letter ballot to be submitted to the corporate membership of The Institute."

In presenting the amendment proposed to Section 29, dealing with the method of election of members by letter ballot of the Council, the secretary read the original communication dated January 12th, 1927, signed by twenty corporate members of the Moncton Branch, and explained that this proposal had been considered at the Plenary Meeting of Council, that Council had suggested the advisability of withdrawing it pending further consideration of the question, but that the members signing desired that the proposal should go out to ballot as it stood.

An active discussion followed, from which it appeared to be the sense of the meeting that some modification in the present method of electing members by letter ballot of Council was desirable, but that probably the proposal of the Moncton members, if carried, would not prove altogether satisfactory when put in operation. It was felt that Council should give the matter further study before putting forward a proposal for ballot. At the conclusion of the discussion, the president appointed J. H. Hunter, M.E.I.C., and C. E. Fraser, M.E.I.C., to prepare a statement giving the reasons for the proposed amendment, and O. O. Lefebvre, M.E.I.C., and W. G. Mitchell, M.E.I.C., to prepare a statement of the reasons against, for inclusion in the letter ballot.

With regard to the reports of the several branches, the president suggested that in view of the fact that these were in the members' hands in printed form, they might be dealt with in one resolution, unless discussion was desired on any particular report.

This was agreed to, and, on the motion of Brig.-Gen. C. H. Mitchell, M.E.I.C., seconded by J. H. Hunter, M.E.I.C., it was unanimously resolved that the branch reports be taken as read and accepted.

Col. E. G. M. Cape, M.E.I.C., drew attention to the development during the past few years of standard contract forms by the Canadian Construction Association, these forms at present three in number, covering respectively the relations between the general contractor and the owner, the general contractor and the sub-contractors, and the nature of contracts to be carried out on a cost-plus basis. The forms had now been tried in practice for some years, and had been extensively modified as the result of experience; the Canadian Construction Association now desired their consideration by The Engineering Institute of Canada. After discussion, on the motion of Col. E. G. M. Cape, M.E.I.C., seconded by J. H. Hunter, M.E.I.C., the following resolution was unanimously adopted:—

> "Resolved, that the Council of The Engineering Institute of Canada be requested to appoint a Committee to consider the standard contract forms adopted by the Canadian Construction Association at its 1928 Convention in Winnipeg, that this Committee be instructed to report to Council concerning these forms and that Council be authorized to act on this report."

Prof. H. E. T. Haultain, M.E.I.C., drew attention to the excellence of the arrangements made by the Montreal Branch in connection with the meeting, and, on his motion, seconded by L. W. Gill, M.E.I.C., it was unanimously resolved that the enthusiastic thanks of this Meeting be accorded to the officers and members of the Montreal Branch for their hospitality and activity in connection with the Annual General Meeting.

Election of Officers

The secretary having read the report of the scrutineers appointed to canvass the officers' ballot for 1928, the following were declared elected:—

President	Julian C. Smith, M.E.I.C.
Vice-Presidents	
Zone B.	A. J. Grant, M.E.I.C.
Zone C.	W. G. Mitchell, M.E.I.C.
Zone D.	F. O. Condon, M.E.I.C.
Councillors	
Victoria Branch	E. Davis, M.E.I.C.
Vancouver Branch	W. H. Powell, M.E.I.C.
Calgary Branch	P. J. Jennings, M.E.I.C.
Edmonton Branch	R. J. Gibb, M.E.I.C.
Lethbridge Branch	R. Livingstone, M.E.I.C.
Saskatchewan Branch	H. R. MacKenzie, A.M.E.I.C.
Winnipeg Branch	H. A. Dixon, A.M.E.I.C.
Sault Ste. Marie Branch	J. M. Silliman, A.M.E.I.C.
Lakehead Branch	R. B. Chandler, M.E.I.C.
Border Cities Branch	A. J. M. Bowman, A.M.E.I.C.
Niagara Peninsula Branch	M. B. Atkinson, M.E.I.C.
London Branch	W. P. Near, M.E.I.C.
Hamilton Branch	W. F. McLaren, M.E.I.C.
Toronto Branch	J. G. R. Wainwright, A.M.E.I.C.
Peterborough Branch	R. L. Dobbin, M.E.I.C.
Kingston Branch	L. T. Rutledge, M.E.I.C.
Ottawa Branch	J. D. Craig, M.E.I.C.

Montreal Branch	Fraser S. Keith, M.E.I.C.
	O. O. Lefebvre, M.E.I.C.
St. Maurice Valley Branch	B. Grand Mont, A.M.E.I.C.
Quebec Branch	A. B. Normandin, A.M.E.I.C.
Saguenay Branch	N. F. McCaghey, A.M.E.I.C.
Moncton Branch	F. L. West, M.E.I.C.
Saint John Branch	J. Stephens, M.E.I.C.
Cape Breton Branch	W. E. Clarke, M.E.I.C.
Halifax Branch	H. W. L. Doane, M.E.I.C.

On the motion of Geoffrey Stead, M.E.I.C., seconded by P. L. Pratley, M.E.I.C., it was unanimously resolved that the report of the scrutineers be accepted, and that the ballot papers be destroyed.

President Decary, before relinquishing the Chair, expressed his thanks for the honour of presiding over the affairs of The Institute for the year 1927, and congratulated The Institute on the benefits which had accrued from the Plenary Meeting of Council held in October 1927. He hoped that this would be only the first of a number of such meetings, and believed that it would be beneficial to have two such meetings each year, if possible. He thanked the members of Council and The Institute's staff for their support and assistance during the year.

On the suggestion of J. L. Rannie, M.E.I.C., the Meeting expressed its appreciation of President Decary's conduct of the business of The Institute by prolonged and enthusiastic applause.

Induction of Newly-Elected President

On relinquishing the Chair, President Decary asked Dr. A. Surveyer, M.E.I.C., past-president, and Brig.-Gen. C. H. Mitchell, M.E.I.C., to escort the president-elect to the Chair, and the gentlemen named complied with his request amidst applause, upon which the retiring president welcomed Julian C. Smith, M.E.I.C., to the Presidential Chair, and bespoke for him the same loyalty and the same measure of co-operation which had been accorded to himself.

In taking the Chair as president, Mr. Smith expressed his appreciation of the honour conferred upon him, which he took as a compliment, not only to himself personally, but also to those men who had been associated with him for many years in engineering work.

The secretary reported the receipt of suggestions from two branches, namely, Hamilton and Ottawa, that the Annual General Meeting for 1929 should be held at one of those cities, and the invitations were confirmed by E. H. Darling, M.E.I.C., and W. L. McFaul, M.E.I.C., on behalf of the Hamilton Branch, and by J. L. Rannie, M.E.I.C., on behalf of the Ottawa Branch.

The president expressed appreciation of these invitations, and pointed out that the locality for the next Annual Meeting is not usually decided at the Annual General Meeting, but is considered by Council. After further discussion, on the motion of L. W. Gill, M.E.I.C., seconded by Prof. C. M. McKergow, M.E.I.C., it was resolved that the question of the locality for the next Annual General Meeting be referred to Council.

There being no further business, the president declared the meeting adjourned.

The Annual General Professional Meeting

Luncheon

At the noon hour between the morning and afternoon sessions of the Annual General Meeting on Tuesday, February 14th, a complimentary luncheon to visiting members and ladies was held in the Rose Room of the Windsor Hotel at which F. C. Laberge, M.E.I.C., chairman of the Montreal Branch, presided and in a short address welcomed the visiting members and ladies. Alderman Mercure, representing His Worship the Mayor of Montreal, welcomed the visitors to the city, following which Mr. George Henderson, president of the Montreal Board of Trade, also addressed the members.

Ladies' Tea

During the afternoon of the same day the ladies were entertained at tea in the Prince of Wales Salon, which was graced by the presence of Lady Willingdon, who had graciously expressed a desire to meet the ladies who were attending the meeting. Mrs. Julian C. Smith thanked Her Excellency for her kindness in honouring the function by her presence, following which a bouquet of orchids and lilies-of-the-valley was presented to Her Excellency.

Popular Lecture

In the evening, Dr. L. E. Pariseau, radiologist at Hôtel Dieu, Montreal, gave a very interesting, instructive and entertaining address and demonstration on "What the Electrical Engineers Have Done for the Physicians of To-day" before a large gathering in the Windsor Hall. Dr. Pariseau had addressed the members of the Montreal Branch on several occasions, but never had he delighted his audience more than on this occasion.

Smoker

After a short intermission following Dr. Pariseau's address, during which tables were set, the members and guests returned to the Windsor Hall, where the remaining hours of the evening were given over to the enjoyment of a smoking concert which, for the quality of the entertainment, deserves special mention. The large hall was filled to capacity, and while refreshments were served the various features of the programme were introduced in rapid succession.

First Technical Session

On Wednesday, February 15th, at 9.30 a.m. the first of the technical sessions was held; two separate meetings being carried on simultaneously, one in Windsor Hall and the other in the Prince of Wales Salon.

The meeting in Windsor Hall was under the chairmanship of F. C. Laberge, M.E.I.C., and the following papers were presented in abstract and discussed:—

"The Chippawa Creek Syphon Culvert of the Welland Ship Canal," by A. J. Grant, M.E.I.C.

"Foundations of the Royal Bank Building, Montreal," by C. S. Proctor.

At the meeting in the Prince of Wales Salon, under the chairmanship of A. A. Bowman, M.E.I.C., the papers presented and discussed were:—

"Notes on the Uniflow Steam Engine," by A. E. Allcut, M.E.I.C.

"The Lock Gates of the Welland Ship Canal," by Frank E. Sterns, M.E.I.C.

Luncheon

At noon an informal luncheon was held in the Rose Room and was attended by a large number of members and ladies.

Visits to Engineering Works

The visits on Wednesday afternoon, February 15th, were deservedly popular, and the arrangements were most favourably commented upon. Through the courtesy of the Montreal Tramways Company, seven busses were provided to transport the visitors to and from the works. As each bus had been supplied with a destination sign, the parties were quickly formed and left the Dorchester street entrance of the hotel sharply at 2.30 p.m.

Montreal South Shore Bridge

The forty or more members of The Institute who visited the site of the Montreal South Shore Bridge left the bus at Delorimier avenue near the end of the city approach, and, under the guidance of P. L. Pratley, M.E.I.C., and engineers of the Dominion Bridge Company, viewed the foundations of the city approach and inspected the north anchor pier. Those who so desired were taken to the deck of the bridge by the contractor's elevator, where they viewed the steelwork of the main span at close range.

Northern Electric Company

A party of fifteen enjoyed a visit to the Northern Electric Company, where they were received by Mr. Campbell. This establishment has about 4,000 employees. The party was conducted through the various departments and had a splendid opportunity to observe the processes by which the different products of the company are manufactured. Of outstanding interest were the large braiders of the cable department.

New Filtration Plant and Water Works

As the result of the mild weather, the new interceptor sewer of the city of Montreal had become filled with mud and water and could not be inspected, so that those who had anticipated taking this visit were, through the courtesy of C. J. Desbaillets, M.E.I.C., shown the new filtration plant and water works of the city of Montreal.

New Cold Storage Plant

The new cold storage plant of the Montreal Rail and Water Terminals, Limited, was visited by a party of members of The Institute. Mr. Curtis, president and general manager, Mr. Webber, assistant general manager, Mr. Carmel, superintendent, and Mr. Patterson, chief engineer, met the party at the plant and made the visit both interesting and instructive.

Associated Screen News

While the party to the plant of the Associated Screen News had been limited to twenty, over forty members of The Institute availed themselves of the opportunity to visit this interesting works. The manager, B. E. Norrish, A.M.E.I.C., welcomed the visitors and conducted them through the plant, where they viewed the various processes of grading, developing, printing, colouring, drying, polishing, waxing, inspecting, producing and reproducing all varieties of art and studio and commercial motion picture films.

Victor Talking Machine Company

A party of forty-eight members and friends visited the Victor Talking Machine Company of Canada, Limited, where they were cordially received by Mr. G. J. White, and were conducted through the plant, visiting all the various departments. Of particular interest was the record department, where records were being made on hydraulic presses at 2,200 pounds pressure.

Royal Bank Building

The new head office building of the Royal Bank of Canada was visited by twenty-seven members and were welcomed by R. M. Robertson, A.M.E.I.C., representing the Dominion Bridge Company, and Mr. H. Ferguson, of the Geo. Fuller Company, and O. A. Barwick, A.M.E.I.C., representing the architectural department of the Royal Bank. The members had an opportunity of inspecting the building from the sub-basement to its uppermost storey.

Dominion Engineering Works

About forty engineers availed themselves of the opportunity to visit the works of the Dominion Engineering Company at Lachine, whither they were conveyed in two busses, under the direction of C. E. Herd, A.M.E.I.C., of the company's staff. They were met on arrival at the plant by G. H. Duggan, M.E.I.C., president of the company, H. G. Welsford, A.M.E.I.C., the general manager, and several other officers of the company, who conducted the party through the works. The main products of this well-equipped plant are paper machines and water turbines, of which a large number were in all stages of manufacture. One of the features of the visit was the pouring of a large head-cover casting in the foundry, weighing about twenty-five tons, to be used in the manufacture of a 28,000-h.p. turbine for the Manitoba Power Company. Great interest was manifested in the large machine and erection shop, which contains some very heavy machinery for turning out the largest paper machines and water wheels.

Ladies Entertained

On Wednesday afternoon, February 15th, by the kindness of Lady Van Horne, the visiting ladies were invited to view the private collection of pictures of the late Sir William Van Horne. Following this the ladies were entertained by Mrs. Geo. H. Duggan at tea at her residence.

Annual Dinner

The Annual Dinner of The Institute, which took place in the Rose Room on the evening of Wednesday, February 15th, was perhaps the outstanding feature of the series of functions of the meeting, each of which in turn was proclaimed a remarkable success. Honoured by the presence of His Excellency Lord Willingdon, HON. M.E.I.C., and presided over by President Julian C. Smith, M.E.I.C., with a distinguished gathering of guests at the head table, the dinner was one of the most successful in the history of The Institute.

After a few introductory remarks by the president, His Excellency addressed the gathering, and in a felicitous speech he dealt with the profound influence exerted by engineers and their work on every phase of present-day life, and described some of his own experiences in Madras, where one of the great modern irrigation schemes was completed and opened during his period of office, bringing under cultivation some 800,000 acres of what was practically desert. This was only one example of the services rendered by engineers in Madras which had done so much to prevent famine and disaster in that great country.

The Hon. Honore Mercier, provincial minister of lands and forests, paid high tribute to the service rendered by engineers to the province, and was followed by Beaudry Leman, A.M.E.I.C., general manager of the Banque Canadienne Nationale, who recalled his early association as an engineer with Mr. Julian Smith, and appealed, on behalf of business, for a larger quota from the ranks of technically-trained university men.

Mr. J. P. Hines, president of the Royal Architectural Institute of Canada, brought the greetings of that association, and an address from Dr. R. A. Ross, M.E.I.C., past-president of The Engineering Institute of Canada, concluded the programme.

Ladies' Dinner

At the same hour as the Annual Dinner, the ladies were entertained at a dinner at the Cercle Universitaire de Montréal, which was presided over by Mrs. F. P. Shearwood. Following the dinner, the ladies were addressed by Mrs. Shearwood, Mrs. B. Grand Mont and Mrs. W. G. Mitchell.

Second Technical Session

The second technical session was held on Thursday morning, February 16th, commencing at 9.30 a.m., when two separate meetings were again held, one in Windsor Hall, under the chairmanship of P. L. Pratley, M.E.I.C., and the other in the Prince of Wales Salon, under the chairmanship of J. A. McCrory, M.E.I.C.

The papers presented and discussed in the Windsor Hall were:—

"Bridges Over the Welland Ship Canal," by M. B. Atkinson, M.E.I.C.

"Steel Work for the Royal Bank Building in Montreal," by R. M. Robertson, A.M.E.I.C.

At the meeting in the Prince of Wales Salon the following papers were presented:—

"The Electrical Heating of Rack Bars in Hydro-Electric Plants," by C. R. Reid.

"Notes on Removal of Carbon-Sulphur Compounds from Coal Gas by Oil Washing," by K. L. Dawson, A.M.E.I.C.

"The Flow of Gases in Reverberatory Furnaces," by W. K. Thompson, A.M.E.I.C.

Third Technical Session

The last of the series of technical sessions was held on the afternoon of Thursday, February 16th, in the Windsor Hall, during which the Chair was occupied by A. Duperron, M.E.I.C., and the following papers were presented and discussed:—

"The Requirements of a Durable Concrete, as Observed from Structures in Service," by R. B. Young, M.E.I.C.

"The Effect of Steam Treatment of Portland Cement Mortars on Their Resistance to Sulphate Action," by T. Thorvaldson and V. A. Vigfusson.

"Appendices A and B to the Report of the Committee on the Deterioration of Concrete in Alkali Soils."

All of the technical sessions were well attended, and in each case the papers gave rise to interesting discussions.

Reception for Ladies

On Thursday afternoon, February 16th, Mrs. W. L. McDougald received the ladies at her residence.

Reception and Supper-Dance

The final function of the meeting was the reception and supper-dance held on the evening of February 16th. Dancing commenced at 9 p.m. in the Windsor Hall, and supper was served about midnight in the Rose Room. The guests on their arrival were received by Mrs. Julian C. Smith, Mrs. J. L. Busfield and Mrs. F. P. Shearwood. This was one of the most delightful functions of the meeting and proved a fitting ending to the three days of business sessions and social functions.

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Young engineer with several years experience to spend part time on machine design work and remainder on survey work in connection with large newsprint mill in province of Quebec. Apply, stating salary expected, to box No. 188-V, The Engineering Journal.

BOOK REVIEWS

Introduction to Contemporary Physics

By Karl K. Darrow, New York, D. Van Nostrand Company, 1926. Buckram, 6 x 9½ in., 453 pp., diagrs., tables, $6.00.

Research workers in physics today are confronted with the task of keeping abreast with the progress of investigation, not only in their particular fields, but also in closely connected domains. The output of scientific papers from laboratories the world over has practically doubled in the last decade. Much new information on properties of matter and radiation is added from year to year as the number of investigators in various countries contribute their share. Many of these new discoveries are certain to be of service to many branches of engineering. To enable the research engineers of the Bell Telephone laboratories to keep fully informed of the latest advances in physics, and physics today is largely atomic physics, Dr. Darrow has made it his special task to prepare for his colleagues, and for the scientific world at large, careful digests of contemporary publications. A perusal of his book is evidence of the thoroughness and success with which he has achieved a difficult piece of writing. So intimately are experimental and theoretical physics connected today, that the mathematical language of the latter is largely employed by experimenters in describing their results, so that scientific papers as published need interpretation to others than specialists. Dr. Darrow has essentially the gift of simple exposition. In simple yet accurate language, with a minimum of mathematical exposition, he develops the entrancing history of atomic discoveries, how electrons are selected, counted, weighed and measured with respect to electric charge, and how by analogous means, utilizing a stream of positively charged atoms, the masses of atomic nuclei may be measured to an accuracy of one part in a thousand, this work of Aston's revealing the existence of elements called isotopes chemically indistinguishable. Rutherford's studies of atomic nuclei are dealt with in an interesting chapter, in such a way as to reveal something of their complex structure, high speed electrons and α-particles being used as projectiles to dissociate atoms and to give us some information as to the intense electrical fields in their innermost recesses. A discussion of X-rays and optical spectra, with their interpretation in terms of Bohr's atom model, occupies the final third of the volume. The final word has not been said, however. . . . So rapid is the output of new material that a book is almost out of date when printed, so much so that in point of fact Dr. Darrow publishes serially in the Bell System Technical Journal current chapters on contemporary advances in physics. The scientific public will look forward with great interest to the publication of this collection as a sequel to the volume just reviewed.

Louis V. King,
Professor of Physics,
McGill University.

The Water Supply of Towns

By W. K. Burton and J. E. Dumbleton, 2 vols., 4th Edition. London, Crosby, Lockwood & Son, 1928, Buckram, 7½ x 10 in., 296 pp., diagrs., tables, $6.00.

This is the fourth edition of Mr. Burton's well-known work which originally appeared some twenty years ago, revised and brought up to date by Mr. Dumbleton.

This book is that comparatively rare thing, a well-written general text without a great deal of specific data. Consequently, it may be recommended to those engineers who desire a general knowledge of water supply engineering and can refer to other sources for more detailed information and data. This type of engineering treatise is much more popular across the Atlantic than on this side; perhaps we try to crowd too much information into too little space here.

The authors have succeeded in producing a most readable book. Its literary qualities are much in advance of those with which we are most familiar, as some of our texts, the very best from a technical standpoint, are exceedingly poor when considered as examples of English composition.

Two appendices, one dealing with the effect of earthquakes on water supply structures, by Prof. John Milne, F.R.S., and the other on sand dunes as a source of water supply, by Mr. John de Rijke, add a good deal to our rather limited knowledge of these two particular subjects.

A somewhat exotic flavour is given to this treatise by frequent references to Japanese practice. These are accounted for by the fact that Mr. Burton was for many years professor of sanitary engineering at the Imperial University in Tokio as well as sanitary engineer to the Japanese Home Department.

Burton and Dumbleton can be recommended as a useful work of this type, but should not be purchased by the practising engineer in the expectation that he will find it a compendium of engineering data relating to water supply, as that is most precisely what the book is not.

R. De L. French, M.E.I.C.

Professor of Highway and Municipal Engineering, McGill University.

Faults and Failures in Hot-Water Work

By Frederick W. Dye. E. & F. N. Spon, Ltd., London, 1927. Buckram, 7½ x 5 in., 216 pp., figs., $2.00.

This interesting reference book takes the form of a series of questions and answers regarding practical problems and difficulties which have actually presented themselves. These illustrate a great variety of mistakes that are frequently made, and show how they may be avoided or overcome. The work thus deals entirely with faults and failures in hot-water installations, both central heating and domestic hot-water supply, and is evidently based on long experience.

The general principles and theories involved are outlined to a limited extent, and are analyzed sufficiently for the purpose of the book, which should prove valuable to anyone engaged in the design and installation of such classes of work.

E. A. Ryan, M.E.I.C.

Consulting Engineer, Montreal, Que.

Mining Engineers' Handbook

By Robert Peele, 2nd Edition. John Wiley & Sons, 1927. Leather, 7 x 4 in., 2,523 pp., diagrs., tables, $10.00.

The new edition of "Peele" recognizes the advances which have been made in mining practice since the publication of the first edition in 1918. It remains the handy reference book for tables and data of use in the every-day work of the mining engineer. A corps of assistant editors, each a specialist in his particular field, supply information in concise form on the various phases of the mining industry. It is interesting to note that Canadian mining is regarded as of sufficient importance to include a summary of the mining laws and regulations of the various provinces. Costs at certain Canadian mines have also secured a place.

Special attention is paid to the increasing use of electric power in mine plants, costs have been brought up to date, some sections have been enlarged and several rewritten. More information is available on surveying, particularly aerial, on flotation and ventilation of mines. Ore dressing as the subject of a chapter has been dropped and replaced by notes found on breaking, crushing and sorting of ore. "Peele" will be found a useful necessity to the student as well as to the operating engineer, the latter finding it advisable to replace his volume with one of the new edition.

J. G. Ross.

Consulting Mining Engineer, Milton Hersey Company, Limited.

Diesel Engines

By A. P. Chalkey. D. Van Nostrand Company, New York, 1927, 6th Edition. Buckram, 6 x 9½ in., 320 pp., tables, figs., diagrs., $8.00.

This book, first published in 1912 when the Diesel engine was comparatively young, has now reached its sixth edition, and this is no small testimony to its value.

The rapid development of the Diesel engine and its increasing application to stationary, locomotive and marine engine practice makes it very difficult to write or revise any book dealing with so progressive a subject. It may be premised, therefore, that this edition contains the principal advances made in Diesel engine practice up to the end of 1926.

The various heat cycles for internal combustion engines are first dealt with, the importance of compression and expansion ratios being duly noted. Necessary modifications in the theoretical cycle due to practical considerations and the advantages and limitations of the four- and two-stroke cycles are then discussed. A noteworthy omission from this part of the book is a reference to the effect of variable specific heat of the gases on the practical application of the various cycles. This might well have been briefly summarized for the benefit of the readers.

Reasons for the increase in the power obtainable from engine cylinders and the properties necessary in the fuels employed are then considered in detail. A very large section of the book is occupied by descriptions of the various designs used in practice, and this section is very copiously illustrated. First, low- and medium-speed engines for use on land or as marine auxiliaries are treated. There follows a discussion of two-cycle engines, scavenging, air compressors and supercharging. The rise to importance of airless injection by the use of precombustion and pump injection, and its influence on the design of high-speed engines for locomotive and similar work, is illustrated by a brief description of engines running at 700-1,500 revolutions per minute. In this connection, much recent research work has been done, particularly relating to the shape of combustion chamber, size of fuel drops, atomization and penetration, but no mention of this appears in this work.

Practical points with reference to installation, space, costs and test results are fully described. A minor criticism in connection with the test results on pages 140-1 and 151-2 is that such figures might reasonably be expressed in FPS units, as the average engineer for whom the book was designed cannot visualize the meaning of some of the figures given in the CGS system and will have to convert them and make up new tables for himself before they can be useful to him.

The large and powerful four- and two-stroke engines now used for marine work are fully described and the problem of reversing is adequately handled.

Altogether, the book is a useful addition to the library of any engineer who is principally interested in practical mechanical detail, but gives little information on problems relating to combustion and the advances made in this connection by recent research. As a compendium of present-day practice and a book of reference in this respect it is admirable.

E. A. Allcut, M.E.I.C.

Associate Professor, Mechanical Engineering, University of Toronto.

A Short History of Physics

By H. Buckley. D. Van Nostrand Company, New York, 1927. Buckram, 7 x 5 in., 263 pp., $3.00.

A prominent automobile manufacturer once made the arresting observation that "history is bunk!" Doubtless, the critic hardly intended his stricture to include the history of a science, but rather meant that inconsequential mass of less significant narratives about battles, kings and dynasties, (with copious dates), to which we used to be exposed as the significant history of the race and earth. There is at present a reaction, and the early twentieth century crop of popularized, though more significant, history is blossoming. Vide:—Outlines of History, (Wells), History of Science, (Thompson), Story of Philosophy, (Durant), History of Religion, History of Civilization, and many other histories. We soon shall have as many histories as Francis Bacon asked for. We may be sure that this popularized history will be followed by more erudite examinations of the same great topics.

The present book is history rather than a story of the science of physics. It could not be called "popular," yet is easy reading and is sound. Since the book comprises only 254 pages of clear print, it has to confine itself to successful survivals of the principles of physical science and pays little attention to theories which lacked survival power against the accumulating evidence of practical experiment. It deals, not with histories and developments of physical devices, instruments and machines, but the evolution of foundation principles underlying all these applications is well traced out.

In method, the author compiles no mere chronological record of physical discovery, rather, he treats a great topic, indicated by the headings of his chapters, by weaving its tale through the centuries to the present day, explaining as he goes the meaning of each discovery and correlating it with previous ones.

Since most of engineering is applied physics or chemistry, the engineer will find in this little book the foundation principles of his profession. For, although the title is "History of *Physics*," the contents of the chapters on Conservation of Mass, The Atomic Theory of Matter, The Atomic Theory of Electricity, The Quantam Theory and The Structure of the Atom give a fine understanding of the combined modern chemico-physics, and include the basic history of much of the chemistry which is of interest to the engineer. These chapters, together with those on Planetary Theory and Mechanics, The Corpuscular and Elastic Solid and Electro-magnetic Wave Theories of Light, Magnetism and Electricity, Radiation and Theory of Relativity cover well the current views of physics of the present day.

The reviewer wishes, even though the book would thereby have grown a little larger, that a short chapter or two had been added tracing historically the successful principles of hydro-dynamics and elasticity, and a short chapter to constitute in essence the evolution of mathematical physics. With these the book would have been even more complete and more useful to the engineer.

It is significant that fully one-third of the book is devoted to the physics of the last thirty or forty years, which shows how rapidly the progress,—or should the reviewer rather say the pursuit,—of science is accelerating. And one who reads may learn of the puzzles and incompatibilities between quantam theory and wave theory, of the necessary revisions in our fundamental formulations in mechanics and physics introduced by the theory of relativity, and of the prevailing physical models of the structure of the atom. If the author had included a brief account of the new wave mechanics, with its unaccountable "Ψ-waves" moving inconceivably fast in a medium of we don't know what, his history might have been said to be "up to the very last minute!" But perhaps the author, instead of including these new surmises, decided it was better to wait.

A useful feature of this short history is the list of "general references" mentioned at the end of each chapter. If a reader wished to pursue the study of physics or of its history and acquired all the books here named he would be the owner of a first-rate physics library.

R. W. Boyle, M.E.I.C.
Dean, Faculty of Applied Science, University of Alberta.

Pyroxylin Enamels and Lacquers

By S. P. Wilson. D. Van Nostrand Company, New York, 1927, 2nd Edition. Buckram, 9 x 6 in., 253 pp., figs., $3.50.

The importance of the subject treated lies in the ever-increasing application of such enamels and lacquers to the automotive industry, the manufacture of artificial leather and their use for the finishing of iceless refrigerators, railway equipment and furniture. The raw material is cellulose, and this implies an increasing consumption of Canadian wood pulp for this purpose.

An interesting feature of the industry lies in the development of new solvents for pyroxylin, such as glycol ethers, synthetic amyl alcohol, (from petroleum), and its acetate, and butyl alcohol. All these developments have been accompanied by a decline in price of the raw materials and finished lacquers, thus further stimulating consumption.

Whilst large and comprehensive textbooks on the subject are available for the expert, this handbook seems calculated to fill the need experienced by many engineers and chemists for a source of recent and accurate information for manufacturing purposes. It is that; and is well printed, as well.

The increasing consumption of pyroxylin lacquers and thinners is shown by the following figures: 1921, 1,410,000 gallons; 1925, 7,390,000 gallons; 1926, 12,980,000 gallons.

The scope of the book is as follows: pyroxylin, solvents and non-solvents, plasticisers, gums and resins, pigments and dyes; bronzing liquids, leather dopes, lacquers, enamels and their manufacture, applications and analytical methods.

It is claimed that by the use of lacquers a car can be finished in two days, as against the one to three weeks formerly required, and that it is very easy to train a man in the use of the spray gun employed.

The chapter on solvents is particularly well written, giving as it does not only an account of their properties but also a brief description of the manufacture of synthetic methyl, ethyl and amyl alcohols, (fusel oil). The only serious omission noticed is the failure to mention the manufacture of synthetic acetone from acetylene at Shawinigan Falls. The reviewer is also pleased to note the warning uttered about the toxicity of synthetic methanol when used for spraying lacquers.

L. F. Goodwin, Ph.D., M.E.I.C.
Professor of Chemical Engineering, Queen's University.

Recent Additions to the Library

Proceedings, Transactions, etc.

Presented by the Societies:
- The Royal Society of Canada: Transactions, 1927.
- The American Society for Testing Materials: Proceedings, vol. 27.
- The Royal Society of Edinburgh: Proceedings, vol. 47.
- The Society for the Promotion of Engineering Education: Proceedings, vol. 34.
- The Institution of Electrical Engineers: List of Members, 1927.
- The Institution of Engineers & Shipbuilders in Scotland: Transactions, vol. 70.
- The New Zealand Society of Civil Engineers: Proceedings, vol. 13.
- The Junior Institution of Engineers: Transactions, vol. 34.
- The National Electric Light Association: Proceedings, vol. 34.

Reports, etc.

Department of Trade and Commerce, Canada:
- Bureau of Statistics: Summary of Trade of Canada, Trade of Canada with United States, Trade of Canada with the United Kingdom.

Department of Mines, Canada:
- Annual Report, 1927.

Road Department, Quebec:
- Annual Report, 1927.

Department of Mines, Ontario:
- Gold Bulletin, Annual Report, vol. 36, pt. 3.

Department of Scientific and Industrial Research, Great Britain:
- Illumination Research: Tech. Paper 7, Penetration of Daylight and Sunlight into Buildings.
- Advisory Council: Report of the Lubricants and Lubrication Inquiry Committee.

Miami Conservancy District, Ohio:
- Technical Reports, pts. 1, 4-10.

American Society of Mechanical Engineers:
- Engineering and Industrial Standards: Safety Code for Mechanical Power-Transmission Apparatus. B16c-1927 Code for Design of Transmission Shafting.
- Tentative American Standard: B16d-1927 Malleable Iron Screwed Fittings.
- Fluid Meters, Their Theory and Application, pt. 1, 2nd edition.

League of Kansas Municipalities:
- Public Utility Rates of 561 Kansas Cities.

Department of Registration and Education, Illinois:
- Division of the State Water Survey. Bulletin 23, The Disposal of the Sewage of the Sanitary District of Chicago; Bulletin 24, Pollution of Streams in Illinois.

Department of Commerce, United States:
- Bureau of Mines: Tech. Paper 420, Geophysical Methods of Prospecting.
- Bureau of Standards: Sci. Paper 563, Gases in Metals; Sci. Paper 565, Thermal Expansion of Beryllium and Aluminum-Beryllium Alloys; Tech. Paper 358, Air-Hardening Rivet Steel.

Department of the Interior, United States:
- Geological Survey: Water Supply Paper 596-F, Laboratory Tests on Physical Properties of Water Bearing Materials; Annual Report of the Director of the Geological Survey.

Technical Books, etc.

Presented by the Author:
- Oxygen, Hydrogen and Industry, by Farley G. Clark.

Presented by Crosby, Lockwood & Sons:
- Water Supply of Towns and the Construction of Waterworks, vol. 1 and vol. 2, by W. K. Burton and J. E. Dumbleton.

Presented by the American Railway Association:
- American Railway Signalling Principles and Practices, Alternating Current Relays.

Presented by the McGraw-Hill Book Company:
- Principles of Highway Engineering, by C. C. Wiley.

Presented by E. & F. N. Spon, Ltd.:
- The Permanent Way, by W. H. Cole.

Presented by Meissner & Christiansen:
- The Port of Hamburg, by I. L. Wendemuth and I. W. Bottcher.

BRANCH NEWS

Border Cities Branch

Orville Rolfson, A.M.E.I.C., Secretary-Treasurer.
(Reported by R. C. Leslie, Jr.E.I.C.)

Bridges

Frank Barber, M.E.I.C., consulting engineer, from Toronto, was the speaker at the February meeting of the Border Cities Branch, held, as usual, in the Prince Edward hotel, Windsor. Mr. Barber's topic was "Bridges," and he brings to his subject a background of highly successful endeavour along the line of bridge construction. Among Mr. Barber's outstanding achievements are his bridges at Peterborough and Leaside.

The speaker went back to the early feats of bridge building that are on record. He spoke very highly of the quality of work done by the ancients in their structures, and cited the case of the Porte Rotto, in Rome, which, though built in 178 B.C., was still standing. It was noted that at the present time over 50 per cent of the bridges in Europe are over one hundred years old, which shows that they were designed and constructed with a view to permanence. In contrast to the thoroughness of the ancients, and even the builders of one to two hundred years ago, their modern successors were building less durable structures. In recent years in America some twenty-nine bridges had failed to stand up as much as two years after being built. The cause of this seemed to be, in most cases, the undermining of the bases by spring freshets.

The importance of proper architectural treatment was emphasized. The engineer was in many cases too prone to neglect this feature, and the result was that often bridges do not properly fit in with their surroundings. While the architectural features of bridges are of great importance, the engineer is still the responsible party for the vital members, making sure that the structure is safe and serviceable for the traffic it must carry.

The speaker illustrated his address by pictures on the screen dealing with the various features upon which he touched.

Mr. Barber was followed by several members of the branch who entered into a general discussion of the subject.

Calgary Branch

H. R. Carscallen, A.M.E.I.C., Secretary-Treasurer.
W. St. J. Miller, A.M.E.I.C., Branch News Editor.

Practical Results of Recent Research on Decay of Concrete by Sulphate Solutions

The following synopsis of the paper delivered by C. J. Mackenzie, M.E.I.C., dean of engineering, University of Saskatchewan, on January 18th, will give some idea of the importance of the subject dealt with, namely, "Practical Results of Recent Research on Decay of Concrete by Sulphate Solutions." He dealt primarily with the findings of a committee which was created as a result of a resolution passed at the Western Professional Meeting of The Institute in Banff during 1920, which committee was also authorized to solicit funds to defray expenses of such a research. Under the chairmanship of Dean Mackenzie, some $47,000 was raised to carry on a very limited programme of field tests at points in Manitoba, Saskatchewan and Alberta where alkali conditions were severe, but the major portion of the fund was allocated to chemical research, of which Dr. Thorvaldson, professor of chemistry at the University of Saskatchewan, was in charge. He explained that a large number of papers and reports have been issued in which the general nature of the problem had been clearly set down. It was in 1905, he said, that the matter of the action of alkali waters of western Canada and the United States on concrete was brought home to western engineers very forcibly. Prominent engineers and architects had before that time refused to admit that well-made concrete could be so destroyed. By the time of the Banff meeting in 1920 it was generally recognized by engineers of the prairie provinces, largely as the result of field tests by committees of the Calgary, Saskatchewan and Winnipeg Branches of The Institute,—(1) that any Portland cement concrete, no matter how well made, would be affected if exposed to alkali ground waters of sufficient strength; (2) that alkali action on concrete was due chiefly to sodium sulphate and magnesium sulphate; (3) that the richer, stronger and more impermeable the concrete the greater its resistance to alkali action; (4) that the sulphates reacted with the free lime to form calcium sulpho aluminate, causing a shattering of the weakened concrete.

He claimed that chemists were now of the opinion that very little was really known about the setting, hardening and nature of Portland cement, either before or after attack by alkali waters, and that laboratory tests have proven conclusively that any Portland cement concrete will be disintegrated by alkali waters if such waters are of sufficient strength. An important finding resulting from the tests made by competent engineers of recent years is that different standard Portland cements which may have similar strengths are very different in their sulphate resistance, and that such cements made at different mills vary even more widely in their resistance to sulphate waters. He pointed out that any extensive series of field tests should undoubtedly be dictated by laboratory leads, especially when such great differences in Portland cements have to be contended with. Also, it has been found that the relative sulphate resistance of two cements may differ with different mixes. Such work as that carried out by Dr. Thorvaldson and others along these lines makes it possible to analyze a local condition with more discrimination, and by tests select a cement that will serve perhaps two or three times as long as some concretes made in the past.

Professor Mackenzie went on to explain the method adopted by Dr. Thorvaldson in testing the action of sulphate solution on cement when in 1922 he discovered a quantitative method, an account of which appeared in the Journal in April of last year. This method saved endless labour and the testing of some hundred and eighty briquet samples in place of the one bar of cement used by him. In short, he found that a Portland cement mortar bar expands continuously until complete failure occurs, when immersed in sulphate solutions, sometimes as much as 3 per cent in excess of normal, and that this increase in length is related definitely to the loss of strength of the bar for every practical cement and mix. Instead of breaking many thousands of briquets, a few bars can be measured at various intervals of time, and the same information obtained, without destruction of the bars. The bars are exactly ⅝ x ⅝ x 7½ inches and the expansion is measured by micrometer. An expansion of 0.5 per cent on an average corresponds to a loss in strength of 60 per cent and one of 1 per cent to a loss of about 70 per cent in strength, which in practice would probably mean the failure of any structure. Full particulars of this method will be published later, some having already appeared in the April 1927 issue of the Journal.

The speaker discoursed at length on the variation of sulphate resistance of different Portland cements and of the claims of the so-called high alumina cements, referring to some extensive tests in France made on this product. He also touched on the steam treatment for the curing of concrete. He paid a tribute to the generosity of the Canadian Pacific Railway Company, the Prairie provinces, the Canada Cement Company and the National Research Council for the financial support which made the work of these researches possible, citing also the latter's extra contribution, beyond that originally offered, and their moral support, and he appealed to engineers as a whole to support freely the objects of the National Research Council, describing it as the most helpful agency in Canada to-day for the placing of individual and scientific research on an effective basis.

Some excellent resolutions in support of the splendid work that the special committee under Dean Mackenzie is doing were carried, being made by A. S. Dawson, M.E.I.C., and seconded by S. G. Porter, M.E.I.C. An interesting discussion on the subject of the lecture followed, after which the thanks of the meeting were tendered to the speaker by the chairman, F. K. Beach, A.M.E.I.C.

Maintaining Efficiency in Hydro-Electric Plants

On Thursday evening last, H. J. McLean, A.M.E.I.C., presented a paper to the Calgary Branch in the Board of Trade rooms on "Maintaining Efficiency in Hydro-Electric Plants," with especial reference to the plants of the Calgary Power Company, Limited, at Seebe, of which he is resident construction engineer. The speaker covered his subject in a very able manner and with the aid of charts gave a clear insight into the methods adopted to improve the plant efficiency, especially when dealing with expected load demands. He explained that the problem at hand at the upper and lower dams is to ensure a continuous, adequate supply at the power plants where at Kananaskis the stored water is used in driving turbines delivering at 12,000 volts to the Horseshoe falls plant lower down the river. Here it is boosted up by transformers to 55,000 volts for transmission to Cochrane, Calgary and south lines.

Situated some fifty miles west of Calgary, the two plants at Kananaskis and Seebe have a capacity of 13,000 h.p. at 73-foot head and 22,000 h.p. at 72-foot head respectively, the combined installed capacity of the two plants being 35,000 h.p. Water in the forebay at Kananaskis is used at both the upper and lower plants, and it has been ascertained that at least 216 k.w. hrs. may be expected from each second-foot of water passing, while a storage of 873 acre-feet is worth an output of over 95,000 k.w. hrs. Similarly, the pondage at Horseshoe falls plant is worth over 26,000 k.w. hrs. Lake Minnewanka, which is situated some thirty-three miles from the plants, forms an additional reserve storage capacity of 44,000 acre-feet.

In explaining plant efficiency, he pointed out that one problem was to discover the most effective load for each machine to carry, emphasizing how inefficient it was to try and carry a load of say, 1,000 k.w. on a 5,000 k.w. unit. Such proper knowledge, correctly applied, enables the operators to adjust their units to the demand, which under the best conditions can exceed the 80 per cent efficiency value generally accepted as a maximum in modern engineering. He explained the salt-velocity, or Allen, method of determining the amount of water required to generate a given load, when electrodes are placed in the penstock and the saline solution affects the electrical apparatus at each end where ammeter readings indicate the velocity.

Communication is hourly kept up by telephone between the two plants in connection with operator's records to show how well each is operating. The hourly records are checked and plotted to show daily combined plant efficiency, daily gross and net output, and the output in kilowatts per second-foot of water available. The local warm Chinook winds have a very disturbing effect on the running of a plant of this kind. In reference to steam electric plants, he pointed out that the bugbear known as " peak load demands " is a source of considerable annoyance to most of them, but with hydro-electric this particular phase offers no trouble at all, providing the pondage is adequate.

This address was followed by a very interesting discussion in which many members took part and a number of technical questions were ably answered by the speaker. Vice-Chairman Thos. Lees, A.M.E.I.C., took the chair for the evening in the absence of the chairman, F. K. Beach, A.M.E.I.C., and he thanked Mr. McLean for a very well presented and valuable paper.

Halifax Branch

K. L. Dawson, A.M.E.I.C., Secretary-Treasurer.

Engineering Education

The Halifax Branch opened its season 1927-28 by a supper-meeting at the " Green Lantern " on Thursday, October 20th, 1927.

Professor F. R. Faulkner, M.E.I.C., addressed the gathering on " Engineering Education." Professor Faulkner dealt with the subject in a skilful manner, showing the faults and merits of college curriculi, and recounted the methods used to analyze the opinions of engineers concerning them and the results of the analyses so obtained. He pointed out that the practising engineer must continue a system of education, particularly in regard to the ethics of his profession and the advances rapidly taking place in structural methods.

Following the address, considerable discussion took place, practically all members present joining in the discussion.

Canadian History

The November meeting of the branch, which was held on November 24th, 1927, was addressed by Dr. H. F. Munro, superintendent of education for the province of Nova Scotia. Dr. Munro's subject was " Canadian History," and in discussing the purpose and scope of history he stated that it is essential that we know whence we and our institutions came and our probable future trend. History was a difficult subject to teach in public schools, because most people have a very vague sense of time and find it very difficult to link the present with the past. The purpose of history is to teach the cause of things and thereby enable individuals to better understand the duties of the present, that is, to become better citizens. The scope of history in the past has been chiefly to chronicle the amours and battles of kings and warriors or other national crises. The true scope of history more suited to modern ideas should include the study of national institutions.

Dr. Munro emphasized the value of local history; national and international events can be vitalized by linking them with local conditions. Even the names of towns, counties, people, etc., are influenced by historical events occurring at some time during the past.

Canada has made a unique and perhaps momentous contribution to history in four outstanding ways:—

(1) Canada has realized responsible government without a revolution and still remains an integral part of the British Commonwealth.

(2) Canada has shown how two peoples, hereditary rivals, can live in harmony together through the will to be one nation.

(3) Canada has developed a government in which are fused the best of the federal and parliamentary systems. It is the federal type of government on a parliamentary basis.

(4) Canada has evolved the Dominion type of government, possessing thereby complete autonomy while remaining part of the British Commonwealth of nations. This type of government is the keystone of the Commonwealth and is now used by all the Dominions.

A hearty vote of thanks was extended to Dr. Munro for his very excellent address.

At the conclusion of the address, two motion pictures showing the manufacture of the electric bulb and the principles of radio transmission and reception were shown through the courtesy of the Canadian General Electric Company, Limited, and C. H. Wright, M.E.I.C., district manager of that company.

Annual Meeting

The ninth annual meeting of the Halifax Branch was held in the St. Julien room of the Halifax hotel on Thursday, December 22nd, 1927. Seventy-two members and guests assembled for dinner. Entertainment was supplied by " The Gas House Quartette," including Paul Mosher, Ken. Dawson, Fred. Faulkner and " Cy " Cox.

Among the guests present were:—

Mr. Justice Mellish, of the Supreme Court of Nova Scotia.
Mr. J. B. Kenny, mayor of Halifax.
Hon. W. L. Hall, attorney-general of Nova Scotia.
Hon. Gordon S. Harrington, minister of mines.
Hon. J. Fred. Fraser, chairman, Nova Scotia Power Commission.
Hon. J. A. Walker, minister of natural resources.
Dr. F. H. Sexton, president, Nova Scotia Technical College.
Lieut.-Col. Bun Russell, O.C., R.C.E.

The address of the evening was given by Mr. Justice Mellish, who spoke in a very humorous way on the elementary engineering implements used by our forefathers. Judge Mellish, in his inimitable way, presented these facts to the great pleasure of his audience.

The following officers were elected for 1928:—

Chairman......J. F. Lumsden, M.E.I.C., general manager of the Nova Scotia Tramways and Power Company, Limited.

W. J. DeWolf, A.M.E.I.C., city engineer's office.

W. B. McKay, A.M.E.I.C., heating engineer, Halifax.

H. W. Mahon, A.M.E.I.C., Nova Scotia Power Commission.

A. R. Chambers, A.M.E.I.C., vice-president, The Malagash Salt Products, Limited.

H. C. Burchell, M.E.I.C., Windsor, N.S.

C. B. McDougall, M.E.I.C.

Montreal South Shore Bridge

The January meeting of the branch was held in the " Green Lantern " on January 12th, 1928. The new chairman, J. F. Lumsden, M.E.I.C., was in the chair, and prior to the address of the evening the matter of increase of fees to members was taken up. Owing to the fact that the meeting was a public meeting at 8.00 o'clock, the question was not finally settled.

P. L. Pratley, M.E.I.C., of Monsarrat and Pratley, consulting engineers, Montreal, then addressed a large gathering on the construction of the Montreal South Shore Bridge. In introducing Mr. Pratley to the meeting, C. E. W. Dodwell, HON.M.E.I.C., spoke reminiscently of his connection with early attempts to build bridges across the St. Lawrence. Mr. Pratley's address was followed very closely, and it was the consensus of opinion that the paper, in its subject matter and presentation, could not have been excelled. A vote of thanks to Mr. Pratley was moved by C. A. Fowler, M.E.I.C., and seconded by R. W. McColough, M.E.I.C.

This address was opportune in the city of Halifax, as it was at the time of the inception of a committee to look into the construction of a bridge connecting Halifax with Dartmouth. In this campaign, the Halifax Branch, through its individual members, is taking a prominent part.

Special Meeting

A special meeting of the Halifax Branch was called on February 2nd, 1928, for the purpose of discussing the matter of closer relationship between The Engineering Institute of Canada in Nova Scotia and the Association of Professional Engineers of Nova Scotia; also the matter of increase in fees to members. The discussion in both matters was very general, and the conclusions reached are summarized in the resolutions which were adopted. H. S. Johnston, M.E.I.C., moved, and W. F. McKnight, A.M.E.I.C., seconded, the following resolution, which was adopted:—

" Whereas, the Association of Professional Engineers of Nova Scotia has authorized its Council to appoint a committee to investigate the possibilities of closer co-operation and even possible affiliation with The Engineering Institute of Canada in Nova Scotia;

"And whereas, the Council of The Engineering Institute of Canada has expressed its opinion that the consideration of the above question is desirable;

"Therefore, be it resolved

"That the Executive Committee of the Halifax Branch appoint a special committee of three to co-operate with the committee appointed by the Council of the Association of Professional Engineers of Nova Scotia for the purpose of investigating and reporting upon the possibilities of closer co-operation and even ultimate affiliation between the said Association and the said Institute in Nova Scotia, and that a copy of this resolution be sent to the Sydney, N.S., Branch of the said Institute seeking its co-operation towards the attainment of this report, and also that a copy of this resolution be sent to the general secretary of the said Institute."

In the matter of the increase in fees, the following committee was appointed to prepare a statement for Council of The Institute, summarizing the opinions of the members of this Branch. This committee consisted of:—

W. A. Winfield, M.E.I.C.
Prof. F. R. Faulkner, M.E.I.C.
W. J. DeWolfe, A.M.E.I.C.
H. F. Bennett, A.M.E.I.C.

This committee forwarded to the Council, prior to the Annual Meeting, a lengthy document in this matter, the gist of which may be summarized as follows:—

"That so long as the standards of Member and Associate Member remain as at present no extra difference in fees should be proposed.

"That the $5.00 increase in fees to Members will force a number of resignations which might be avoided by a small increase to all corporate members and Juniors.

"That the $5.00 increase in fees to Members only will help to restrict that grade to those who can pay rather than to those whose qualifications and responsibilities warrant special recognition.

"That it is most unfortunate that this proposal is made at this time, and we would strongly recommend that the proposed amendment be withdrawn, or defeated in balloting, so that Council can institute a thorough canvass of the membership and have ready for submission at the next Annual Meeting a revision worthy of The Institute as a whole."

A letter was read by the chairman from the Hon. Gordon S. Harrington, minister of mines of the province of Nova Scotia, asking that The Engineering Institute of Canada appoint a member on an Advisory Board to be convened by the Department of Mines of Nova Scotia for the investigation now going on as to the best methods of using Nova Scotian coals. The meeting appreciated the privilege of appointing a member, and recommended to Mr. Harrington the name of K. L. Dawson, A.M.E.I.C., to act for The Engineering Institute of Canada.

The Romance of Railway Location

The regular February meeting of the branch was held on February 16th at the "Green Lantern." The address of the evening was given by A. S. Gunn, A.M.E.I.C., assistant engineer in charge of construction, Canadian National Railways, Moncton, N.B. Mr. Gunn's subject dealt with the "Romance of Railway Location," and his very interesting talk took the members back to the days when large railway undertakings were in progress in this country. That Mr. Gunn's talk was appreciated was shown by the general discussion which followed.

During the meeting, motion pictures showing the "Caterpillar" tractors operating in the removal of snow and on highway construction were shown through the courtesy of R. R. Murray, A.M.E.I.C.

Hamilton Branch

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

Branch Meeting, January 31st, 1928

A meeting of the Hamilton Branch was held in the cafeteria of the Technical School on the evening of Tuesday, January 31st, with L. W. Gill, M.E.I.C., in the chair. There was an attendance of well over one hundred, including A. J. Grant, M.E.I.C., chief engineer of the Welland ship canal, and E. G. Cameron, A.M.E.I.C., assistant engineer from St. Catharines, and T. J. Mahoney, M.L.A. On the recommendation of the Executive Committee and on the motion of E. H. Darling, M.E.I.C., seconded by H. A. Lumsden, M.E.I.C., it was unanimously decided to invite the parent society to hold the Annual General and General Professional Meeting for 1929 in Hamilton.

St. Lawrence Waterways Project

Mr. Gill then introduced F. I. Ker, A.M.E.I.C., who spoke on the economic and political features of the St. Lawrence waterways project. Mr. Ker briefly outlined the history of navigation on the Great Lakes and St. Lawrence river, including the canals at Sault Ste. Marie, the channels through the St. Clair and Detroit rivers, the Welland canal and the St. Lawrence canals. He read several interesting extracts from the records of the original undertaking. Up to the present time, including the Welland ship canal, Canada has appropriated $235,000,000 upon improvement of navigation on the St. Lawrence and the Great Lakes, whereas the United States has spent $44,700,000.

At the present time the large freighters on the upper lakes can only proceed as far as the foot of lake Erie. The result of this restriction has been to create transfer elevator centres on the Georgian bay and at Port Colborne and Buffalo. The elevator capacity at Buffalo is 35,000,000 bushels, whereas the total capacity on lake Huron and Georgian bay is 23,000,000 bushels.

Mr. Ker gave figures regarding the cost of movement of Canadian wheat over existing routes and stated that the present movement is approximately 240,000,000 bushels. Proponents of the deep waterway say that the new rate with the deep waterway in operation would mean a saving of five cents a bushel or $12,000,000 on 240,000,000 bushels. It is, however, exceedingly unlikely that more than half this saving would be realized.

An estimated cost of enlarging the St. Lawrence waterways, according to the report of the Joint Board of Engineers, is approximately $180,000,000, of which $142,000,000 would be spent by Canada and $38,000,000 by the United States. It is obvious, therefore, that the saving effected by Canada on the grain movement would not justify the expenditure on the St. Lawrence waterways.

The deep waterways system would, however, result in a much greater saving for the people of the United States. The Hoover Commission estimates that approximately 20,000,000 tons of American shipping would be available for the St. Lawrence route, and it is estimated that there will be a saving of $3.00 a ton or $60,000,000 a year. The people of the United States quite realize the difficulties of the position and are quite willing to negotiate a fair division of the cost.

According to treaties now in existence, the British and American shipping have equal rights on all international rivers including the St. Lawrence, Columbia, Yukon and even the Mississippi. It is, therefore, impossible for Canada to develop the St. Lawrence waterways and charge tolls to American shipping without charging Canadian shipping at the same time. There are proposals regarding the division of cost, either by direct contribution from the United States or by a schedule of tolls collected from the shipping from both countries with the United States Government guarantee of a minimum of 20,000,000 tons. It would seem that this would be the better plan, in that it does not allow the United States to have any equity, actual or moral, in the capital cost of public works carried out in this country.

Power Development

The people of Ontario are primarily interested in the project from the view point of the power to be developed. At present the Niagara system supplies over 86 per cent of the total power distributed by the Hydro-Electric Power Commission of Ontario. In the area supplied by the Niagara system, the per capita consumption last year was 1,534 kilowatt hours. In eastern and central Ontario there is scarcely one-fourth of the power presently available per capita in the southwest of the province and the average rates are much higher. In the area which would be served by the St. Lawrence river power, the average consumption per capita was 378 kilowatt hours. This illustrates that there is the demand for St. Lawrence power in Ontario. To meet current requirements the Hydro-Electric Power Commission of Ontario recently contracted with the Gatineau Power Company for 260,000 horse power for a period of thirty years. This Quebec power is regarded as a stop gap pending the development of Ontario's power on the St. Lawrence.

Mr. Ker then went into the report of the Joint Board of Engineers in a general way and outlined the various alternative schemes which were proposed.

The harmony of our relations with the United States and the joint use of the St. Lawrence river for over a century have been largely a result of British diplomacy. Their recent proposal that we should join with them in carrying out the recommendations of the commissions affords one of the major opportunities that Canadian statesmanship has had of showing that it possesses the breadth of vision and quality of fair dealing so essential to the amicable settlement of international questions.

J. W. Tyrrell, M.E.I.C., in moving a vote of thanks, remarked that the large audience must have been intensely interested in the address they had listened to that evening, and that Mr. Ker must have devoted a great deal of time and study to the subject to present it with such clearness. J. J. MacKay, M.E.I.C., in a short speech, seconded the motion.

Executive Meeting

A meeting of the Executive Committee of the branch was held in the office of W. L. McFaul, M.E.I.C., on February 6th, 1928, with L. W. Gill, M.E.I.C., in the chair, and four other members of the executive present.

L. W. Gill, M.E.I.C., and E. H. Darling, M.E.I.C., were appointed official representatives of the Hamilton Branch at the Annual Meeting in Montreal. They were requested to present the invitation of the branch to hold the next Annual Meeting in Hamilton in accordance with the resolution passed at the branch meeting held on January 31st.

It was decided to ask the co-operation of the Niagara Peninsula Branch in the proposal to hold the next Annual Meeting in Hamilton and to offer the assistance of the Hamilton Branch in their proposed summer meeting.

Since the Hamilton Chamber of Commerce was very desirous of obtaining the Annual Meeting for Hamilton and had offered their support, the secretary was instructed to advise them of the proposal to invite The Institute to hold the 1929 Annual Meeting in Hamilton.

Kingston Branch

D. G. Geiger, A.M.E.I.C., Secretary-Treasurer.

A well attended meeting of the Kingston Branch was held in Carruthers Hall, Queen's University, on February 1st, 1928, Prof. D. S. Ellis, A.M.E.I.C., chairman of the branch, presiding.

The speaker of the evening, P. L. Pratley, M.E.I.C., of the firm of Monsarrat and Pratley, consulting engineers, Montreal, was introduced by Prof. W. P. Wilgar, M.E.I.C., and spoke on the history and construction of the Montreal harbour bridge.

At the close of Mr. Pratley's address a vote of thanks was moved by Prof. A. Macphail, M.E.I.C., and seconded by Prof. W. L. Malcolm, M.E.I.C.

London Branch

Frank C. Ball, A.M.E.I.C., Secretary-Treasurer.

Annual Dinner Meeting

On Wednesday, January 25th, the London Branch held its annual dinner and election of officers. Members and friends enjoyed the accommodation and cuisine of the new Hotel London. This meeting rivalled other meetings of the past year in surpassing the attendance of former meetings.

The business session was preceded by dinner served in the Grill room of the hotel. A report of the past year's activities was read by the secretary and the financial statement was read by one of the auditors, Roy W. Garrett, A.M.E.I.C.

Following the acceptance of these reports the officers for the year 1928 were elected by ballot of those present at the meeting. The election resulted as follows:—

Chairman	Jas. A. Vance, A.M.E.I.C. (acclamation)
Vice-Chairman	G. E. Martin, A.M.E.I.C.
Secretary-Treasurer	Frank C. Ball, A.M.E.I.C.
Executive Committee	J. A. Coombs, A.M.E.I.C.
	R. W. Garrett, A.M.E.I.C.
	W. C. Miller, A.M.E.I.C.
	W. P. Near, M.E.I.C.
	W. M. Veitch, A.M.E.I.C.

Jno. R. Rostron, A.M.E.I.C., the retiring chairman, who becomes an ex-officio member of this year's executive, addressed the meeting and turned the chairmanship over to the chairman-elect. Mr. Vance spoke briefly, and then called on W. P. Near, M.E.I.C., to introduce the speaker of the evening, H. G. Acres, M.E.I.C.

St. Lawrence Deep Waterways Scheme

Mr. Acres read his paper on the "St. Lawrence Deep Waterways Scheme." His hearers were greatly impressed with the magnitude of the project and the difficulties encountered, a great many of which were not of an engineering character. They also recognized the vast amount of study and time that had been given to the question in order to give to the two countries the fullest benefits to be derived from that great river. Those present were grateful to Mr. Acres for bringing to them the findings and opinions of one who has been so closely connected with the project from its earliest days.

A hearty vote of thanks to Mr. Acres was moved by H. B. R. Craig, M.E.I.C., and seconded by J. R. Rostron, A.M.E.I.C. In seconding the vote of thanks, Mr. Rostron expressed his opinion that everything possible should be done to get the project under way, and he pointed out some of the advantages to be derived from the waterway.

During the evening, members and guests were entertained by Mr. E. G. Wood and Mr. E. D. Carpenter, who sang numerous solos. The company joined in songs from The Institute song sheet at intervals through the evening.

The members were pleased to have as their guests His Worship Mayor Wenige and Aldermen Towe, Hayman and Kilbourne. The Mayor addressed the meeting briefly, referring to Mr. Acres' connection with the new Springbank dam to be constructed near London.

A large number of friends of members of the branch were present.

It is the intention of the London Branch to hold a "smoker" and social evening as its February meeting. The success of last year's "smoker" warranted an evening of the same kind this year.

Montreal Branch

C. K. McLeod, A.M.E.I.C., Secretary-Treasurer.
H. W. B. Swabey, M.E.I.C., Branch News Editor.

Montreal Building Code

The Montreal Branch held its first meeting of the year on January 12th, when Paul Baily, A.M.E.I.C., presented the branch with an interesting description of the many considerations that were provided for in the formulation of the "Montreal Building Code."

After a brief historical outline of building by-law legislation in Montreal, the speaker declared that as it was inadmissible that a city of Montreal's importance should be without a modern building code, radical changes had had to be made in the old building by-law No. 260 passed by the city in 1901. While this old by-law had served its day, the many recent developments in the art of reinforced concrete and structural steel construction had rendered it inadequate for present-day requirements.

The Building Department of Montreal thereupon examined the essential features that should be covered in the preparation of a modern building code. These conditions are seven in number and constitute the main object of the present by-laws.

1. To protect the public in prohibiting the construction or erection of dangerous structures.
2. To promote better construction at all times.
3. To establish definite rulings and principles that should be followed by all the engineers, architects and builders of this city.
4. To limitate the stresses and loads that should be used in any design and calculation of structures.
5. To protect the building profession against friction with civic employees.
6. To open the door to any progress and improvement and to eliminate any incompetence in the building trade.
7. To obtain a fair and logical competition among the engineers, architects and builders, and provide fair market conditions.

In elaborating on these requirements, the speaker held that the present by-laws were liberal in their conception, that they afforded an opportunity for experienced engineers to profit by their skill and that, although the author had to be mindful of the possibility of unfavourable working conditions and inferior materials, he was also anxious to avoid waste by unnecessarily stringent demands.

In conclusion, the speaker referred to the need to follow up the by-laws with responsible supervision of the designs and adequate inspection of the work.

Five by-laws have been prepared and may be obtained at the City Hall on request. These are No. 915—Reinforced Concrete; No. 917—Structural Steel; No. 895—Timber Construction; No. 914—Live and Dead Loads; No. 887—Construction Blocks.

The animated discussion which followed, led by Prof. E. Nobbs, favoured the preparation of further by-laws along these lines and their publication each year with added amendments.

J. T. Farmer, M.E.I.C., expressed the appreciation of the meeting to the speaker for his effort to crystallize public opinion on this important endeavour.

The chairman of the branch, F. C. Laberge, M.E.I.C., presided.

The First Commercial 1,200-Pound Steam Plant

A paper of particular interest in that it dealt with the first commercial 1,200-pound steam plant in the world was presented to the branch on January 19th, by I. E. Moultrop, chief engineer for the Edison Electric Illuminating Company of Boston.

In opening his paper, the speaker referred to the New England hydro-electrical development as being probably the greatest in America, and yet amid such surroundings it was economical to obtain power from coal costing $6.00 a ton and possible to produce electricity by that means for less than four mills per kilowatt hour.

While the location of the steam plant at tidewater was essential by reason of the tremendous demand for water to meet condensation requirements, and economical for the delivery of coal by boat, at the same time such a situation required heavy expense for transmission lines when the maximum voltage is limited to 30,000 volts and a two-tower line costs up to $20,000 a mile.

With the materials readily available at present, 750° Fahrenheit is approximately the highest safe temperature for steam. Steam heated above this temperature calls for materials of excessive cost, and is therefore uneconomical.

The great advantage of a high temperature and high pressure installation is the notable increase in efficiency for the same capital cost of plant.

In the plant under consideration the four and one-half inch drum forging, weighing 96,000 pounds and measuring 4 feet in diameter, was tested and analyzed, by means of X-rays, with wonderful result.

An important adjunct to successful operation of these high pressure plants is the purity of the feedwater, for not only must the water be 100 per cent chemically pure, but it must also be entirely free from oxygen, which would at these high temperatures speedily cause rusting in the turbine.

The speaker referred to the utilization of superheaters, reheaters, air heaters, water-cooled furnace walls and steel-supported refractory walls in the intelligent design of this large plant.

Mr. Gates, engineer of The Superheater Company, J. A. Combe, M.E.I.C., and J. T. Farmer, M.E.I.C., took a leading part in an interesting discussion. The former mentioned the untimely and sudden death of his associate, B. N. Broido, following shortly after presenting his paper to the branch in January 1927. Prof. C. M. McKergow, M.E.I.C., in moving the thanks of the meeting, commented on the cordiality and frankness of the speaker and the pleasant means he had chosen to present such an informing and well-illustrated address. K. B. Thornton, M.E.I.C., presiding as the chairman, presented the motion in fitting terms.

Annual Meeting of Institute

Preceding the branch meeting, President A. R. Decary, M.E.I.C., called to order the 42nd Annual Meeting of The Institute for the purpose of appointing scrutineers and auditors and the reading of minutes of the last annual meeting, all of which is reported elsewhere.

Some Special Features in Engine and Car Terminals

An interesting description dealing with the coach and engine house facilities of the extensive and well-nigh ideal rearrangement of the Canadian National Railways' Toronto yards was presented to the branch, presided over by J. E. Armstrong, A.M.E.I.C., on January 26th by S. B. Wass, A.M.E.I.C., in a paper entitled "Some Special Features in Engine and Car Terminals."

The locomotive coaling plant consists of six 100-ton circular reinforced concrete bins capable of supplying coal to engines on four tracks. Engine sand, after being dried in an adjacent building, is hoisted by compressed air and stored in the interstices between the bins, while a continuous chain and bucket conveyor is utilized to elevate the coal.

Another continuous chain conveyor passing under hoppers placed in each of five engine tracks transports the cinders up an incline to be discharged over cars on the cinder track.

Three standpipes serving six engine tracks supply water from the 150,000 gallon storage tank. A locomotive turntable 100 feet long, of the twin span type, has eliminated the necessity of balancing the load on the table and is especially advantageous in handling dead equipment. It is approached by fifty tracks, five of which are running tracks.

The engine house has a capacity of thirty-six stalls and is constructed with wooden frame, brick walls and a mill type roof, the latter as being least likely to cause condensation in cold weather.

Light structural steel frame doors are provided with hinges having adjustable pins. All the service piping inside the engine house has been installed in leadized pipe to assure protection against acid-bearing gases.

Drop wheel pits equipped with electro-pneumatic jacks and Cardwell spring tracks have been provided for changing wheels and springs.

A special exhaust system for locomotives has been provided by which the smoke from the engines is collected and driven up a tall chimney. To accomplish this, a rectangular duct of asbestos board has been constructed around the house above the stacks of the locomotives. The stacks are connected to it by means of aluminum jacks, having both universal and telescopic joints and have spherical bowl ends to provide tight connections with the stacks.

The smoke is exhausted from the duct by a fan and forced up a chimney 7 feet in diameter and 165 feet high. This apparatus provides the draught to fire the engines and obviates the need of a steam blower.

Large machine, wheel and coach shops adjoin the engine house. These are all of reinforced concrete, fireproof construction and equipped in the most up-to-date manner. These shops are heated with featherweight unit heaters which have proved both satisfactory in operation and economical to install. A three-storey stores building serves the shops and a bunk house provides fine accommodation for out-of-town crews.

The coach yard, with concrete platforms and service facilities, adjoins a commissary and car building. A freight car repair yard with attending buildings has also been provided.

The yard is well lighted at all working points by a flood light system which has been installed on five 120-foot steel towers bearing clusters of powerful lamps.

An animated discussion followed, led by E. A. Ryan, A.M.E.I.C., and J. H. Hunter, M.E.I.C., and a hearty vote of thanks was tendered the speaker by W. McG. Gardner, A.M.E.I.C.

Reproduction of Sound

(Reported by A. B. Rogers, A.M.E.I.C.)

On February 2nd an interesting and instructive talk on "Sound Reproduction," accompanied by slides and a demonstration on a special sound reproducer, was given by H. J. Vennes, A.M.E.I.C., transmission engineer of the Northern Electric Company, Limited.

Mr. Vennes began with a brief history of the study of sound analysis. One of the recent authorities, Professor Dayton C. Miller, of Cleveland, constructed a special instrument called a "Phonodyke" for analyzing sound. This study has been carried on by the telephone engineers as a necessary adjunct to the proper design of reproduction equipment.

In principle, each sound is caused by wave disturbances in the atmosphere. The waves corresponding to a particular sound are alike and periodic. They are more or less compounded, and can be resolved into their simple components, consisting of a fundamental and some harmonics. The character of the sound is dependent on the various harmonics and the amplitude thereof.

What is known as a "sound spectrum" is obtained by plotting on a frequency base, vertical lines representing the various components, the amplitude being represented by the length of the line above the base. The sounds of various musical instruments were represented by their spectra thrown on the screen from slides prepared for this purpose.

Slides were also shown showing the range of the auditory sensation areas. These show that at low frequencies more energy is required.

The analyses of the various vowel sounds were indicated by slides showing their spectra.

It was pointed out by Mr. Vennes that unfaithful reproduction of a sound or distortion is due to two main causes, namely:—

1. Eliminating the fundamental or certain harmonics.
2. Introducing additional harmonics.

A third, but lesser important, cause was by changing the phase of the sound. This was done by the character of the reproduction apparatus.

The demonstration of these effects was well shown by means of gramophone records reproduced on the special sound reproducer mentioned above.

The meeting was presided over by G. A. Wallace, A.M.E.I.C., and J. L. Busfield, M.E.I.C., expressed the thanks of the meeting to the speaker for his paper, which was at once very technical and withal very popular.

What Aviation Means to Canada

(Reported by T. C. Thompson, Jr.E.I.C.)

At the regular meeting of the Montreal Branch on February 9th, Wing-Commander E. W. Stedman, O.B.E., M.E.I.C., chief aeronautical engineer, Department of National Defence, gave an address on "What Aviation Means to Canada."

The speaker opened his remarks by explaining that such a subject would compel an original and broad study of the effects of aviation on our Dominion.

Aviation was once a question of transportation and photography, whereas now it materially assists the discovery and exploitation of Canada's natural resources. Whereas, in Europe and the United States rapid mail and express and passenger transportation were the predominating demands encouraging the development of aviation, in Canada the situation is unique. It is Canada's natural resources which afford the predominating demand.

The speaker then dealt briefly with the part played by aviation in agriculture, in patrol work for the Customs Department, in geological surveys, in payment of Indian treaty money, in surveys of water powers, in surveys of transmission line routes, in mapping, in fire detection and prevention, in surveying timber limits, in topographical surveys, in assisting parties travelling by ground routes, in fishery patrol work, in establishing submarine channels and reefs, in mail service to winter-bound places and reporting ice conditions for navigation. Excellent slides were shown illustrating each phase of the work done by aeroplanes.

In agriculture, much loss is encountered yearly through rust spore, and it was found that these spores exist everywhere in the atmosphere, at all heights investigated, like volcanic dust. Combating this condition and others similar, such as the spruce bud-worm, can be done conveniently from aeroplanes by dusting the locality with sulphur or other preventative chemicals. Fertilizers may also be spread by dusting.

The Customs Department has found that narcotics are frequently dropped overboard from inbound vessels near the Canadian shore to be picked up by small boats and smuggled into the country. Aeroplane patrol has prevented, to a marked degree, this practice by watching the actions of any boat intent on retrieving the parcel.

Geological surveys conducted by aero-photography give a more accurate account of the structure of the country, such as rock-outcrop, dykes, etc., and over a range greatly exceeding that possible by ground methods and in much less time. In addition, air photographs afford permanent records which can be referred to perpetually as an answer to a large number of distinct questions relative to the country.

In distributing treaty money to the Indians, the trip, which previously took three months, now requires only a month using aeroplanes.

Power engineers tell, Commander Stedman pointed out, some of the economies effected by employing aeroplanes in securing data by photography for the choice of the location of dams, power house sites, transmission line routes and land contours along these routes.

Mapping outlying country by aerial photography is not only much quicker than by ground methods, but is very much more accurate in the case of rapid surveys. This was strikingly illustrated by a slide showing Island lake mapped by aerial photographs and spattered by islands, whereas the same lake shown as in existing maps obtained by ground methods is apparently practically devoid of islands.

The work of fire prevention and protection by aeroplane was briefly reviewed by the speaker, and in connection with forestry work he showed that the extent and value of timber limits can easily, accurately and quickly be determined by examination of aerial photographs Again the speaker emphasized the value of the permanence of the record and its possible repeated consultation

Its enforcing fishery laws regarding the length of nets, etc., used by the fisherman, the aeroplane is much superior to the older patrol steamer method. The smoke of such an inspecting vessel of maximum speed of about ten knots per hour on the horizon would give ample warning to the fishing craft using illegal methods which could easily be corrected before the advent of the inspector. This, of course, is not the case with the aeroplane.

The Public Works Department can use the aeroplane to great advantage in securing photographic data regarding channels in a river, hidden reefs, etc. These, besides being a great boon to navigation, are very valuable in directing dredging operations.

Aeroplanes afford an additional aid to navigation in reporting ice conditions. This was illustrated by two incidents in the vicinity of Hudson bay.

An example of transportation by aeroplane where other means were quite impossible within the time limit was mentioned. Eight thousand pounds of explosives were required in Churchill. Dogs or horses were quite impossible and the contract for delivery by plane was let out. The quantity was later increased to fifteen thousand pounds and the whole amount delivered very easily in twenty-seven trips.

Advantage is taken of the aeroplane for transportation where rapid delivery is required. Such articles as gold, women's hats and gowns, flowers, financial papers, etc., are often delivered by air in other countries. Insurance rates are lower, since the risk of tampering is reduced and packing expense is reduced to a minimum. Commander Stedman prophesied an air route to New York from Montreal for such purposes in the comparatively near future.

In a short discussion, it was remarked the difficulty of fueling planes in remote territories during trips of say a month's duration. This was answered by the speaker by stating that fuel caches were established at various points taken there by ground methods.

The members of the Montreal Branch were privileged to hear such an entertaining and instructive lecture, and J. A. McCrory, M.E.I.C., expressed the appreciation of the audience. The meeting was presided over by J. S. Hall, A.M.E.I.C. and F. S. B. Heward, A.M.E.I.C.

Ottawa Branch

F. C. C. Lynch, A.M.E.I.C., Secretary-Treasurer.

During the past month the Ottawa Branch has had two luncheons at the Chateau Laurier, and the Annual Ball was held on February 6th, also at the Chateau. The latter was a brilliant social function held under the distinguished patronage of Their Excellencies the Governor-General and the Viscountess Willingdon. Upwards of 300, including members and friends, were in attendance and were received by Mrs. Chas. Camsell, wife of the newly-elected chairman of the Ottawa Branch, Mrs. F. H. Peters and Mrs. H. A. K. Drury. A feature of this year's ball which added to the enjoyment of the occasion was the excellent supper served at tables in the main dining room.

Professional Engineers and the E.I.C.

Professor H. E. T. Haultain, M.E.I.C., came from Toronto to address the members of the Ottawa Branch at luncheon on January 26th on the subject of "Professional Engineers and the E.I.C." Announced as a talk to the family, Professor Haultain outlined the relations existing between the Association of Professional Engineers of Ontario and The Engineering Institute of Canada, and gave his views on the general policy and future of both organizations. He expressed gratification at the formation of a Technical Service Council, which commenced to function in December last and numbered on its advisory committee such distinguished figures as Dr. H. J. Cody, chairman, Board of Governors, University of Toronto; C. A. Magrath, M.E.I.C., Sir Edward Kemp, Sir John Aird and S. R. Parsons.

The Council, according to the speaker, is co-operating with the Canadian Manufacturers' Association in an effort to stem the exodus of Canadian brains to the United States and to bring back those Canadian engineers who have already gone there. Professor Haultain dwelt on the hopes and aspirations of professional engineers generally and stressed the necessity of co-operation.

Some Phases of Railway Development in Canada

It is not very often that engineers are accorded the privilege of listening to an address from the business viewpoint on an engineering development of such magnitude as the Canadian railway system. Mr. E. P. Flintoft, assistant general solicitor in the law department of the Canadian Pacific Railway Company in Montreal, is especially well posted on the development of Canada's 40,000 miles of railway, and delivered an exceptionally interesting address, choosing as his subject, "Some Phases of Railway Development in Canada." Mr. Flintoft touched briefly, but in a most interesting manner, on the development of Canada's main systems of railway since the first road was constructed, a distance of 16 miles, from La Prairie to St. Johns, Quebec, to the present, when Canada had the greatest per capita mileage in the world.

How little the marvellous developments in railway construction in a few decades were realized only a short time prior to Confederation might be visualized, said Mr. Flintoft, by the statement made in 1863 by Captain Palliser, sent out by the British government to explore the territory west of the Great Lakes. He declared that the location of the international boundary along the 49th parallel forever precluded the possibility of building a railway through Canada to the Pacific coast. Yet others held more optimistic views, and one of the cardinal terms of the treaty of union between British Columbia and the Dominion in 1871 was that such a railway should be built.

Mr. Flintoft traced in turn the early struggles of the Grand Trunk, the Intercolonial, the Canadian Pacific, Canadian Northern and the Grand Trunk Pacific. He referred to the building of 725 miles of railway into Calgary in the early eighties during the course of fifteen months, involving the handling of a million tons of material, as a record in construction then unequalled in the history of railroad construction.

The result of all these efforts was that Canada had to-day over 40,000 miles of railway, the greatest per capita mileage in the world, with a capitalization which exceeded $3,500,000,000. This country's roads, Mr. Flintoft said, were equipped in a manner to compare favourably with those of the United States, and in no other part of the world was a sustained and reliable railway service maintained under such adverse conditions.

Touching on rates, Mr. Flintoft stressed the impossibility of Canada's roads operating with any degree of prosperity on the existing schedules. The rates allowed on the carriage of grain on the United States roads were from 25 to 90 cents higher in the western area than in Canada, and this only permitted them to pay a reasonable dividend to their shareholders. He emphasized the enormously increased competition by water on the Great Lakes and the effect of haulage by motor truck. The great difficulty, he contended, is that railway service in Canada on practically all roads was being provided at less than cost.

Dr. Chas. Camsell, M.E.I.C., the new chairman of the Ottawa Branch, presided at both luncheons, taking the place of Naulon Cauchon, A.M.E.I.C., chairman last year.

Ottawa members have learned with regret of the death at Winnipeg of H. V. Brayley, who was secretary of the Ottawa Branch from 1910 to 1913, succeeding S. J. Chapleau, M.E.I.C., the first secretary. Mr. Brayley when in Ottawa was connected with the engineering department of the Transcontinental Railway and took an active interest in the Ottawa Branch of The Engineering Institute of Canada from its inception in 1909. After leaving Ottawa, he was for some years connected with the firm of Gunn, Richards and Company, industrial engineers, and later conducted industrial investigations for various financial interests. Latterly, he had been occupying the post of income tax inspector of the Department of National Revenue, Montreal, and it was while returning from an investigation he had been conducting for the department at Calgary that he was stricken with acute indigestion and passed away at the Royal Alexander hotel, Winnipeg. Mr. Brayley was in his fifty-first year, and had been in normal health.

Peterborough Branch

W. E. Ross, A.M.E.I.C., Secretary.
B. Ottewell, A.M.E.I.C., Branch News Editor.

The Welland Ship Canal

A regular meeting of the Peterborough Branch was held on January 26th, 1928, when A. J. Grant, M.E.I.C., engineer-in-charge of the Welland ship canal, gave a most interesting address, being a general description of the work on the new Welland ship canal. As a former resident of Peterborough and engineer-in-charge of construction of the Trent canal, Mr. Grant was especially welcome. As the various phases of the work on the canal are given in several papers presented at the Annual Meeting and published in the February issue of the Journal, details of Mr. Grant's paper are not given here.

After a lengthy and interesting discussion, a cordial vote of thanks was given to Mr. Grant for his address.

Regular Meeting, February 9th, 1928

This meeting was arranged entirely by the Juniors and Students of the branch, the chairman for the evening being S. O. Shields, S.E.I.C. Three papers were presented, as follows:—

1. "Tirrill Voltage Regulators and Their Application," by M. C. Lowe, S.E.I.C.
2. "A Power Site Survey," by O. T. Foulkes, S.E.I.C.
3. "Fisheries of Nova Scotia," by St. C. J. Hayes, S.E.I.C.

A brief summary of each of these papers is given below.

This is the second occasion on which the Students and Juniors of the Peterborough Branch have provided the entire programme for a regular meeting, and mention might be made that all the three speakers are members of the engineering department of the Canadian General Electric Company.

An active discussion followed each paper, and at the close of the programme the three speakers were accorded a very hearty vote of thanks for their papers.

Tirrill Voltage Regulators and Their Application

M. C. Lowe, S.E.I.C., introduced his subject with a brief historical survey of the origin and development of the voltage regulator, as applied first to direct current generators and then to alternating current machines. The benefits due to improved voltage regulation by the use of the Tirrill regulator were mentioned. With the help of a diagram, Mr. Lowe gave a detailed explanation of the construction, methods of connection and operation of this type of regulator.

With the generators in parallel, the exciters may be operated separately or in parallel under control of the regulator. For holding constant voltage at the end of a long line, the line drop compensator is used.

In conclusion, the speaker described the various adjustments necessary for proper operation, and cited an example of a regulator which gave poor results due to several errors in connections and adjustment. When these points were corrected the regulator operated perfectly.

A Power Site Survey

Experiences during the summer of 1925 on survey work in the Saint John river valley, New Brunswick, were described by O. T. Foulkes, S.E.I.C., in this paper.

This work was a preliminary to the development of the Grand Falls power site by the Saint John River Power Company. The flow at this point varied from 100,000 to as low as 800 second-feet, thus making the question of storage of primary importance. Approximately one-half of the available storage lies in Canada and the other in the United States.

The initial development at Grand Falls will be 50,000 h.p. using only Canadian storage. The total possible development is 150,000 h.p.

The author then described three types of survey in which he took part,—storage survey on the St. Francis river, a flowage survey to determine the area of the land to be flooded and a transmission line survey.

Details of the methods used were clearly explained and the address was well illustrated by diagrams and photographs of the country surveyed.

The Fisheries of Nova Scotia

The paper by St. C. J. Hayes, Jr.E.I.C., described briefly the history of the fishing industry on the Atlantic coast. It is known that previous to John Cabot's time the cod-banks of Newfoundland were frequented by the Normans, the Bretons and Basques. One of the oldest place names in America is Cape Breton, which is a memorial of the early French fishermen who frequented that vicinity previous to 1502.

Nova Scotia occupies a remarkable geographical location within easy reach of the most extensive fisheries in the world. The smaller fishing banks, such as Roseway, Lahave, Browns and Sambro, are all within a few hours sail of the fishing ports. The larger banks, viz., Georges, Middle, Banquereau and Sable, are within a radius of 150 miles of the principal fishing ports, and the Grand Banks are only 600 miles from Lunenburg.

The fisheries are of three distinct types so far as the operating methods are concerned. These types are (1) the in-shore, (2) the off-shore, and (3) the deep sea fisheries.

The in-shore fisheries are carried on by fishermen in smaller vessels and motor boats. These boats set out from the villages and ports very early in the morning for the nearby fishing grounds and return to port the same day with their catch.

The off-shore fisheries are essentially an extension of the in-shore fishery. Larger boats are used, accommodating two to six men, and are usually absent from port three to six days during the season.

Lunenburg is the chief centre of the deep sea fishery, but vessels sail from Canso, Yarmouth, Liverpool, Port Hawkesbury and Halifax. The fishermen use vessels for the salt fish trade, while the larger corporations are using steam-trawlers for the fresh fish trade. The vessels are from 60 to 100 tons and are equipped with sail and also with oil engines. Each vessel carries six to ten dories and the average crew numbers twenty men. On arriving at the banks, the men go out two to a dory and use trawl lines which are sometimes a mile long and have baited hooks every four feet. Some twelve vessels use the hand-line method and catch the fish by jigging. This method is more laborious than the trawl line, but has the advantage that no bait is necessary. The vessels make three trips per year.

As the steam trawlers operate primarily for the fresh fish trade, their trips occupy only ten days to two weeks and the average catch is 150,000 pounds. Some eleven ships are now engaged in this industry.

The striking characteristic of the Lunenburg fishery is that the ownership of the vessels and the operation is largely co-operative. The result is that the property is well cared for and the industry intelligently operated.

The fishing industry gives employment to about 20,000 people. The fishermen are daring and resourceful and highly prize the independence which comes from the direct ownership of their means of livelihood.

Following this paper, a motion picture film depicting these Canadian fisheries was shown.

Saint John Branch

W. J. Johnston, A.M.E.I.C., Secretary-Treasurer.

A meeting of the Saint John Branch was held on the evening of February 3rd, 1928, in the New Brunswick Telephone Company building, at which S. R. Weston, M.E.I.C, presided.

A report from the Executive Committee on the question of proposed increase in fees of $5.00 to members was read. The report was the result of a thorough study of the question carried on at several meetings of the executive. The report favoured an increase of fees of Associate Members $1.00 and of Members $3.00, so as to obtain the same amount of extra revenue required, and also gave a list of several preferred ways in which revenue should be expended. The report was adopted as presented, with instructions to have it sent to Headquarters and all branches of The Institute.

The Functions of the Courts

An address on a legal subject, "The Functions of the Courts," was given by H. O. McInerney, K.C., Judge of Probate. In introducing his subject, the speaker explained the reason for various courts of justice to decide different legal problems of varying degree of importance and of the limits of jurisdiction of judges in the several courts deciding on different questions. It was a clear description of the various courts told in a manner so that anyone not of the legal profession could understand it.

Beginning with the lowest court, presided over by a justice of the peace, the speaker in turn described the police and stipendiary magistrates' courts, county courts and the various divisions of the

Supreme Court of Canada. In detail, the various functions of the Appeal Division, Chancery Division and the King's Bench Division were described. Courts dealing with special classes of cases were mentioned, including bankruptcy, divorce, exchequer, admiralty and probate.

The method of appointment of judges in the different courts by provincial and Dominion authorities was also explained, and also of exceptions in some of the provinces. The Privy Council of England was mentioned as being the final court of appeal and the several methods described in which permission was granted for hearing cases before this court.

A vote of thanks to Judge McInerney was moved by Geoffrey Stead, M.E.I.C., and J. N. Flood, A.M.E.I.C.

Sault Ste. Marie Branch

A. H. Russell, A.M.E.I.C., Secretary-Treasurer.

The regular monthly meeting was held on Friday, January 27th, 1928, at 8 p.m., in the Y.W.C.A. rooms. At the dinner held at 6.45 p.m. there were guests from Espanola and Sturgeon falls, besides the speakers for the evening.

W. S. Wilson, A.M.E.I.C., chairman, called the meeting to order and disposed of the regular business. C. H. E. Rounthwaite, A.M.E.I.C., reported for the auditors and the report showed a nice balance to the credit of the branch.

C. H. Speer, M.E.I.C., reported for the special committee on the purchasing of a lantern and screen for the branch. The committee hoped to have the equipment on hand for the February meeting.

Mr. Wilson introduced Mr. C. A. Price, of the Canadian Westinghouse Company of Hamilton, and Mr. J. W. R. Taylor, of the same company of Toronto. Mr. Price gave an excellent talk on " Making a Motor " and Mr. Taylor handled the slides for him.

Making a Motor

Mr. Price, in choosing the subject for his paper, specialized in the design and manufacture of the induction motor. "A motor," he said, " was the agency used to change electrical energy to do mechanical work, and in the design of such a machine there was always something new turning up to meet the requirements of the users." By the use of numerous slides and blackboard diagrams, he showed the graphs used in getting the relationship between the torque, the revolutions per minute and efficiency for the various designs that they were required to put on the market, and more especially those for special purposes. They carry about 115 standard motors listed in stock, but for the special ones the windings are changed to give the required specifications.

The slides showing the construction of a motor, giving the details of all its parts, were very interesting and showed very clearly to what an expense in special machinery such a manufacture had to go to to turn out the finished product.

A general discussion followed, and the electrical men present gave Mr. Price a merry time of it, judging by the numerous questions asked him. In this discussion a better understanding of the motor was arrived at, and all present felt that they owed Mr. Price a hearty vote of thanks for his splendid and instructive address. This vote was given on motion of Messrs. Rounthwaite and Kohl.

Toronto Branch

W. B. Dunbar, A.M.E.I.C., Secretary-Treasurer.
J. W. Falkner, A.M.E.I.C., Branch News Editor.

The Photo-Elastic Method of Determining Stress

(Reported by J. R. Montague, A.M.E.I.C.)

On Thursday evening, January 19th, in the Mining building of the University of Toronto, Professor T. R. Loudon, M.E.I.C., assisted by Mr. K. B. Jackson, presented to a well-attended meeting of the Toronto Branch a most interesting paper on the "Photo-Elastic Method of Determining Stress." The meeting was ably presided over by the chairman, R. B. Young, M.E.I.C. The lecture was illustrated in a most interesting way with lantern slides, and with the photo-elastic apparatus used by Professor Loudon in the extensive investigations being carried on by him at the University of Toronto.

Briefly, the method employed consists of the projection of polarized light rays through celluloid models of structural members, or mechanical parts, under stress conditions corresponding to that to be expected under actual working conditions, and observing the distribution, inclination and intensity of the principal stresses, as determined from varying colours and shades on the image projected on the screen.

The polarized light used in these investigations is obtained by passing the rays from an ordinary arc light through two Nicol prisms with axes at right angles to each other. The difference *(P-Q)* between the principal stresses at the different points of the model is brought out on the screen by coloured areas which vary from a pale yellow to green, blue, red, and black, depending on the intensity of the stresses. As additional loads are added to the model, the colour range is repeated until failure occurs.

The models used are made of celluloid, great care being necessary in their preparation to obtain a uniform texture and thickness, and to avoid the setting up of initial stresses. Failure in these respects would tend to confuse the results obtained.

The three principal kinds of stress usually considered by designing engineers are uniform, uniformly varying, and combinations of these two. In many cases the stress distribution resulting from these combinations presents indeterminate solutions. It is with a view to isolating these stresses that polarized light is used, enabling a thorough study of the stress intensities at all points to be made.

While it is generally assumed for designing purposes that stresses are uniform across the section of a member, it has been found that there is often a very appreciable complex variation across the sections, particularly in structural members, in the vicinity of rivet holes. This variation was strikingly illustrated by Professor Loudon through the photo-elastic projections of models.

Some very interesting results have been obtained in the investigation of structural members and machine parts; a striking example given showed the variation of stress in a gusset plate of a roof truss model. In another instance the stress lines in a machine gear, under operating load, as determined by the photo-elastic method, demonstrated that the actual stresses followed closely to the assumptions used in gear design.

While the application of the photo-elastic method is only in its infancy in this country, it has reached an advanced state of application in Europe, particularly in England. Its field of application is by no means confined to determinate stresses, but promises to find a very practical application, as well, in the investigation of indeterminate stresses in structures such as bridge bents, building frames, and rectangular water conduits and other hydraulic structures.

Interesting sidelights were brought out in discussion by William Gore, M.E.I.C., Professor C. R. Young, M.E.I.C., R. B. Young, M.E.I.C., George McCarthy, M.E.I.C., J. G. R. Wainwright, A.M.E.I.C., J. M. Oxley, M.E.I.C., F. M. Byam, M.E.I.C., J. W. Falkner, A.M.E.I.C.

A vote of thanks, proposed by George McCarthy, M.E.I.C., was heartily endorsed by the audience, and proffered to the speaker and his assistant by the chairman.

The Montreal Harbour South Shore Bridge

(Reported by J. W. Falkner, A.M.E.I.C.)

The regular meeting of the Toronto Branch on Thursday evening, February 2nd, was preceded by a well attended dinner at the Faculty Union, Hart House, to welcome the speaker of the evening, P. L. Pratley, M.E.I.C., who had made the journey from Montreal especially for this meeting. The dinner was followed by an opportunity for informal discussion with the speaker before the meeting, which was much appreciated by members of the branch.

Mr. Pratley afterwards presented at the regular meeting of the branch, held in the Mining building, and with R. B. Young, M.E.I.C., chairman of the branch presiding, a most interesting and exceptionally well illustrated paper on the " Montreal South Shore Bridge," dealing in detail with the history, design, economics and construction to date of this most important Canadian bridge-engineering project. Especially interesting was the description of the pneumatic caisson methods used, also the description of the caisson for pier No. 24, probably the fourth or fifth as to size in the world.

At the outset the speaker sketched the historic background of this important project, illustrating by slides the many schemes and ideas which had been put forward between 1876 and 1924, when the present undertaking was authorized and begun. Mention was made of the original site of the Victoria bridge, and the elaborate design for the Royal Albert bridge which was proposed for this same site twenty years later in 1876. Again, after some twenty years, in 1897, the Royal Albert bridge project was revived, a competition arranged after much preliminary data had been collected, many interesting designs being submitted, and a winning plan selected.

As before, however, the plan was doomed to failure through want of authoritative support, financial and political. Further designs following at intervals up to the war period were likewise unfruitful except insofar as they provided food for study when the present engineers took up the problem again after the 1920 fire on the Victoria bridge. Into this history of the various efforts to bridge the St. Lawrence at Montreal, Mr. Pratley wove the theme of the varying needs that from time to time prompted the citizens, engineers or promoters to re-open the question. He also showed how the erection and replacement of other bridges in the neighbourhood had affected the chances of success by supplying the needs of railway transport. The Lachine bridge of the Canadian Pacific Railway, the double-tracking of the Grand Trunk Railway Victoria bridge, the replacing and doubling of the Lachine bridge, served in succession to relieve the railway situation between 1885 and 1912.

The speaker then went on to show that the advent of the motor-car had entirely changed the problem, and that from about 1909 on, highway traffic had begun to show signs of congestion at the entrances to and exits from the large centres of population and industry. The war served to accentuate the importance of automobile transport, and the tremendous growth in the number of motor vehicles simultaneously provided a huge new source of revenue for bridge finances. Thus when the fire absolutely stopped traffic on the Victoria bridge, the citizens of Montreal and district became urgent in their demands for some alternative and more convenient means of crossing to the south shore. While the public were seeking favourable consideration from the Federal Government, the engineers were studying the physical and economic problems and making preparatory designs.

The government were not at first able to see their way to do very much, but finally the chairman of the Harbour Commissioners persuaded them to grant powers to this body to undertake the financing and construction. The enabling legislation passed the house in 1924, the engineers were appointed, designs established and the first contract let in May 1925 for the southern half of the substructure. including twenty piers. Mr. Pratley spoke of the advantages and disadvantages of different sites and pointed out the fact that the one chosen was almost exactly that proposed fifty years ago. Views of alternative types of span were shown and the choice of the *K.* cantilever explained.

The capacity of the new structure was stated to be a clear 37½-foot vehicular roadway, with separated rapid-transit tracks on either side, and footwalks outside these again. The total length of the bridge is just two miles, including the city viaducts and the south shore embankment, the main channel span being 1,097 feet, giving a 1,000-foot channel for vessels and 163 feet vertical clearance. There are in all forty-seven steel spans, besides thirteen towers and six concrete girder spans at the north end. There are twenty-six piers beside the south abutment and the thirty-four pairs of pedestals on the north side. In addition there are the retaining walls and 200 feet of reinforced concrete viaduct at the north end and the abutment and three pairs of pedestals on the island ramp. Well over 100,000 cubic yards of concrete and 30,000 tons of steel are included in the three main contracts, in addition to which are the flooring slabs, asphalt surfacing, macadam bases on fills, fences and handrails, and the island pavilion.

This latter is a concrete and steel building on St. Helen's island, forming part of the bridge-deck and providing recreational facilities, elevators to the island roads and the Swimming Club grounds, and the ramp for motor and vehicular connection to the municipal playground which will be developed in the near future. After touching on the financing and the expectations with regard to revenue the lecturer proceeded to show considerably over a hundred slides illustrating progress with the various parts of the work. Especially interesting were those dealing with the pneumatic caissons which were used for the main river piers. The foundation work was stated to be of extreme importance and to have comprised many types of construction, on land and in water, by open and pneumatic excavation, on piles, on rocks, on hard-pan, and on boulder clay. Headway with the steel work was also indicated, and reference made to the economic choice of spans. The programme for the future was detailed and the approximate date of completion mentioned as the fall of 1930. Satisfaction was expressed at the rate of progress, with the class of workmanship, and with the fact that Canadian engineers and contractors were building in Montreal a truly monumental bridge structure, of outstanding usefulness and impressive magnitude.

The hour being late, and the speaker having to catch the night train to Montreal, many members who wished to ask questions, or to take part in the discussion, were unfortunately unable to do so for lack of time. J. M. Oxley, M.E.I.C., therefore, at the chairman's request, moved the vote of thanks, which was most heartily concurred in by the meeting and suitably presented by the chairman; and the speaker, in his reply, very kindly offered to answer any questions sent to him at Montreal, mentioning that the paper would not be printed, as it had been agreed upon between the consulting engineers and the bridge company not to release any paper or papers for publication until the completion of the project.

Vancouver Branch

F. P. V. Cowley, A.M.E.I.C., Secretary-Treasurer.

Annual Meeting

The annual meeting of the Vancouver Branch was held on Wednesday, December 14th, 1927, at 8 o'clock. The notice calling the meeting and the minutes of the previous annual meeting held on December 16th, 1926, were read by the secretary and the chairman then called upon J. R. Grant, M.E.I.C., and T. E. Price, A.M.E.I.C., to act as scrutineers for the counting of the ballots. The secretary then read the annual report of the branch, which, upon the resolution of Major Geo. A. Walkem, M.E.I.C., and W. H. Powell, M.E.I.C., was received and adopted.

W. Brand Young, A.M.E.I.C., then addressed the members, expressing regret that F. W. Alexander, M.E.I.C., the retiring chairman, was not present, and suggested that, if it was the wish of the meeting, a letter be sent Mr. Alexander expressing the regrets of the branch at his absence.

Referring to the meetings of the branch held during the year 1927, special attention was drawn to the high order of the papers given and regret expressed that there had not been a larger turn-out of members to hear them.

The papers which will be given before the branch during the balance of the winter were then briefly sketched, showing that different branches of the profession would be dealt with.

Special reference was made to the excellent work of the Royal Engineers Tablet Committee, and of the committee responsible for the creation of the student section at the University of British Columbia.

The members were urged to support the Western Professional Meeting to be held in Vancouver June 7th to 9th, 1928, and it was pointed out that a successful meeting would do much to help The Institute as a whole and the branch in particular.

Mr. Young concluded by expressing the regrets of the branch at the loss of two of its active members, J. H. Kennedy (life member) and E. Dundas Todd.

Mr. Young's address was received with applause by the members.

At the conclusion of the chairman's address, it was moved by Major Geo. A. Walkem, M.E.I.C., seconded by A. C. R. Yuill, M.E.I.C., and carried unanimously, "that a letter be sent to F. W. Alexander, M.E.I.C., regretting his inability to be present, and wishing him every success in his new position."

Major Geo. A. Walkem, M.E.I.C., then read a paper on "The Inception of the Canadian Society of Civil Engineers, Now the Engineering Institute of Canada," by R. A. Davy, M.E.I.C.

At the conclusion of the reading of the paper it was moved by Major Walkem, M.E.I.C., seconded by W. H. Powell, M.E.I.C., and carried, "that the general secretary of The Institute be asked to write to Mr. Davy notifying him that his paper had been read before the annual meeting of the Vancouver Branch, and thanking him for his valuable record."

E. A. Wheatley, A.M.E.I.C., then reported on behalf of the Royal Engineers' Tablet Committee, and it was moved by Major Geo. A. Walkem, M.E.I.C., seconded by A. S. Wootton, M.E.I.C., and carried, "that a vote of thanks be tendered Messrs. Greig and Wheatley for their efforts in connection with this committee."

The chairman then called upon J. R. Grant, M.E.I.C., to take the chair, and the scrutineers reported the result of the ballot as follows:—W. Brand Young, A.M.E.I.C., chairman; W. B. Greig, A.M.E.I.C., vice-chairman; F. P. V. Cowley, A.M.E.I.C., secretary-treasurer; A. S. Wootton, M.E.I.C., E. A. Wheatley, A.M.E.I.C., and H. B. Muckleston, M.E.I.C.

These, together with those elected in 1926 for the two-year period, namely, P. H. Buchan, A.M.E.I.C., H. W. Frith, M.E.I.C., and A. C. R. Yuill, M.E.I.C., and with the ex-officio member, E. A. Cleveland, M.E.I.C., (councillor), constitute the Executive Committee of the branch for the year 1928.

The report was received with applause by the members.

Mr. Grant then called upon Mr. Young to take the chair, and Mr. Young thanked the members for the honour tendered him and said that the co-operation of the members did much to help him in his duties, and asked for its continuance.

Mr. Greig thanked the members for electing him vice-chairman.

After further business of the annual meeting had been disposed of a general discussion of the forthcoming Western Professional Meeting took place.

The Lethbridge Northern Irrigation District

At the regular meeting of the branch, held on January 12th, the speaker of the evening was H. B. Muckleston, M.E.I.C., who gave a most interesting paper on "The Lethbridge Northern Irrigation District."

Mr. Muckleston was chief engineer of this district and directly in charge of all the construction work, and was thus able to explain lucidly and minutely the many difficulties met with and overcome during the progress of the work. Some fifty lantern slides were shown, illustrating both the work of construction and the country in general, and bringing before his hearers more clearly than words the extreme variations of the precipitation and run-off.

Brief reference was made to the early attempts at irrigation in the district, especially on the part of Mr. Harris as long ago as 1873, the speaker complimenting his work by showing that the general scheme as now in operation follows very closely, although of course on a much larger scale, the original scheme of this pioneer.

The history of the district was then dealt with, reference being made to the Northwest Irrigation Act of 1898, the settlement of the district following 1907, and the work done by the federal government making topographical surveys. The Lethbridge Northern Irrigation District was created in 1919, but it was only in 1921, when the bonds of the district were guaranteed by the government, that the money was raised to actively push on the work.

During the period of construction, 1921-23, the personnel of the irrigation council consisted by C. M. Arnold, H. G. Cochrane, A.M.E.I.C., P. M. Sauder, M.E.I.C., and F. S. Dyke, A.M.E.I.C. The many types of construction work undertaken are well illustrated by the various contracting firms undertaking the work, amongst whom might be mentioned: Grant Smith and Co. and McDonnell, A. G. Creelman and Co., H. G. McDonald, H. H. Boomer, Smith Bros. and Wilson, Dominion Bridge Company, Canadian Wood Pipe Company, Pacific Sheet Metal Works, Manitoba Bridge and Iron Works.

The headworks of the system were located on the Old Man river and the total area brought under irrigation was 105,000 acres.

The Forest Products Laboratory, Vancouver

The second general meeting of the month was held on January 18th and was addressed by J. B. Alexander, supervisor of timber tests of the Forest Products Laboratory, Vancouver, on the work of the laboratory with special reference to the timber mechanics' division. The speaker first reviewed the economic importance of forest products in British Columbia and throughout the Dominion, quoting official statistics issued by the federal and provincial governments. He then gave a short historical sketch of the development of testing of materials for specific information, and continued with a detailed description of the work of the Vancouver laboratory. The work of the laboratory, he explained, is distributed between two technical sections—timber products and timber mechanics—and it was more particularly with the latter section, which has to do with the determination of the strength of woods and manufactured articles, that he confined his remarks.

Student Section of the Vancouver Branch

The Cariboo Highway

The activities of the student section of the branch have been very marked since the students' return after the holidays, well attended meetings having been held on January 18th, January 25th and February 1st, at the University of British Columbia. The meeting of January 18th was an exceptionally good one, and raised the interest in the student section considerably. The support received from those outsiders who are interested in the engineering students and in The Institute will be a factor in making this first year a success.

The speaker of the meeting was P. Philip, M.E.I.C., deputy minister of public works, who presented an excellent address on the "Cariboo Highway."

Mr. Philip preceded his subject with a few remarks on the character of the engineering student. He then gave a brief history of the old Cariboo road and the construction of the present modern highway recently opened to traffic. He added some comparative statistics on British Columbia and also gave an idea of the standards adopted in road construction in this province.

A great many lantern slides were shown, illustrating the scenic wonders of this new highway.

About one hundred and thirty students, members of the faculty and visitors, attended the meeting.

Town Planning

Another splendid meeting was held on January 25th, when "Town Planning" was the subject of the meeting and the address was delivered by H. L. Seymour, M.E.I.C., resident engineer of the Vancouver Town Planning Commission.

Mr. Seymour explained the meaning of town planning, what it involves and what it means to the modern city. He gave examples of what it means to those large cities which are spending huge sums of money to rectify the errors of laying out without due regard for the future. He gave the six chief headings under which town planning is handled, as: (1) major streets, (2) transit or the routing of traffic, (3) transportation, rail and water, (4) public recreation, (5) zoning, (6) civic art.

The speaker then summed up under the short phrase "Community Foresight." The lecture was illustrated by lantern slides. About seventy students were present.

Requirements of a Municipal Engineer

At the meeting of the student section of the Vancouver Branch, held on Wednesday, February 1st, W. B. Young, A.M.E.I.C., assistant city engineer and chairman of the branch, presented an address on the "Requirements of a Municipal Engineer." A new angle from which to consider engineering was introduced by the speaker, since his remarks dealt with the human side of the profession rather than with the technical side.

Although making specific reference to municipal engineering, Mr. Young's address applied equally well to any other engineering activity. He showed that there are many corners in the mind of an engineer which cannot be filled by technical training. While technical education is perhaps the fundamental requirement, there are other things which the engineer must acquire by his own initiative outside the walls of university or office. The engineer who has not the ability to present his problems to the business or non-technical man in lucid form, who cannot convincingly address and correspond with those in other walks of life, who is unsympathetic to the viewpoint which is outside the rut of his profession, or who does not understand the workings of the business and social world, cannot hope to be truly successful. The tendency of the engineer is to choose his circle of friends from among those of his own profession. This, in the mind of the speaker, is unwise, and that the young engineer should include in this circle those of other professions, business men and non-technical men, whenever possible. In closing, the speaker pointed out that in The Engineering Institute of Canada is found the best organized method of broadening the mind of the engineer.

Cuprous-oxide Current Rectifier

An examination of the subject will show that the increasing use of alternating-current distribution must bring in its train a greater demand for devices for generating direct current without the use of revolving machinery. As it is, at the heavy-current end of the scale the mercury rectifier and its modifications are being more and more employed, both for general and traction work, while at the light-current end the requirements of wireless, control and measuring apparatus of various kinds, open up even more important fields of application for such devices. From the commercial point of view, perhaps, the most fertile of these fields is the wireless market, where it is often desirable for even the amateur to be able to obtain direct current from an alternating supply for charging his batteries or even for operating his set directly. The apparatus that can, at present, be used for these purposes may be classed under the headings of valve rectifiers, vibratory rectifiers and chemical rectifiers, respectively. The first of these gives very efficient rectification, but it consumes energy for heating the filament and generally has a fairly high resistance. The vibrating rectifier works well and its efficiency is high, but it requires attention, while in chemical rectifiers, though there is only a small loss of energy and little attention is required, the use of liquids is a disadvantage. It is stated that most of the advantages claimed for the various types of rectifier, without the accompanying disadvantages, are obtainable by using what is known as a metal rectifier, an interesting example of which is being developed in this country by the Westinghouse Brake and Saxby Signal Company, Limited, of King's Cross, London, N.

This rectifier, the discovery of which is due to Mr. L. O. Grondahl, consists essentially of a disc of copper, on one face of which a layer of cuprous oxide has been formed at a high temperature. It has been found that a plate of this kind is an unsymmetrical conductor of electricity; that is, the resistance to the passage of current in the direction from the oxide to the copper to the passage of current in the opposite direction is in ratio of about 1:1,000, or even higher.

It will be obvious from what has been said that if this rectifier is connected in an alternating-current circuit, one-half of the wave will practically be suppressed.—*Engineering.*

Long Distance Flights

It may not be out of place to emphasize that the true purpose of long-distance aeroplane flights is to test the engine and the machine, and not to cover the aviator with glory or oblivion, as the case may be, nor to provide stunts for the newspapers. Some of the flights, which have recently been attempted, have had in them more than a little of the foolhardy, and even when they have proved successful, have not always been so useful from the point of view of design and construction as they would have been had they been less spectacular. A great deal more that is useful can be learnt from a flight which is within the capacity of the engine, the machine and the pilot than from one which only proves, what was pretty evident beforehand, that there are certain tasks that cannot be successfully accomplished at present. At the moment, no less than five long distance flights are in progress. Capt. R. H. McIntosh and Mr. Hinkler are making a journey to India on a Fokker machine, driven by a British Bristol engine, though they were not successful in doing this without a stop. A group of four R.A.F. flying boats, under Group-Capt. A. M. Cave-Browne-Cave, and an Avro, with Captain Lancaster and Mrs. Keith Miller on board, are all bound for Australia. Two R.A.F. Fairey biplanes are on their way from Cairo to Nigeria, and Sir Alan Cobham, accompanied by Capt. H. V. Worrall, has begun his survey tour of 20,000 miles through and round Africa. The first of these, though it has failed to beat Mr. Clarence Chamberlin's long distance record from New York to Eisleben, should help to establish an air route between this country and India. We may be forgiven for holding that the latter is the more important result of the two. Sir Alan Cobham will have ample opportunity of testing the capabilities of his machine, not the less because he will have to take off and alight no less than 43 times. But he will also carry out a most useful survey of what is still a little known country, and perform an Imperial service in trying to secure the support of the administrations in Africa for aviation, and in attempting to convince them that air transport is an important factor in the development of their country. The machine which Sir Alan is flying is a Short-Singapore flying boat, and has been lent by the Air Ministry. It is the first all-metal machine which Great Britain has produced, and has a span of 93 ft. with a length of 63 ft. Its total weight, in flying trim, is 9 tons, of which 3 tons is the disposable load. It is equipped with two 700-h.p. Rolls-Royce Condor, (Series IIIA), engines, and has a speed, in still air, of about 120 m.p.h. Its radius of action, with full load, is 1,000 miles. The present boat will carry a crew of six, but Messrs. Short Brothers have under construction a similar machine which is designed to accommodate 15 passengers.—*Engineering.*

The Deterioration of Steam Turbine Blades

So long as steam speeds remained low there was very little erosion of steam-turbine blading. In fact, speaking at a meeting of the Institute of Metals on September 17, 1915, Admiral Oram stated that blade erosion was unknown in the navy, and in land practice it is certainly true that the blading of old-type reaction turbines showed no material wear even after two or three years' continuous service. Such slight erosion as did occur was evident rather to the sense of touch than to that of sight. If the finger were run along the leading edges of the blades near the tips, a certain roughening could be detected, much as if the object felt had been a very fine saw. Such blades were also apt to be coated with a layer of lime derived from the drops of water entrained in the steam and carried by it into the superheater. The evidence available until comparatively recently was insufficient to show whether the erosion observed was due to this lime or to the water, and, so far as they went, Admiral Oram's observations seemed rather to point to the lime as the agent responsible for the erosion, since in the navy distilled water is used for making up the feed. It was, therefore, not unnatural to connect this absence of erosion with the absence of entrained solids.

The evidence now secured, however, seems to show very definitely that, in general, it is the water suspended in the steam which is the main agent of destruction. The modern power station employs a feed as free from dissolved solids as that used in the navy. Nevertheless, erosion, at times of a very serious character, has been far from uncommon. We have seen blades of 5 per cent nickel steel of which the leading edges in the neighbourhood of the tips were as full of holes as a colander. At times, moreover, this erosion is curiously selective. In a certain impulse turbine where, in the high-pressure section, the steam was expanded down from the stop-valve pressure to atmospheric pressure in seven stages, the fifth-stage blading was cut to pieces in the course of a few weeks and had to be replaced by blades made from more resistant material. The succeeding stages had suffered very little, although traversed by a still larger proportion of water. It has been suggested that this peculiarly limited attack was due to air entrained in the steam, which it was assumed became an active corrosive agent near the saturation line, when the separation out of moisture wetted the blades, and thus provided the catalytic agent without which Professor Armstrong has ever emphatically maintained that chemical reactions are impossible.

The escape of the succeeding stages was attributed to the fact that all the oxygen was used up in oxidizing the blading of the row first attacked. It is, however, very difficult to believe that this could be the case, and it seems much more probable that the selective effect observed was really connected with the phenomenon of supersaturation.—*Engineering.*

Structural Steel and the Safety of Buildings

The basic causes of corrosion have been the subject of many theories from the time of Faraday onwards, none of which have received universal acceptance, though the electro-chemical theory is probably the most popular at the present time, and none of which have provided a complete explanation of the many apparently discordant phenomena which occur.

This being so, Mr. Frank W. Skinner has done a real service to engineering in presenting in a paper on "The Unlimited Potential Durability of Structural Steel," which he read before the Brooklyn Engineers' Club in the early part of the present year, a mass of data, collected from many sources, on the extent to which corrosion occurs on structures of all kinds, and the methods that have been adopted to check its inroads. This important subject is approached from a somewhat unusual angle. Mr. Skinner states that, on account of the widely-spread misleading and disquieting statements regarding the safety, reliability and stability of structural steel, particularly in the frameworks of large buildings, which have been published in New York, he determined to make an elaborate investigation of the subject.

Mr. Skinner's paper indeed amply disproves the possibility of any danger from corrosion in structures which are designed to comply with present standards and are properly protected, inspected and maintained. In those qualifications, of course, lie the gravamen of the charge, which Mr. Skinner has successfully refuted. Failures of steel structures there have been. But those failures can usually be ascribed to faulty design or to overloading; and it is hard to find an instance where the attrition of the material by corrosion has occurred, if care has been taken in the first place to guard against it. To quote Mr. Skinner again:—Though corrosion may possibly occur owing to improper design, construction or unjustifiable conditions, these possibilities can be enumerated and explained and methods for preventing them are known, so that any danger can be easily and permanently eliminated. He goes so far as to add that when structural steel is properly treated by ordinary methods and at reasonable expense all risk of rusting is removed.—*Engineering.*

Preliminary Notice

of Applications for Admission and for Transfer

February 18th, 1928.

The By-laws now 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 election 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 1928.

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 or 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.

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.

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

FARQUHARSON—STANLEY, of Arvida, Que., Born at Christchurch, New Zealand, Jan. 25th, 1899; Educ., 5 yrs. civil engrg., Canterbury Univ., 1923; 1919-22, articled cadet, Haumer & Barker, engrs. trigonometrical and plane surveying, laying out streets and sewerage systems; 1922-1923, instrumentman. stadia & plane table trig. surveying, investigation, Warmakariri development for city of Christchurch; 1924-27, instrumentman, dftsman, estimating reinforced concrete detailing and design with B.C. Electric Ry. Co., Vancouver; 1927-28, designer with Power Corp. of Canada, Montreal; at present, on design and construction of development on Saguenay river with Aluminum Co. of Canada, Arvida, Que.

References: E. E. Carpenter, W. H. Powell, P. Buchan, H. G. Cochrane, H. S. Grove, E. A. Wheatley, A. C. Eddy, J. H. Trimingham.

GRIME—LEONARD, of Toledo, Ohio, Born at Stretford, England, May 26th, 1904; Educ., B.A.Sc., Univ. of Toronto, 1926; May to Oct. 1926, concrete detailer with Truscon Steel Co., Detroit; June 9, 1927, to date, structural dftsman with Am. Bridge Co., Toledo, Ohio.

References: P. Gillespie, T. R. Loudon, C. R. Young, J. R. Cockburn, W. J. Smither.

WALTON—CLARKE GIBBS, of Sandwich, Ont., Born at Gananoque, Ont., Mch. 20th, 1892; Educ., B.Sc., Queen's Univ., 1915; 1910-11, Nat. Trans. Ry. as instrumentman; 1915-16, asst. engr., Corbin Coal & Coke Co., Corbin, B.C.; 1917 (3 mos.), mining engr., Algoma Steel Corp.; 1916-19, engr and res. mgr. of Globe Graphite Mining & Refining Co., Port Elmsley, Ont.; 1919-20, mining work for Chas. Spearman, Montreal; 1920, bldg. constrn. in Detroit; 1921, engr. and supt. for Storrington Feldspar Co. at Rock Lake, and also with Chas. Spearman on spec. mining work; 1922 to date, constrn. engr. with Ford Motor Co. of Canada, Ltd., Sandwich, Ont.

References: W. R. McGie, J. E. Porter, L. McG. Allan, W. J. Fletcher.

FOR TRANSFER FROM ASSOCIATE MEMBER TO A HIGHER GRADE

DAVIS—GEORGE SANFORD, of Montreal, Que., Born at Cincinnati, Ohio, Nov. 28th, 1874; Educ., 1883-91, public school, and 1892-93, private preparatory school. Cincinnati; 1894-95, general repairs with Cincinnati Edison Co.; 1895-96, general repairs and testing, Cincinnati Elec. Light & Gas Co.; 1896-98, contracting and general repairs, built power plant and wired town of Olney, Ill., for street and house lighting; 1898-1900, general foreman, lines and distribution, Niagara Falls Hydro Pr. Co.; 1900-1901, foreman for house wiring for New York and Brooklyn contractors; Jan. to Mch. 1901, general foreman, Niag. Falls Hyd. Pr. Co.; 1901-02, general electrical work, Shawinigan Water & Power Co. for Wallace C. Johnson; Apl. to Dec. 1902, general foreman in experimental dept., Pittsburgh Reduction Co., Niagara Falls, N.Y.; 1902-04, switchboard and wiring cable work, Shaw. Water & Power Co.; 1904-05, supt., constrn. bldg. and remodelling lines, power houses and substations, Albion Power Co., Albion, N.Y.; Mar. to Nov. 1905, general foreman, temporary power & lighting and on final testing when plant put in operation, Ontario Power Co.; 1905-20, erecting engineer with Can. General Electric Co.; 1920 to date, electrical engineer with J. M. Robertson, Montreal.

References: A. C. Tagge, J. M. Robertson, F. Thomson, F. T. Kaelin, R. S. Kelsch, P. T. Davies, W. H. Wardwell, W. A. Bucke.

DINGWALL—ROBERT MACFARLANE, of Calgary, Alta., Born at Glasgow, Scotland, Mch. 16th, 1880; Educ., Assoc. Royal Tech. College, Glasgow, 1914; 1906-11, apptce. as mech. engr.; 1912-14 (summers), marine engr., i/c watch and leading mech.; 1917-19, lieut., R.E., i/c power plants, British Forestry Corps; 1919, master mech., N.A. Collieries, Ltd., Alberta; 1920, master mech., Mountain Park Coal Co., Ltd., Alta.; 1920-26, head of mechanical dept., Pro. Institute of Technology, Calgary; 1926 to date, engr. sales mgr., Riverside Iron Wks., Ltd., Calgary.

References: J. Haddin, C. C. Richards, A. S. Dawson, B. L. Thorne, R. W. Boyle, P. T. Bone.

HOLLOWAY—EDWARD S., of St. Hilaire, Que., Born at Montreal, July 18th, 1885; Educ., B.Sc., McGill Univ., 1908; 1905 (summer), instrumentman, C.P.R.; 1906 (summer), i/c constrn. bridge substructures, C.P.R.; 1907 (summer), instrumentman. Toronto terminals, C.P.R., constrn. of shops, roundhouses, track mtce., etc.; 1908, engr. i/c surveys and location of Canada and Gulf Terminal Ry.; 1910-11, i/c constrn. same road during winters exploration for extension of line to Gaspé; Oct. 1911 to Jan. 1912, locating engr. for Quebec Eastern Ry., Sherbrooke to Levis; Jan. to Oct. 1912, ch. engr., same road, design all structures; 1912-20, ch. engr. with Canada Gulf & Terminal Ry., also doing design and constrn. work, reports on harbour work, Matane and Cap Chat, Que., investigational work in logging pulpwood operations, pulp mills, etc.; 1920-27, i/c Matane operations, designed wharf, loading plant, flumes, piers, booms, etc., and also constructed same with Hammermill Paper Company; summer 1927, reports on harbour improvements, Moisie river, Que.; at present, engaged in reporting on various pulpwood operations, wharves, loading plants, etc., i/c, for Kerry & Chace, of surveys, hydro-power, on Ottawa river.

References: J. G. C. Kerry, J. M. R. Fairbairn, R. de B. Corriveau, K. M. Cameron, H. Cimon, A. B. Normandin.

FOR TRANSFER FROM JUNIOR TO A HIGHER GRADE

LECLAIR—WILLIAM JAMES, of Dalbeattie, Scotland, Born at Ottawa, Ont., Aug. 24th, 1891; Educ., grad. with honours, Ottawa Collegiate Institute, 1909, extra-mural course, Queen's Univ., in higher maths., physics and languages, 1911-12, 3rd year., B.A.Sc. course., Univ. of Toronto, 1915-16; 1909-11, served under and acted as asst. to supt. of constrn. on hydro-electric development works for the Bronson Co., Ottawa Power Co., Ottawa Elec. Ry., etc.; 1911-16, with Dept. of Pub. Works, Canada, preparing plans and specifications. general constrn., surveying and levelling, last 2 yrs. ranked as asst. engr.; 1916-19, tech. officer in Can. Forestry Corps, for 2 yrs. i/c sawmill, camps, railroad and road constrn. and operation of La Freese dist. in France; 1920 to date, ch. engr. and managing partner of Lawson & LeClair, Dalbeattie.

References: C. R. Coutlee, J. Murphy, A. Gray, J. L. Lang, F. E. Bronson, G. F. Dalton.

PERRITON—DOUGLAS ERIC, of Westmount, Que., Born at Montreal, Que., Jan. 16th, 1898; Educ., B.Sc., McGill Univ., 1922; 1919 (summer), mechanical design, P. Lyall & Sons; 1920-21, estimator, Grand Trunk arbitration; 1922 to date, with Dom. Bridge Co., Ltd., as: 1922-24, checking and designing, and May 1924 to date, estimating and contracting, as assistant to contracting engr.

References: D. C. Tennant, F. P. Shearwood, L. R. Wilson, F. Newell, P. L. Pratley, C. M. McKergow.

VOGAN—GEORGE OLIVER, of York Mills, Ont., Born at Riceville, Ont., Dec. 18th, 1892; Educ., B.Sc., Queen's Univ., 1917; asst. designing engr. for the hydraulic dept., H.E.P.C., Toronto, in responsible charge of detailed design of South Falls plant; during 1926-27, i/c detailed design of the Alexander power development for the H.E.P.C. of Ont.; since Jan. 1st, 1928, designing engr. for the Alcoa Power Co., Ltd., Arvida, Que.

References: T. H. Hogg, O. Holden, J. J. Traill, R. L. Hearn, A. E. Nourse, J. A. Knight.

FOR TRANSFER FROM STUDENT TO A HIGHER GRADE

CROSS—GEORGE ESPLIN, of Westmount, Que., Born at Westmount, Mch. 14th, 1899; Educ., B.Sc., McGill Univ., 1923; gold medallist, Mtl. Tech. School, 1919; estimator and dftsman with Geo. W. Reed & Co., Ltd., from May 1923 to Feb. 1926; March 1926 to date, structural dftsman with Dom. Bridge Co., Lachine, Que.

References: A. Peden, A. R. Roberts, C. M. McKergow, J. Weir, E. Brown, D. C. Tennant, N. Cageorge.

JONES—HERBERT CECIL, of Peterborough, Ont., Born Ninga, Man., Feb. 20th, 1900; Educ., B.Sc., Univ. of Man., 1926; May 1926 to date, with Can. General Electric Co., Peterborough, in test. dept., A.C. eng. dept., and, at present, induction regulator and meter eng. dept.

References: N. D. Seaton, B. L. Barns, A. B. Gates, W. M. Cruthers, B. Ottewell, E. P. Fetherstonhaugh.

LEADLEY—FRANCIS ROBERT, of Hamilton, Ont., Born at Hamilton, Mch. 7th, 1898; Educ., B.Sc., Queen's Univ., 1925; 1925-26, course for grad. engrs. in commerce and finance, Queen's Univ.; 1922-23-24 and 25 (summers), engrg. dept., Toronto, Hamilton & Buffalo Ry.; Jan. to Aug. 1927, res. engr. at Port Maitland during constrn. of coal dock and yards for Toronto, Hamilton & Buffalo Ry.; from Aug. 1927, res. engr. during double-track grading, east mountain section, with same company.

References: W. P. Wilgar, A. MacPhail, W. L. Malcolm, R. L. Latham, C. J. Nicholson.

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The Viaduct Structure at the New Union Station, Toronto

Features of Design and Construction

Major A. R. Ketterson, D.S.O., A.M.E.I.C.
Assistant Engineer, Canadian Pacific Railway Company.

Paper read before the Toronto Branch of The Engineering Institute of Canada, January 5th, 1928

General Description

The scheme of grade separation along the Toronto waterfront involves, generally speaking, the elevation of the tracks from a point near Bathurst street,—the westerly limit,—to a point in the vicinity of Queen street (on the line of the Canadian Pacific Railway) and Logan avenue on the line of the Canadian National Railways)—the easterly limits—making a total length of about 3.6 miles. Between these two limits, *i.e.*, Bathurst street and Logan avenue, the elevated tracks will be carried on an earth embankment, with subways at intervals in order that certain intersecting streets may pass under the tracks and give access to the waterfront area, which lies to the south.

At the new Union station, which is located between the two limits mentioned, this track elevation reaches its peak. Here the top of the rail is 29.5 feet above the zero on the harbour gauge, *i.e.*, about 20 feet higher than the old Union station tracks.

The new Union station building extends throughout the block from Bay street on the east to York street on the west, and will have, when the project is complete, twelve station tracks and ten platforms running alongside its south face.

Immediately south of these station tracks there are the Canadian Pacific Railway coach yard tracks, and adjoining these to the south are the Canadian National Railway

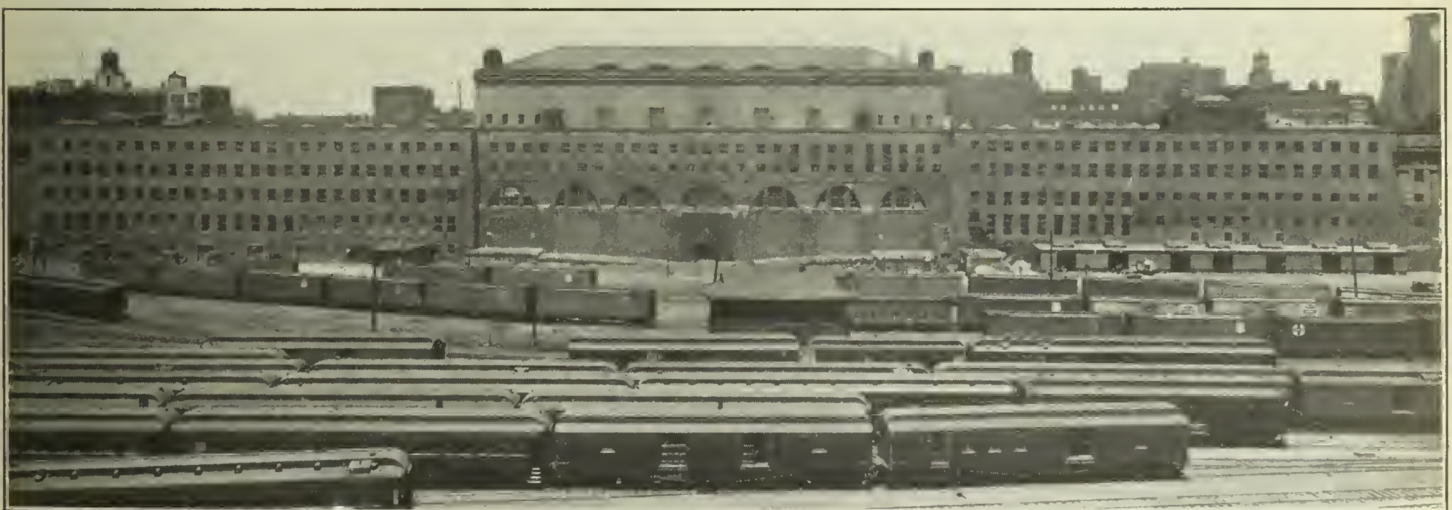


Figure No. 1.—View Looking North showing Rear of Station Building and a Portion of the Site before Construction.
The finished tracks are about the same elevation as the centre of the lower row of windows in the station building, i.e., 20 feet higher than those shown in the foreground.

through freight tracks. All these tracks will be on the high level.

As previously stated, the track elevation is being accomplished by earth fill, but in order to provide ample facilities for baggage, mail, express, waiting room and other services connected with the station, the scheme required that the twelve station tracks and platforms be carried on a structure in order that the area underneath be available for these purposes. The floor of this sub-track area is a continuation of the nearest floor on the adjoining station building, and access to the platforms above is obtained by an elevator on each baggage platform.

In the case of the sub-track waiting room, its floor is connected by a ramp with the main ticket concourse in the station building and access to the tracks is obtained by stairs leading up to each passenger platform. (Figure No. 5.)

The structure, as illustrated in figure No. 2, extends from 90 feet east of Bay street to 90 feet west of York street and embraces a part of Bay and York street subways. The portion carrying the twelve station tracks and platforms will be about 1,180 feet long with a width of approximately 300 feet.

In addition to passing under the station tracks and platforms, the Bay street subway continues under the neck of the Canadian Pacific Railway coach yard and the Canadian National Railway's through freight tracks, making the total length of this subway about 420 feet and its width 80 feet. At York street the coach yard trackage has increased, making the total length of this subway about 826 feet and width 66 feet.

The 90-foot strip, east of Bay street, provides trucking area under the tracks for the Canadian Pacific Express Company. The floor of this trucking area will be on the same elevation as the ground floor of the Canadian Pacific Express building to be erected east of Bay street and north of the tracks, and its north end will connect with the express building. This area has elevator access to each baggage platform above. A similar 90-foot strip, west of York street, provides identical facilities for the Canadian National Express Company building which will be constructed west of York street and north of the tracks.

Between Bay and York streets the structure is, roughly speaking, divided into three parts. The eastern portion, 310 feet long and 300 feet wide, which adjoins the post office wing of the station building, is devoted to mail service. The western portion, also 310 feet long and 300 feet wide, which adjoins the baggage wing of the station building, is devoted to baggage and other services incidental to the operation of the terminal. Both of these areas have direct elevator access to the baggage platforms above and their floor level is practically a continuation of the corresponding floor in the respective wings of the station building. The post office portion has a teamway about 45 feet wide alongside Bay street, while the baggage portion has an identical teamway alongside York street.

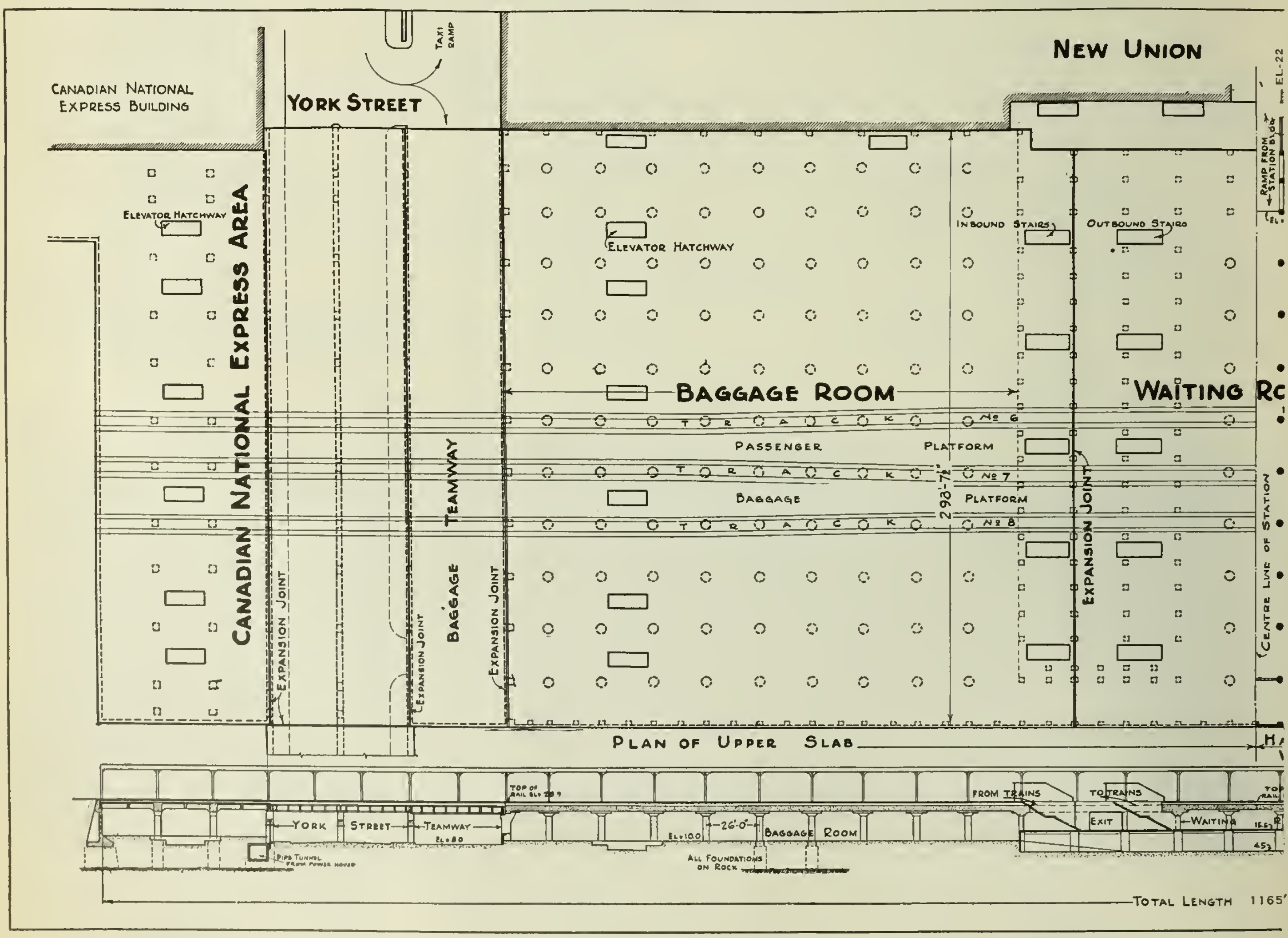


Figure No. 2.—Viaduct Structure, General

The central portion, 236 feet long by 300 feet wide, is constructed with two floors under the tracks. The so-called 15.5 level provides for sub-track waiting room, exit passages, concession spaces and certain offices. This sub-track waiting room, irrespective of concession spaces, etc., is 78 feet wide by 280 feet long, with stairways at intervals along each side leading up to each passenger platform. Underneath this waiting room, a floor at the 4.5 level provides suitable accommodation for various railway services and storage purposes.

Outbound passengers proceed from the ticket concourse in the station, (see figure No. 5), through the ramp passage leading to the sub-track waiting room on the 15.5 level, and thence through one of the train gates which are located at the foot of the stairs leading up to the various passenger platforms, (see figures Nos. 2 and 6b).

Each passenger platform is served by two direct stairways from the sub-track waiting room. One leads up from the east side of the room and the other from a point directly opposite on the west side. Thus when an eastbound and a westbound train occupy the same track, the passengers are directed to the east or west stairway, (as the case may be), and reach track level alongside their respective trains.

The inbound passengers take the nearest stairway leading to one or other of the two exit passages. These passages, each 16 feet wide, which lead to the main exit concourse in the station building, are located symmetrically with respect to the centre of the structure (one on east side of the waiting room and the other on the west side), and

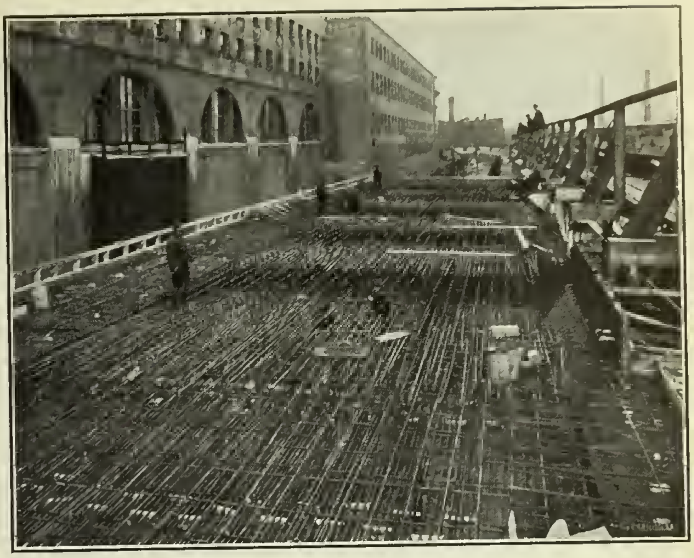
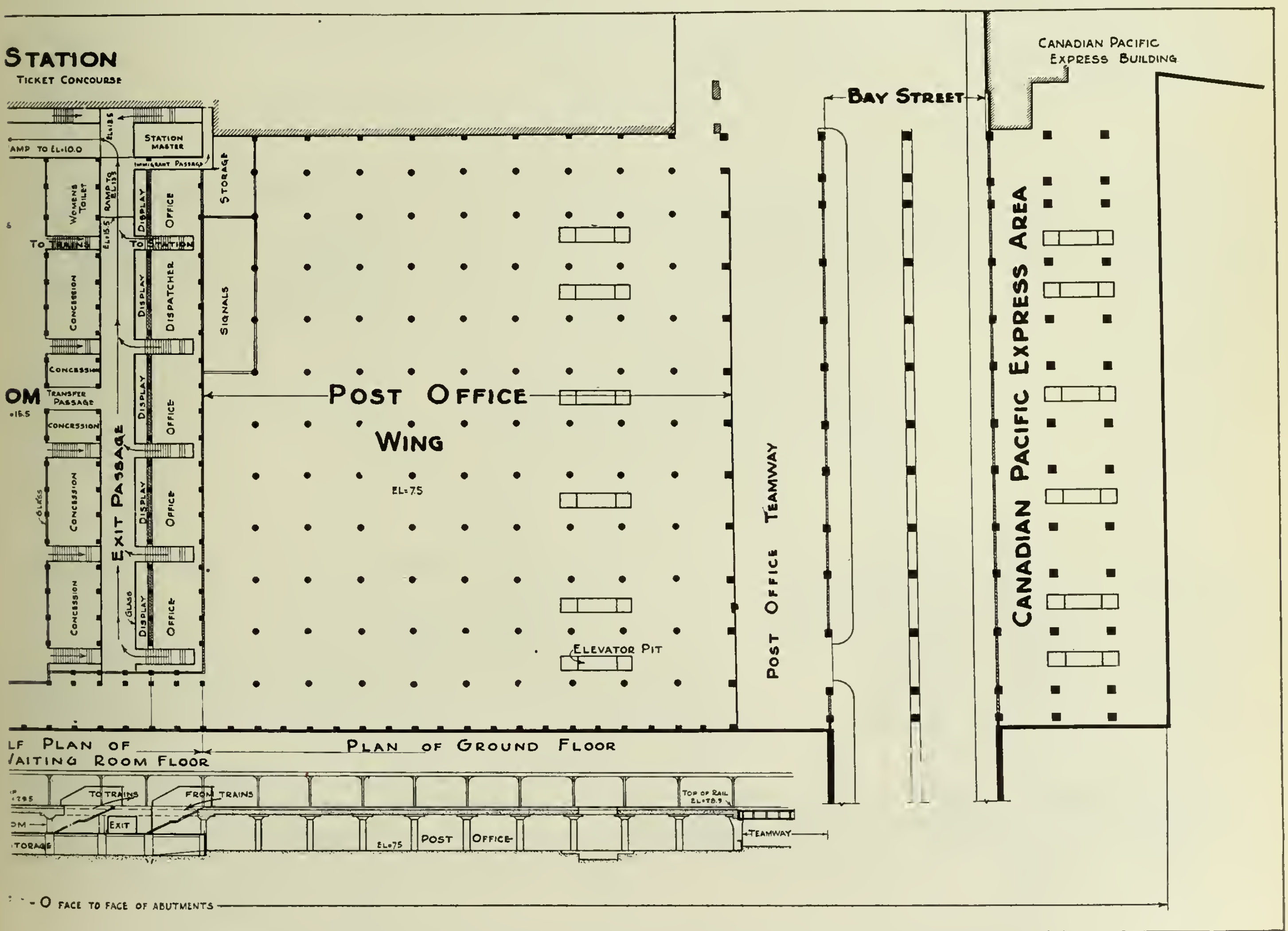


Figure No. 3.—Reinforcing for Double Track (simple) Slab Carrying Tracks Nos. 1 and 2 over Train Waiting Room.



Plan and Cross-section.

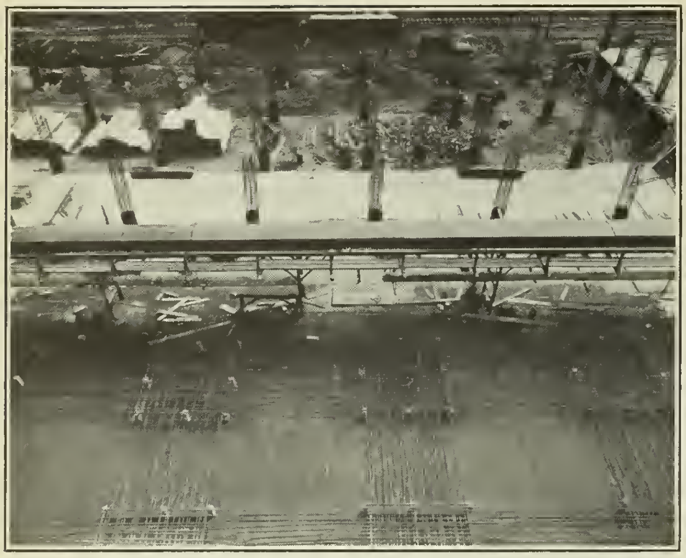


Figure No. 4.—View Looking South from Station Building showing Belt Conveyor and Pre-moulded Concrete Blocks to Carry the "Four-way" Reinforcement in the Track Slab.
(Taken before diagonal bands were placed.)

each is served by stairways leading from the passenger platforms.

Outgoing or incoming baggage, mail or express reaches or leaves the baggage platform by means of the elevators leading to their respective areas. As each track is provided with a separate passenger and baggage platform all trucking is carried out without inconvenience to passengers.

Design

In deciding on the type of construction to be used, due consideration was given to the respective merits of structural steel and reinforced concrete. Preliminary designs were drawn up covering the typical features of both types, and the estimates indicated a very large saving in favour of reinforced concrete with none of the annoyance to adjacent offices, which would be the case during the erection of structural steel. This is not intended as a general statement applicable to all similar cases, but certainly applied to the greater portion of the viaduct structure. There are certain portions of the work, however, for which steel was naturally more suitable; for instance, the 47-foot spans over the post office and baggage teamways, also those carrying the station tracks and platforms over Bay and York streets.

Various types of reinforced concrete construction were also investigated as to the cost, utility and general appearance. Mr. Ambrose, chief engineer of the Terminal Company, recommended the type commonly known as "flat slab" construction, and visits to similar structures on the East Orange improvement work of the Delaware and Lackawanna Railway impressed one with their " clean cut " and efficient appearance.

Although this type of construction has been employed quite extensively for buildings designed for heavy floor loads, it has not, except in comparatively few cases, been used for the heavy concentrations which exist with railway loading. A few such structures for railway loading have been built in the United States, but in no case, (as far as the writer is aware), do they cover as *large an area* as the one now under construction in Toronto, or do they exceed it in the size of the individual panel, viz., 26 feet by 25 feet $8\frac{3}{4}$ inches, centre to centre of columns.(1)

The practically uniform ceiling surface which this type affords, with no downward projections except the isolated drop panels around the column head, allows the maximum headroom to be obtained throughout the panel and permits the piping, (a very extensive feature in this structure), to be carried close to the ceiling with the minimum intrusion into the clear headroom. This consideration was especially important in the case of the sub-track waiting room. Here, the relationship between the floor level of the main concourse in the station building and the floor of the sub-

(1) The complete viaduct structure at the Union station is confined within a comparatively short length, but it is equivalent to a double track viaduct about three miles long.

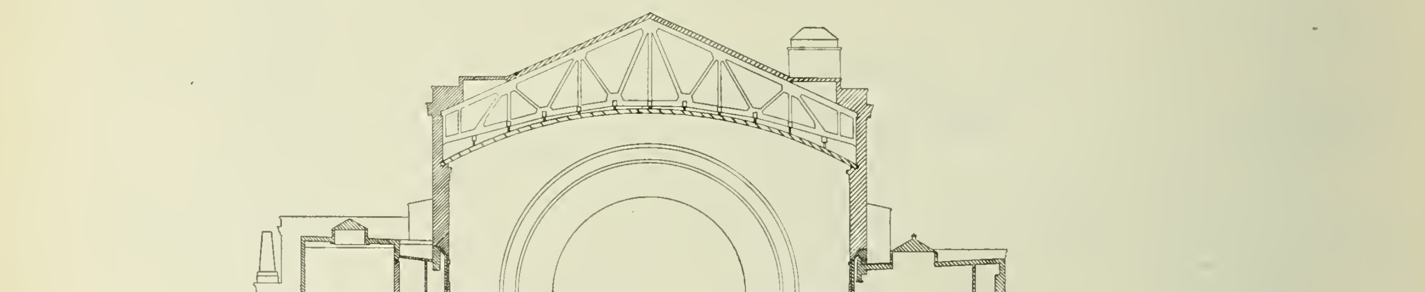
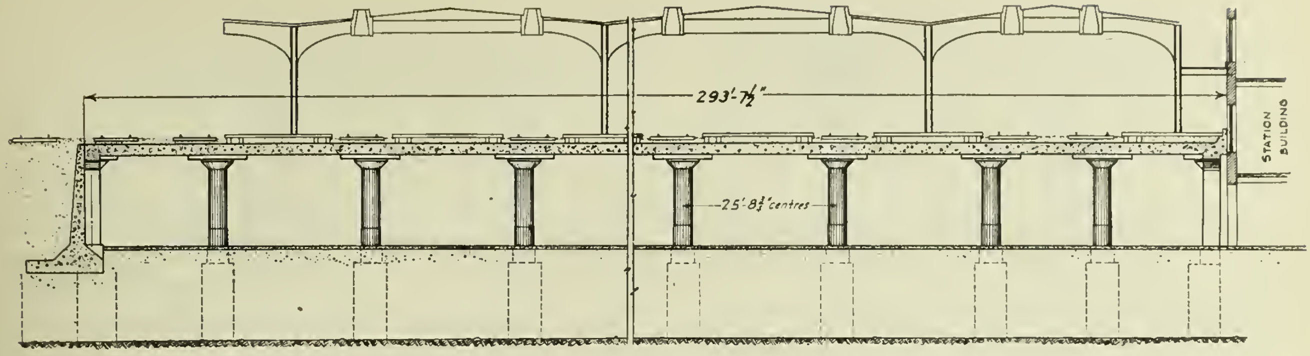
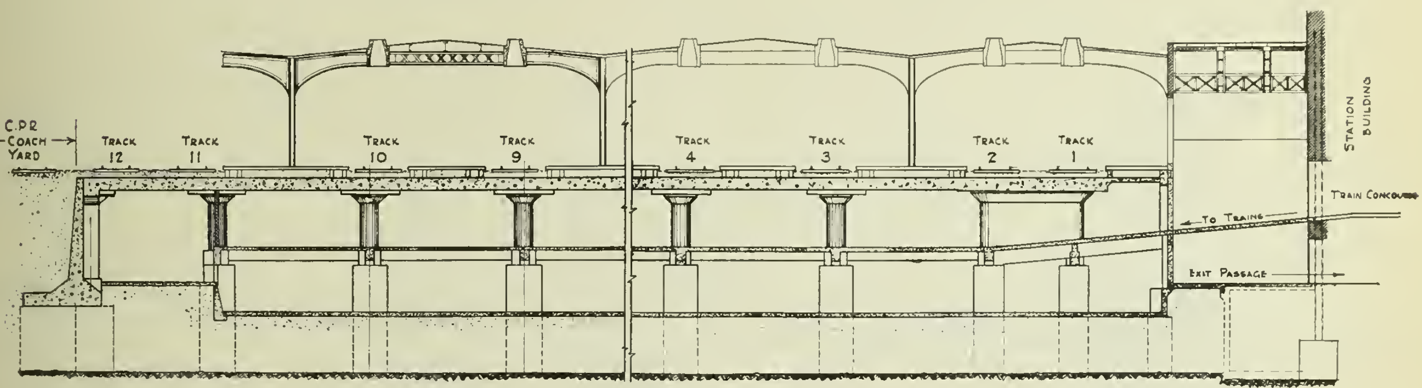


Figure No. 5.—Cross-section through Station showing Connection with Viaduct Structure.

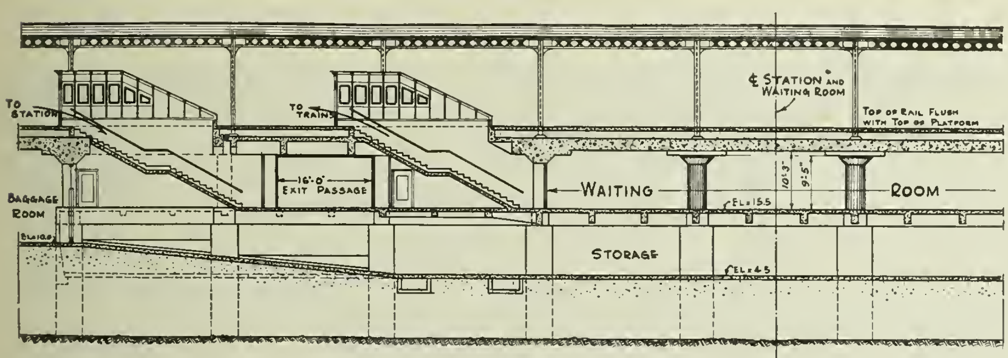


Baggage Area.

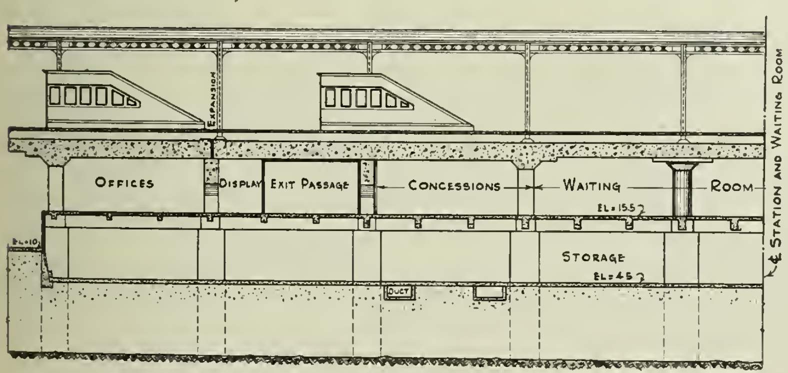


Waiting Room.

Figure No. 6a.—Part Cross-sections through Baggage Area and Waiting Room.



Stairways.



Concessions.

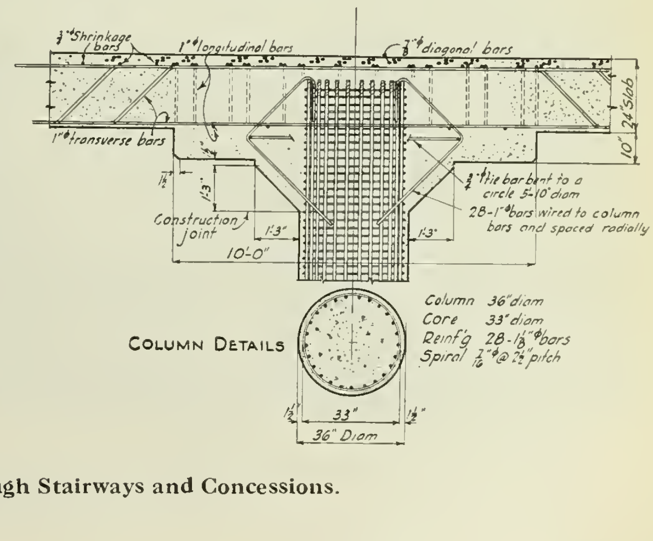


Figure No. 6b.—Longitudinal Sections through Stairways and Concessions.

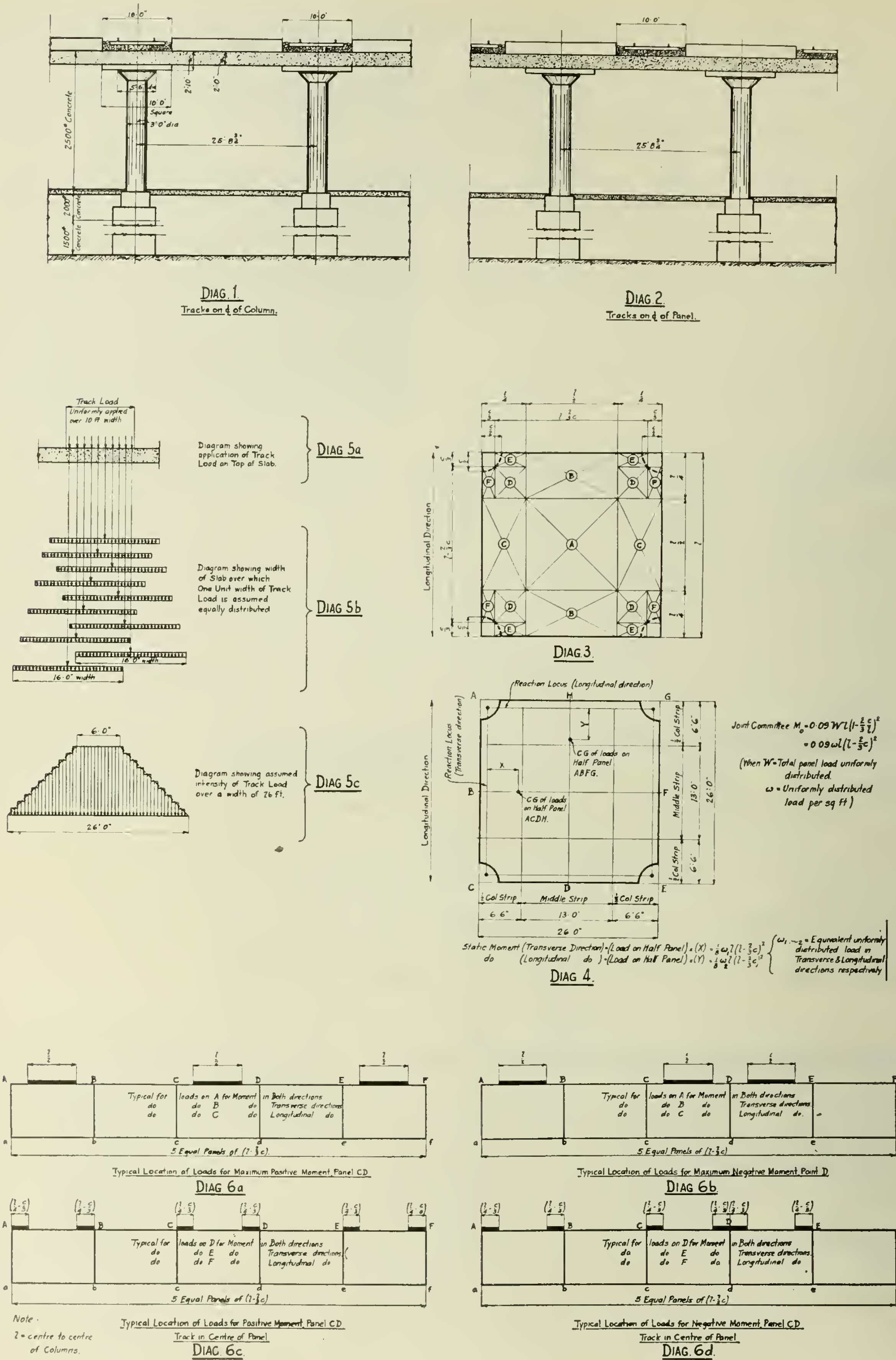


Figure No. 7.—Sub-track Structure, Calculation Diagram.

track waiting room required that the latter be at elevation 15.5, while the elevation of the underside of the slab carrying the tracks above is 25.75, *i.e.*, a total headroom of 10 feet 3 inches. When it is considered that this waiting room will be 78 feet wide by about 280 feet long, the necessity of maintaining a uniform ceiling surface, without the breaks which would be obtained with a beam and slab design, is apparent.

In the architectural finish of this waiting room, the architects endeavoured to maintain the engineering features of the construction. (See photographs.)

The structure is designed for a track live load based on Cooper's E-60 loading with an impact allowance of $\frac{L^2}{L+D}$. Allowance was also made for platform live load and the concentrations from the train shed columns. The "four way" system of reinforcing was adopted as the most suitable for distributing the heavy irregular loading involved.

The theory of flat slab design being largely empirical, there is some difference of opinion among designing engineers as to the best practical method of calculating the total moment in a panel for railway loading and the distribution of that moment among the various reinforcing bands.

During the last few years considerable research work has been done by various authorities both in the mathematical analysis of the moments and in tests of actual flat slab buildings, and although these investigations have been confined mostly to the specific case where the load is uniformly distributed throughout the panel, the results have been most valuable in clearing up much of the uncertainty hitherto connected with this type of construction.

The Joint Committee,(2) when preparing their latest specification, evidently devoted considerable attention to the question of flat slab design, and recommended the formula $M_0 = 0.09Wl\,(1 - \frac{2}{3}\frac{c}{l})^2$, where M_0 equals the sum of the positive and negative moments in the rectangular direction in which the moments are considered; l equals the length centre to centre of columns in the rectangular direction in which the moments are considered; c equals the diameter of the column capital; W equals the total load uniformly distributed over a single panel area. Of this total moment 62 per cent is assumed to be negative, and 38 per cent positive, this latter being assumed equally divided between the column strip and middle strip, *i.e.*, 19 per cent to each.

The Masonry Committee of the American Railway Engineering Association in last year's report to that organization stated that "the recommendations of the Joint Committee for designing of flat slabs are formulated for structures which carry uniformly distributed loads such as occur in buildings," adding that, while it did not approve these recommendations for railway loading, it was not prepared at that time to offer any definite alternative, and suggested further study by the committee during the succeeding year.

In the computation for this structure, the Joint Committee recommendations were used as the means of arriving at approximate moments, but as these are based on a load uniformly distributed throughout the panel, whereas the actual panel load consists of heavy loaded track strips alternating with relatively light loaded platform strips, the moments thus found were checked by an independent analysis applying the slope-deflection theory.

An equivalent uniformly distributed load was computed by static analysis, (see diagram 4, figure No. 7). This figure was used in the Joint Committee's formula and the total

(2) The Joint Committee on Standard Specifications for Concrete and Reinforced Concrete, which consisted of representatives of the American Society of Civil Engineers, American Society for Testing Materials, American Railway Engineering Association, American Concrete Institute, and Portland Cement Association.

Figure No. 8.—View Looking South from Station Building showing the "Four-way" Reinforcing in Place in the Background and a Portion of the Finished Slab in the Foreground.

Figure No. 9.—Interior View of the Post Office Area showing Construction around Elevator Hatchways.

moment thus found was divided among the various bands as recommended in the Joint Committee's specifications. From these sub-divisions of the total moment and the shears, the thickness of the slab, dimensions of drop panel and reinforcing in the various bands were established. The diameter and reinforcing in the columns were ascertained for concentric and unbalanced loading.

As previously stated, in checking the maximum positive and negative moments used in the foregoing a method of analysis based on the theory of slope-deflections was employed, and in order to simplify the work, certain assumptions were made which were considered justified in view of the very indeterminate nature of the problem, and the fact that the actual stresses in flat slab structures as found by extensometer tests are in almost every instance less than the design stresses. Instead, therefore, of attempting to use a variable moment of inertia for the slab an average moment was assumed constant throughout the span.

A similar assumption was made in the case of the columns which were also taken as rigidly fixed at their base, since at that point they are anchored into large pedestals founded on rock, and are also held laterally by a thick concrete floor where column and pedestal connect. It was, therefore, assumed that the foot of the column has no rotational movement when the structure distorts under load. It was also assumed that the only movement at the top of the column was rotational, or in other words, any translational movement was neglected.

The computations were based on a structure five 26-foot panels long and five 26-foot panels wide. The actual distance between expansion joints is more than this, but for reasons previously stated it was considered an unnecessary refinement to assume more than five panels, as it would have involved needless additional labour with only a slight modification in the result from a practical standpoint.

The panel was divided into the usual strips which have become associated with flat slab design. These were subdivided into the elementary areas *A*, *B*, *C*, *D*, *E* and *F*, shown in diagram 3, figure No. 7, and the moments due to the load on each were considered as resisted in either the longitudinal or transverse direction, depending upon the location of the area in the panel. For instance, the effect of a load distributed over *A* is, (in a square panel), resisted equally in both directions. Moments due to loads on areas *B* and *E* were assumed to be resisted entirely by the transverse bands, and *C* and *F* by the longitudinal bands, while the load on area *D*, which is located on the corner of the cantilever and immediately over both the longitudinal and transverse bands, was assumed divided equally in two directions.

In computing the various moments, only those spans were loaded which would give the maximum in the span considered in the same manner as for any slab continuous over five spans. (Figure No. 7, diagrams 6a to 6d).

Lateral Distribution of Track Live Load

The track live load is directly applied through the ballast on a surface of slab 10 feet in width, (see diagram 5a, figure No. 7), and this 10 feet wide concentration was considered as carried by 26 feet width of slab, the intensity of the distribution throughout this width varying from a maximum under the track to zero along the edges, as indicated by diagram 5c, figure No. 7.

From the published results of tests made on simple slabs, it appears that, when the width of the slab exceeds 1.5 times the span, the stresses due to a concentrated load placed in the centre may be considered as uniformly resisted over a width of slab equal to 72 per cent of the span, which width in this case would be 16 feet.

On this basis, therefore, if the 10 feet wide concentration on the slab surface be divided, say, into ten 1-foot concentrations, each of these could be considered as uniformly distributed over a width of 16 feet, as shown in diagram 5b, figure No. 7, and the summation of these unit distributions would give the intensity diagram indicated by diagram 5c.

As the tests cited are reported to have been made on simple slabs with no transverse reinforcement, the foregoing distribution for a " four way " flat slab would certainly be conservative. For tracks placed on centre line of columns diagram 5c would give a distribution of approximately 70 per cent of the live load to the column strips, and 15 per cent to each of the adjoining middle strips.

After deciding on the distribution of the live load, (platform and track), over reach of the elementary areas *A*, *B*, *C*, *D*, *E* and *F*, (diagram 3, figure No. 7), the maximum negative and positive moments, due to the loads on each area are calculated in either the longitudinal or transverse directions as indicated in diagrams 6a to 6d and allotted to their respective moment sections in the strips.

An equation was written for the resisting moment at the top of each of the six columns and at the ends of each of the five spans. These were in the form of the general slope-deflection equations,[3] omitting the term which would

[3] See Wilson Richart and Weiss,—Analysis of Statically Indeterminate Structures by Slope-Deflection Method. University of Illinois Bulletin No. 108, 1918.

Figure No. 10.—Post Office Teamway before Erection of the Steel Spans which Carry the Overhead Tracks.

represent translational movement of the column capital, (if any), since the only movement there is assumed to be rotational.

For column Bb (diagram 6a, figure No. 7) $M_{Bb} = 4\,EK_1\,\theta_B$

and for span $A\,B$ $\begin{cases} M_{AB} = 2\,EK_2\,(2\theta_A + \theta_B) - C_{AB} \\ M_{BA} = 2\,EK_2\,(2\theta_B + \theta_A) + C_{BA} \end{cases}$

where the letters have their usual significance, viz.:—

M_{Bb} = Resisting moment, (or moment of internal stresses), at top of column Bb.

M_{AB} and M_{BA} = Resisting moment at A end and B end respectively of span AB.

θ_A and θ_B = Change in slope of the tangent to the elastic curve at the A end and B end respectively of the span when the column capital rotates.

K_1 = Ratio of moment of inertia of column to its height.

K_2 = Ratio of moment of inertia of slab, (26 feet wide), to its net span, $(l - \frac{2}{3}c)$.

C_{AB} and C_{BA} = The resisting moment at the A end and B end respectively of an absolutely fixed beam, of the same span and loading as span $A\,B$.

E = Modulus of elasticity.

By writing the corresponding equation to the foregoing for the top of each column and for the end of the span or spans which connect at the column, the following are typical for, say, the joint at top of column $Dd.$, (diagram 6b, figure No. 7).

$M_{Dd} = 4\,EK_1\,\theta_D.$

$M_{DC} = 2\,EK_2\,(2\theta_D + \theta_C) + C_{DC} = 4\,EK_2\,\theta_D + 2\,EK_2\,\theta_C + C_{DC}.$

$M_{DE} = 2\,EK_2\,(2\theta_D + \theta_E) - C_{DE} = 4\,EK_2\,\theta_D + 2EK_2\,\theta_E - C_{DE}.$

As the algebraic sum of the resisting moments at each joint must equal zero.

$M_{Dd} + M_{DC} + M_{DE} =$

$2\,EK_2\,\theta_C + (4\,EK_1 + 8\,EK_2)\,\theta_D + 2\,EK_2\,\theta_E + C_{DC} - C_{DE} = 0.$

Since the numerical value of K_1 and K_2 is known from the preliminary design, also C_{DC} and C_{DE} from the loading, the only unknowns in the equation are the θs, and the equation may therefore be written—

$$P\theta_C + Q\theta_D + P\theta_E + C_{DC} - C_{DE} = 0$$

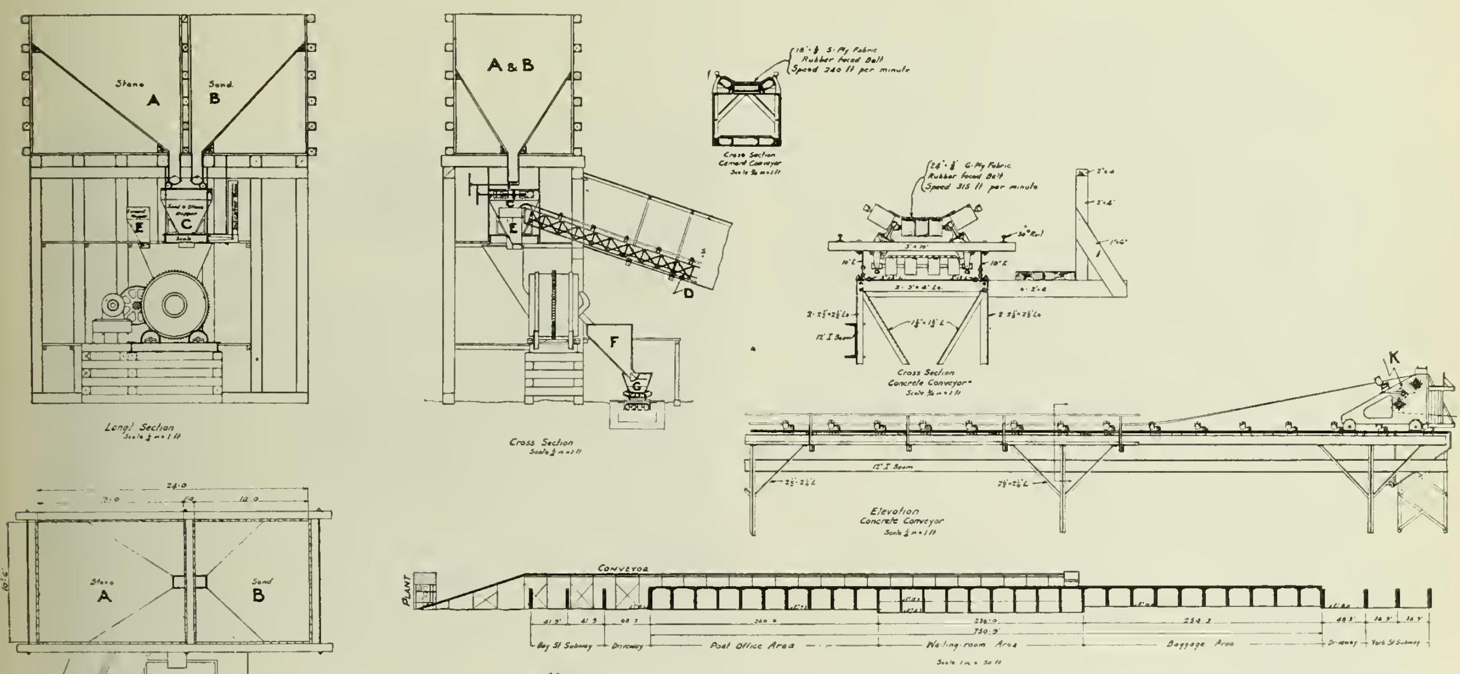
where P, Q, C_{DC} and C_{DE} have a known value.

A similar equation being written for each of the six capitals, six equations are found involving the six unknown θs, and, by solving these as simultaneous, the value of each θ is obtained.

Knowing the value of each θ, the resisting moment at the ends of the various spans is obtained directly from the slope-deflection equations.

If the negative moment at the column head section is required, say, at D for span CD, (diagrams 6b and 6d, figure No. 7), it will be equal, (numerically), to the resisting moment M_{DC}.

If the positive moment in the column strip or middle strip is required, say, for span CD, (diagrams 6a and 6c, figure No. 7), it will be equal to the moment at the centre of a simple supported span of same length and loading minus half the sum of the resisting moments M_{CD} and M_{DC}.[4]



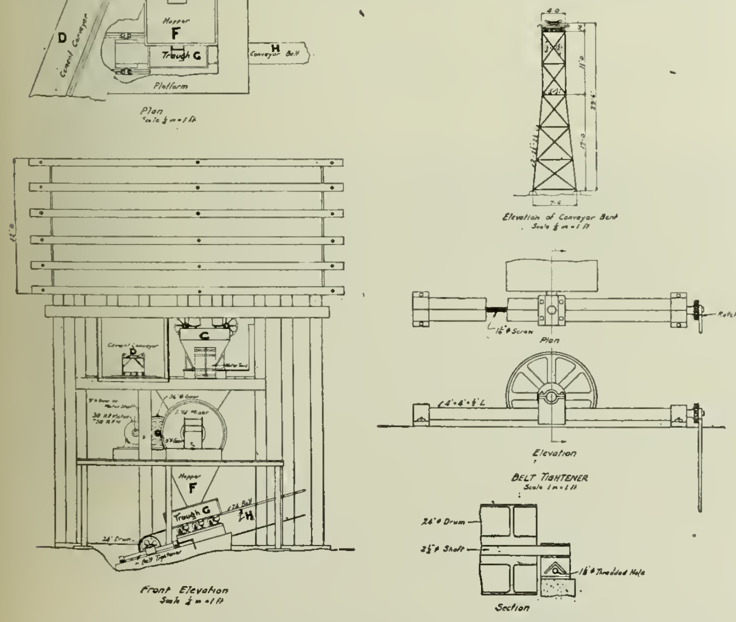


Figure No. 11.—Plan of Contractor's Concrete Mixing Plant.

[4] This is a general statement. In the case of span CD, which is the centre span of a symmetrical structure symmetrically loaded, $M_{CD} = M_{DC}$.

Figure No. 12.—One of the Arch "Bents" on Bay Street Subway which Support the Steel Spans Carrying the Overhead Tracks.

Comparison with Results Based on Joint Committee Formula

Comparing the total moment and its distribution as found by the foregoing analysis, using slope-deflection equations, with the corresponding moments using the Joint Committee's formula and an equivalent load uniformly distributed throughout the panel, it was found that the total moment in the ruling direction agreed to within about 5 per cent for tracks on centre line of column and about 4 per cent for tracks located along centre line of panel. The following table gives the percentage distribution of the moments calculated for panel strips of alternating light and heavy loading by the analysis described, and the distribution recommended by the Joint Committee's specification where uniformly distributed load is assumed. The three cases given represent the comparisons for a square interior panel having columns at 26-foot centres.

Case 1—Tracks on centre line of columns, *i.e.*, at 26-foot centres with platforms intervening.

Case 2—Tracks offset 1 foot 6 inches from centre line of columns in alternate panels, *i.e.*, tracks alternating at 23- and 29-foot centres with platforms intervening.

Case 3—Tracks on centre line of panel, *i.e.*, at 26-foot centres with platforms intervening.

The difference in the percentage of total negative and total positive moment in slope-deflection column for each case, and the corresponding distribution recommended by the Joint Committee for an equivalent uniformly distributed load is, (considering the type of structure), negligible as far as practical design is concerned.

In the calculations, average moments of inertia were assumed for the slab and column, and a comparatively small variation in the $\frac{I}{h}$ of column and $\frac{I}{l}$ of slab, (*i.e.*, the ratio of their respective rigidity), would give a small redistribution of the total moment between the postive and negative.

The table shows, however, a considerable difference in the division of the total positive moment as calculated, and the Joint Committee distribution for uniform load. In the latter, this moment is divided equally between the column strips and middle strip, whereas the calculated moment was much larger for the column strips, which seems more reasonable for the design loading.

While the Joint Committee moment distribution gives results which are conservative for uniformly distributed loads or the ordinary irregular intensities common to buildings, the writer believes that for railway structures of this type, (the columns of which are usually only one storey high), it is advisable to analyze the moment distribution with reference to the relative rigidity of the actual columns and slab, and the irregular loading, by first arriving at a preliminary design based on the Joint Committee's recommendations, using an equivalent uniformly distributed load which would give the same static moment on a span of $\left(l - \frac{2}{3}c\right)$ as the design loading), and then checking the result by some analysis which takes the relative restraint of the component parts of the assumed structure into consideration in the calculations.

Figure No. 13.—View showing Junction of East and West Exit Passages under the Bridge Carrying the Ramped Passage Connecting Ticket Concourse (El.22) with Train Waiting Room (El.15.5).

It is the case that, although the slope-deflection equations are exact in theory, their application to flat slabs with the assumptions herein stated, in order to simplify

	Joint Committee's Distribution for Uniformly Distributed load	Calculated by Slope—Deflections		
		Case I	Case II	Case III
Total Moment *Mo* (in Ruling Direction)		Agreed with Joint Committee within 5 per cent.	Agreed with Joint Committee	Agreed with Joint Committee within 4 per cent.
Total neg. moment (per cent of *Mo*)	62	60.5	60.5	60
Total pos. moment (per cent of *Mo*)	38	39.5	39.5	40
Pos. moment in column strips (per cent of *Mo*)	19	26.5	26	25.5
Pos. moment in middle strip (per cent of *Mo*)	19	13.0	13.5	14.5
Ruling direction		longitudinal	transverse	transverse

Figure No. 14.—Portion of Train Waiting Room (El.15.5) after Stripping the Forms.

the work, must give results which are more or less approximate, but this statement could apply to any method of analysis except one which would involve so much labour and abstruse mathematics as to make it unsuitable for ordinary use. By using the slope-deflection method with judicious assumptions, the labour involved is not excessive and the results should be sufficiently accurate for practical purposes.

Construction

In order that interference in the operation of the terminal be reduced to a minimum, the structure is being built in two sections. The first section, (now under way), is the northerly strip, extending the full length and wide enough to accommodate six tracks and platforms.

As several of the old station tracks and platforms were on the site of the westerly end of this strip and its approach, it was necessary to re-vamp the station track layout and locate them south of and parallel to this first construction strip. This change was not made until the work had reached the stage when the new station could be put into operation, which was done as soon as the sub-track structure was completed from Bay to York streets. Both outgoing and incoming passengers use the centre portion of the structure as a means of access between the temporary station tracks, which lie to the south of it, and the station building on the north. The east wing is being used for mail purposes as intended, and the Canadian Pacific Express occupy temporarily the greater portion of the west wing.

When the filling, etc., on the east and west end of the whole project has reached the proper stage, all operation will be transferred to the viaduct tracks, after which the second, (or southerly), section of the structure will be built on the site now occupied by station tracks.

Foundations

The character of the ground in the vicinity of the station is such that all track carrying structures are being taken down to rock, the elevation of which has a gradual dip towards the bay. For the northerly pedestals, rock was met about 15 feet below ground line, (elevation —5), increasing to about 19 feet for pedestals along the south side. At the southerly end of York street subway, however, the foundations of the abutments under the through freight tracks are about 25 feet below street level. Steel sheet piling has been used throughout for all pedestal foundations.

Concrete

Three classes of concrete are being used in the construction, viz.:—

1,500-pound concrete for all pedestals from rock up to an elevation about 2½ feet from their top.

2,000-pound concrete for the upper 2½ feet of pedestal and the short stub column for the dowels, also for the beams and floor slab of the sub-track waiting room.

2,500-pound concrete for the columns and the track slab.

Figure No. 15.—Portion of Train Waiting Room after Completion.

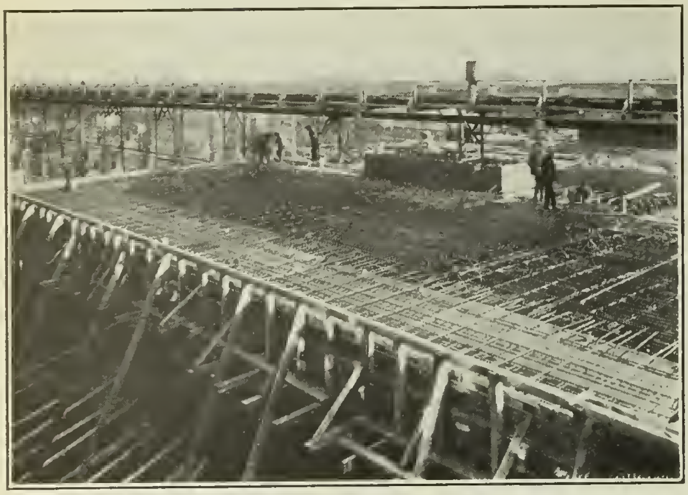


Figure No. 16.—View showing Belt Conveyor and Reinforcing of Double Track (simple) Slab in Place Ready for Concreting.

After deciding on the source from which the aggregates would be supplied, the contractor made extensive tests to ascertain the proportions which would give the strength of concrete specified under varying conditions.

This procedure was advisable, not only in the contractor's interests, but also in the owners', as it established ratios for the particular aggregates before the work began, and thereby assisted in maintaining uniform strength throughout.

This was checked from time to time by tests made by the engineers from samples taken from every pour.

The track slab was poured in strips of such width as would permit concreting to be carried on continuously between expansion joints. For this purpose, longitudinal bulkheads were placed in the forms at the desired construction joints, which are in all cases located under a platform. In addition to the ordinary slab reinforcing, short bent bars projected through the bulkhead at nine-inch centres to reinforce the joint for shear. Before proceeding with the adjoining pour, the surface of the joint was thoroughly cleaned and washed to insure bond.

Where conditions prevented the ground floor slab being poured in advance of the track slab, care was taken to guard against settlement of the posts supporting the heavily loaded forms, since these posts thus lacked the assistance of the ground slab to distribute their load over a soil of low bearing value. To take care of settlement should it occur, wedges were placed between the foot of the posts and the sills and wires were stretched horizontally alongside series of posts across the strip about to be poured, marks being placed in the posts at the elevation of the stretched wire. Constant observation was kept on the relative position of these marks and the horizontal wire during the pour and any settlement immediately corrected by tightening up the wedges.

The forms were set so that the track slab would have a drainage slope of one inch per panel, (26 feet), longitudinally. The peak of the slope is located at the centre of the structure to correspond with the peak of the track grade and the dip is east and west from that point.

Waterproofing

The waterproofing specification for the track slab was substantially in accordance with the recommendations of the American Railway Engineering Association, with slight modifications to suit the particular conditions.

Plant

The only portion of the site which was not occupied by tracks in constant use was the strip located alongside the station building and extending from a point east of Bay street to the east boundary of York street, approximately 1,000 feet long and 180 feet wide.

As practically all of this strip was required for the first section of the structure, probably the most critical problem in the construction was the location of the central mixing plant and its accessories and the method by which the concrete could be efficiently distributed over the large area involved.

The chief engineer of The Terminals Company and the contractor, after a careful study of the application of the more commonly adopted methods to this particular work, recommended that the interests of the contractor and the owners would be best served by locating the plant east of Bay street, (at eastern extremity of the work), and transporting the mixed concrete by an endless belt conveyor carried by a trestle running from the mixer westward about 800 feet, the belt being at an elevation nine feet above the track slab. This plant is shown diagrammatically on figure No. 11. The fine and coarse aggregates are raised from the material dump to the main bins *A* and *B* above the plant by clam shell operated by a derrick. These bins have sufficient capacity to furnish 125 cubic yards of concrete without refilling, which represents a three-hours' continuous pour.

From them the coarse aggregate is fed, as required, into a lower hopper *C* mounted on a scale, and is shut off when the pointer indicates that the required weight of this aggregate is in this hopper. In like manner, the required weight of fine aggregate is dropped into this lower hopper. At the same time, in the adjacent cement house, the necessary quantity of cement is deposited on a covered belt conveyor *D* which carries it to hopper *E* alongside the aggregate hopper above the mixer. On a bell signal, these two hoppers are opened and their contents dropped into the one-yard mixer. The prescribed quantity of water for each batch is furnished from a tank also located above the mixer. The batch is turned for about one minute, and then dumped into hopper *F*, then to regulating trough *G* which feeds it on to the moving belt conveyor *H*, which in turn carries it out to the work, where it is taken from the belt by means of a tripper arrangement *K*, (which can be placed where desired), and dropped into a hopper underneath. From this it is fed into man-handled buggies and wheeled to the place of deposit in the forms.

The length of the conveyor is 800 feet and total length of belt is 1,600 feet. The belt is 24 inches wide and is dished in the centre, which prevents the concrete spilling over the sides. The pulleys on which it travels are so located as to ensure that the dish is maintained. The rate of travel is 315 feet per minute and the average capacity is about 35 cubic yards per hour. The longest continuous pour was 1,400 cubic yards of track slab in forty-one hours.

Personnel

The consulting engineers for all work in connection with the grade separation are J. M. R. Fairbairn, D.Sc., M.E.I.C., chief engineer, Canadian Pacific Railway, and C. B. Brown, M.E.I.C., chief engineer, Canadian National Railways.

J. R. W. Ambrose, M.E.I.C., chief engineer, Toronto Terminals Railway, assisted by Mr. Erskine Duncan, is in direct charge of construction work. The planning and design of the viaduct structure were done by the chief engineer's office, Canadian Pacific Railway, in the department of P. B. Motley, M.E.I.C., engineer of bridges, (assisted by the writer); W. A. Duff, M.E.I.C., engineer of standards of Canadian National Railways, co-operating. The heating and ventilating were planned by Mr. E. B. Plant, of the engineer of buildings department, Canadian Pacific Railway, and electrical installation by J. A. Shaw, M.E.I.C., chief electrical engineer, Canadian Pacific Railway, with Mr. R. Meadows in charge. Mr. Hugh G. Jones and Associates carried out the decorative and architectural features.

Messrs. P. Lyall and Sons are the general contractors for the structure, and are represented on the work by Mr. P. Lyall, Jr., with N. L. Morgan, A.M.E.I.C., as general superintendent.

Electric Heating of Rack-Bars in Hydro-Electric Plants

Method of Application and Results Obtained, with Particular Reference to an Installation at Shawinigan Falls, Que.

C. R. Reid,
Superintendent of Generating Stations, Shawinigan Water and Power Company.

Paper presented at the Annual General Professional Meeting of the Engineering Institute of Canada, at Montreal, Que., February 16th, 1928

Frazil ice is formed in turbulent open water at zero temperature. The turbulency may be caused by conditions of stream flow or it may be due to high wind. When ice begins to form on the water surface it is in the shape of slender needle-like crystals which, if undisturbed, spread over the surface and unite to form a continuous sheet. However, if the water is turbulent, the needles are swept beneath the surface and distributed throughout the body of water to a depth depending on the turbulency. When these needles reach a set of rack-bars at zero temperature they are caught on the bars like so many fibres and a matted layer is soon formed at and near the surface of the water.

This layer is more or less porous and will continue to build up until it is six inches or more in thickness. The needles freeze together and to the rack to form a mass that, while not nearly so strong as solid ice, it is practically impossible to clear off by mechanical means. At first the layer of ice forms on the bars only to the depth to which the needles have been carried by the turbulency of the water, but, as the openings are stopped up near the surface, they are carried downward by the entering water. Thus, the layer is extended downward until the flow is practically cut off. The head is apt to drop on the lower side of the racks due to the water draining away through the turbines, and the resultant unbalanced pressure may be sufficient to crush the rack structure.

Methods of Overcoming Frazil Ice Troubles

The best method of overcoming frazil ice troubles is through proper design of the hydraulic system above the rack-bars. A large body of quiet water will freeze over quickly and an ice covering of sufficient size will intercept the frazil ice. This is due to the ice needles either adhering to the under side of the ice covering or being remelted in the warmer water under the ice. If the velocity of approach is low and the racks are set at a considerable depth, and if, in addition, the bed of the approach channel is smooth and grades down easily to the bottom of the racks or even considerably below that, frazil ice troubles should be entirely eliminated.

The most common method of dealing with frazil is to raise the racks and let it pass through the turbines. Racks are usually made in two or more sections to reach from top to bottom. It is usually sufficient to raise the top section from three to six feet. The upper rack will be covered with frazil, but after that the needles are carried down and pass through the opening, leaving the lower part of the racks free of ice. Except in the case of very low heads the frazil passes through the turbine without giving any trouble. In some low head plants electric heating has been applied to the runner to keep it clear of ice. The worst objection to raising the racks is that it defeats the purpose for which the racks are intended, i.e., to keep trash out of the turbines. Trash entering the turbines blocks the water passages, reducing the output of the unit; causes unbalance of the runner, with consequent vibration; and may do considerable damage to the runner and guide vanes. It is necessary to shut down the turbines frequently for cleaning during the time the racks are raised. As a usual thing, frazil ice trouble lasts for only a week or two while the river is freezing up and occasionally in the spring after the ice has gone out.

Electric Heating of Rack Bars

If it is desired to operate without raising the racks, it is necessary to provide some form of heating for the rack-bars in order to prevent the adherence of the frazil ice. At Shawinigan Falls, electric heating has been successfully applied for this purpose. This paper will describe the method of application and results so far obtained.

In the design of the installation at Shawinigan Falls, use was made of the published data on the rack heating equipment in several Norwegian and Swedish plants. This data was obtained from a paper entitled "Ice Troubles in Norwegian Power Plants," by Mr. Ruth, published in the

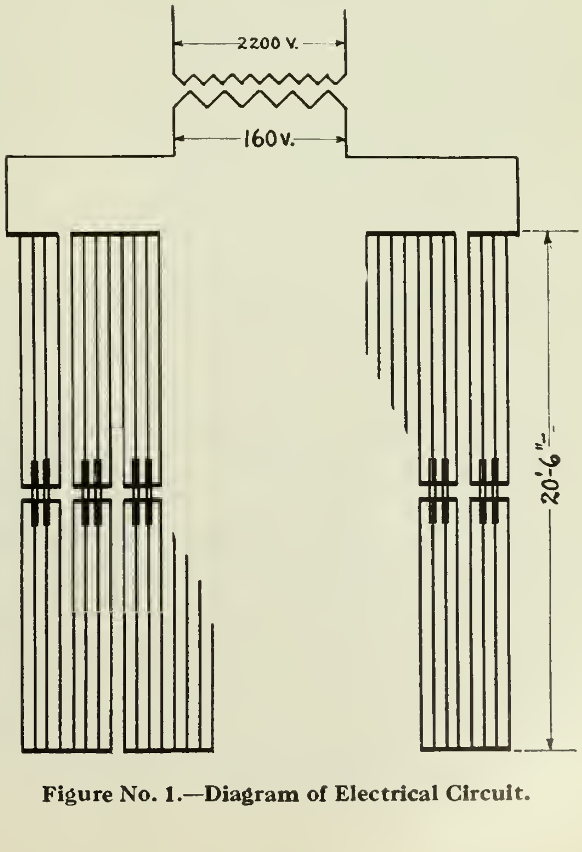


Figure No. 1.—Diagram of Electrical Circuit.

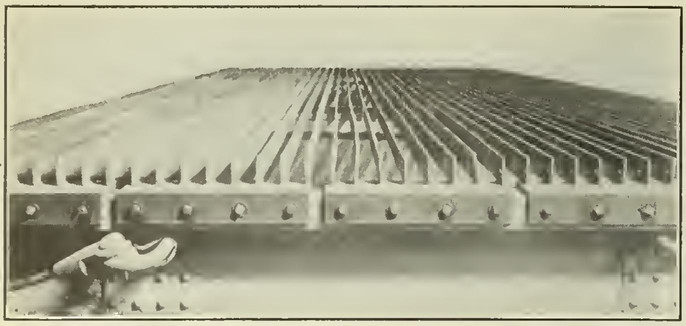


Figure No. 2.—Upper End of Rack showing Arrangement of Bars in Groups.

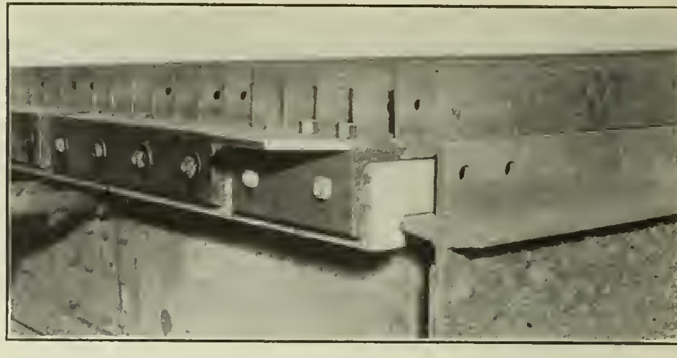


Figure No. 4.—Upper End of Rack showing Insulation of Bars.

Transactions of the World's Power Conference, London, 1924, and from an article in the Swedish "Teknisk Tidskrift Electrotechnic," No. 1, 1917, describing the rack heating equipment at Trollhattan.

It is apparent that it is difficult to determine exactly the amount of energy required to keep the racks free from ice. An installation might work successfully on a number of occasions and then, due perhaps to a combination of severe ice conditions and low voltage on the heating circuit, might prove inadequate. The data available on the Norwegian and Swedish installations show an energy consumption of from 140 to 425 watts per cubic foot of water per second. Further, these installations were reported as working satisfactorily. For the installation at Shawinigan Falls, provision was made to obtain an energy input of 225 watts per cubic foot of water per second with transformer taps provided to allow for a maximum of 425 watts if required.

Electrical Layout

The racks of the 40,000 kv.a. unit are arranged in five bays. Each bay is 12 feet wide and the racks extend to a depth of 25 feet 6 inches, made up of three sections. The top section, 10 feet 6 inches, and the middle section, 10 feet in length, are heated. There are forty-eight bars of 3½ by 5/16 inch section in each bay. These are grouped four in parallel and twelve such groups in series. Connection is made between the bays so that two and a half bays constitute one series circuit with thirty groups of four multiple bars connected in series. This gives a circuit length of 20.5 by 30, or 615 feet exclusive of connections. The two circuits obtained in this way are supplied with two-phase, 30-cycle current from the secondaries of two 750 kv.a. transformers which are connected to a 2,200-volt circuit direct from the power house bus bar.

Structural Details

The rack-bars are supported by being electrically welded to pieces of structural steel angles. At top and bottom these angles are long enough to bridge eight bars, and thus serve to connect electrically one group of four bars to the next. The intermediate angles bridge four bars only. The angles are supported on oak pieces that are attached to the rack frame and serve as insulation. The oak pieces are "L" shaped in order to support the weight of the bars in compression. Connection is made between the bars in the upper section and the middle section by means of fish plates. Connection between the transformers and the racks is made with two 5/16 by 5 inch copper bars in parallel laid in ducts and insulated by hardwood cleats.

Performance

An average set of electrical readings on one transformer secondary and rack circuit is as follows:—

Voltage at transformer terminals	135.5 volts
Voltage at rack terminals	126.5 volts
Current	3680. amps.
Output at transformer terminals	347. kw.
Loss in connections	7. kw.
Input into one rack circuit	340. kw.
Total input into racks	680. kw.
Power factor measured at transformer terminals	69.7%
Power factor measured at rack terminals	73.2%
Power per cubic feet per second	227.0 watts

Sufficient experience has been gained with this installation to demonstrate that just about the right amount of

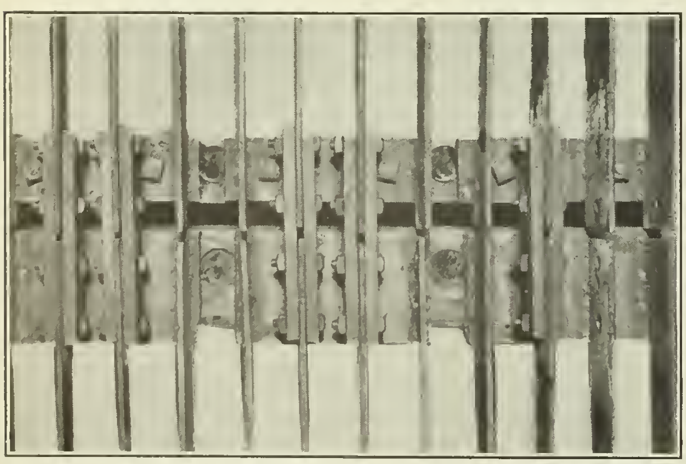


Figure No. 3.—Connection between Upper and Lower Section of Rack.

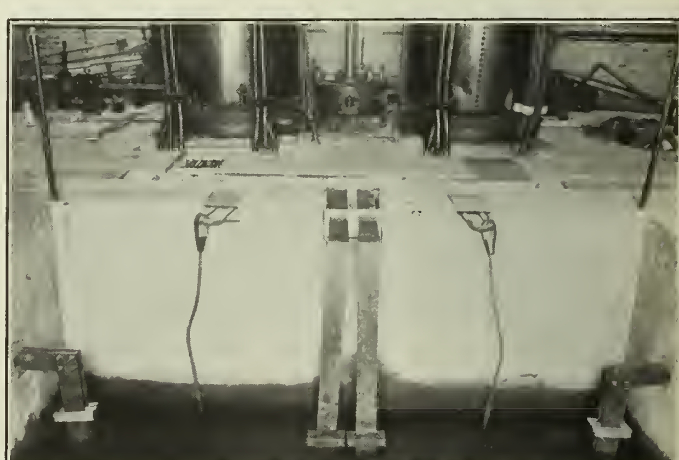


Figure No. 5.—View showing Connection between Bus and Racks and between Bays.

Figure No. 6.—Severe Ice Conditions in Forebay, Shawinigan Falls.

energy input has been provided. Severe frazil ice conditions have been handled with entire success on several occasions. It has been found, however, that broken ice is cleared slowly by melting. If it comes on to the racks in considerable quantities it is necessary to clear it off by hand in order to prevent the drop through the racks becoming excessive.

The power required for given installation may be assumed to be directly proportional to the total length of rack-bar and velocity of the water passing the bars. This relationship may be expressed by the formula,—

(1) $P = K.n.l.V.$

in which P is the power in kilowatts, K a constant to be determined, n the number of bars, l the length of each bar, and V the velocity of the water entering the racks.

Formula (1) may be modified as follows:—

(2) $P = K\frac{N.s.l.V.}{s} = K\frac{AV}{s} = K\frac{Q}{s}$

in which s is the spacing of the bars, A is the area of the racks and Q the quantity of water. It will be convenient to take s in inches and Q in cubic feet per second. A further variable which might enter into the formula is the width of rack-bar. The wider the bar the more subject it will be to the cooling action of the water. However, since rack-bars for modern installations are usually between three and four inches in width, this factor may be neglected, at least for a first approximation.

Substituting in formula (2) the values P, Q and s used in our installation gives K the value 0.7 in round numbers.

The empirical formula:—

(3) $P = 0.7\frac{Q}{s}$

is to be considered as a first approximation in determining the power required. On this basis low head plants are not economically barred from the use of heated racks. If the rack spacing can be increased in proportion to the increase in the quantity of water required per unit of output, the percentage of energy required for heating should remain the same.

In the above calculations it has been assumed that all the water passes through the heated portion of the racks. Since the lower five feet which is unheated is apt to be stopped up at times with logs and trash, this assumption is valid. However, it would be satisfactory to heat the racks only as far down below the surface as the turbulency of the approaching water carries the frazil ice, if such a point could be determined. In such a case the energy requirement could be cut down in proportion. In a more recent installation the upper halves of the racks only have been heated.

Electric heating of racks is of particular value in locations where frazil ice trouble develops quickly and where it is not of long duration. When such trouble is experienced more or less continuously, it would no doubt be more economical to install rack-bars made of tubing welded into headers and to circulate warm water through them.

From an operator's viewpoint, it is very reassuring during ice troubles, to know that the units with heated racks may be relied on to carry their full load.

Figure No. 7.—Bank of Two 750-Kv.a. Transformers for Heating Racks of Unit No. 6.

Notes on Removal of Carbon-Sulphur Compounds from Coal Gas by Oil Washing

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Paper presented at the Annual General Professional Meeting of The Engineering Institute of Canada, at Montreal, Que., February 16th, 1928

At the gas works of the Nova Scotia Tramways and Power Company, Limited, which operates electric light, tramway and gas utilities in Halifax, N.S., partial removal of the carbon-sulphur compounds from coal gas is being accomplished by washing the gas with oil. The process was conceived from the published results of investigations of the change in the quality of gas produced when benzol was removed by scrubbing the gas with oil, which indicated that the same oil, which absorbed benzol, also absorbed CS_2.[(1)] After some months of laboratory and draughting room work carried out at the company's plant at Halifax under the direction of Mr. E. R. Hamilton, the existing scrubbing equipment was designed. The reasons for its subsequent installation are, briefly, low installation cost, low operating cost, the opportunity of utilizing unused apparatus designed for distillation of tar, and the fact that something had to be done at once to reduce the quantity of sulphur in the finished gas which was being made from Nova Scotia coals.[(2)]

After four years of operation the original design remains practically unchanged. A few details have been altered. At present its operation is almost automatic. With proper control of the temperatures of the gas and the oil a reduction of 50 per cent in the carbon-sulphur compounds can be obtained. The fundamental laws of physical chemistry may be employed to predict and explain results, but no tests having sufficient accuracy have been made which might be used to indicate the accuracy with which these laws apply.

Description of Apparatus

The arrangement of apparatus is illustrated by the sketch, figure No. 1. The gas enters No. 1 scrubber at the bottom, is conducted upwards through scrubbers Nos. 1, 2 and 3 in turn and leaves No. 3 scrubber at the top. The renewed oil is taken from its storage tank and forced to circulating tank No. 3 by a gear pump driven by a motor which is controlled by a switch operated by a float in circulating tank No. 3. From circulating tank No. 3 the oil is forced by a second gear pump through the cooling coil to the top of scrubber No. 3. After spreading downwards over the packing in a thin film it collects in the bottom and overflows through a seal into circulating tank No. 2. A third gear pump raises it from tank No. 2 to the top of scrubber No. 2. The oil from scrubber No. 2 runs into tank No. 1, from which it is raised to the top of scrubber No. 1. From scrubber No. 1 it overflows into the storage tank for used oil. The flow of oil through the scrubbers is controlled by a system of valves on the oil circulating lines. The oil in No. 3 circulating tank is replenished at intervals. The surface of the oil in this tank rises and falls through a distance of about a foot. At the same time oil is being removed from it at a practically constant rate and discharged into the top of scrubber No. 3. The rate of removal is controlled by the valves A and B, which are adjusted by hand to keep the oil in the pipes between them under pressure and to permit the desired quantity to enter scrubber No. 3 while the excess is returned to circulating tank No. 3. The flow of oil through scrubber No. 2 is governed in a similar manner except that the opening in the valve through which the excess oil is returned to circulating tank No. 2 is regulated by a lever which has one end fastened to the plug of the valve and the other end attached to a ball floating on the surface of the oil in the circulating tank. The flow of oil through scrubber No. 1 is controlled in the same manner as for scrubber No. 2. The use of the float-controlled valves provides the means of automatically adjusting the rates of flow in scrubbers Nos. 2 and 1 to equal the rate through scrubber No. 3. From the used oil storage tank the oil is pumped to the continuous still, from which it flows through a seal into the hot oil container. A fifth gear pump takes it from the hot oil container and forces it through a cooler into the storage tank for renewed oil.

The vapours which are driven from the oil in the still pass from the top to the water-cooled worm condenser. The condensate flows into the gravity separator, where it is divided into water and benzol.

Each scrubber is a steel shell four feet in diameter by sixteen feet high. Beginning two feet from the bottom and extending to within two feet of the top is the packing which consists of four layers of excelsior of about 21 inches deep separated and supported by wooden grids 12 inches deep. For the details of the grids and packing, see figure No. 2. By actual measurement the packing occupies the entire cross-section of the shell for a height of 12 feet, giving a scrubbing volume of 150.8 cubic feet for each scrubber or 452.4 cubic feet for the three. The oil is admitted to each scrubber through a ¼-inch orifice made by drilling a hole in a ½-inch pipe cap. The jet so formed impinges on a metal disc about ⅝-inch in diameter. After striking the disc the oil spreads out into a thin film about 12 inches across, of which the edges break into drops which fall on the top of the packing in the tower.

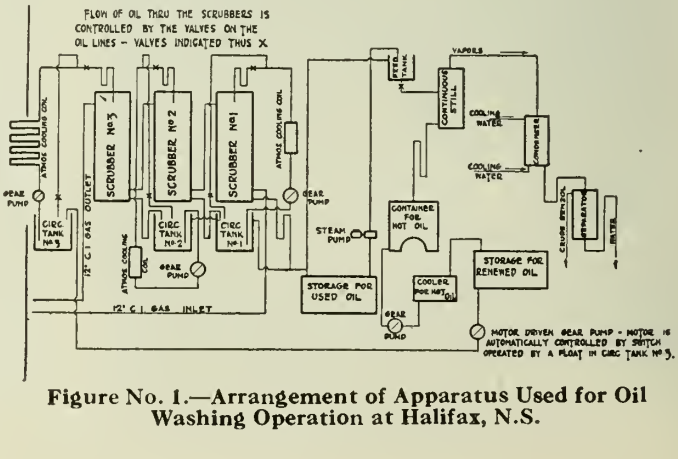

Figure No. 1.—Arrangement of Apparatus Used for Oil Washing Operation at Halifax, N.S.

(1) L. J. Willien, American Gas Institute News, Dec. 1917, mentions a reduction of 50 per cent in the quantity of CS_2.

(2) E. R. Hamilton, Proc., Canadian Gas Association, 1920-21.

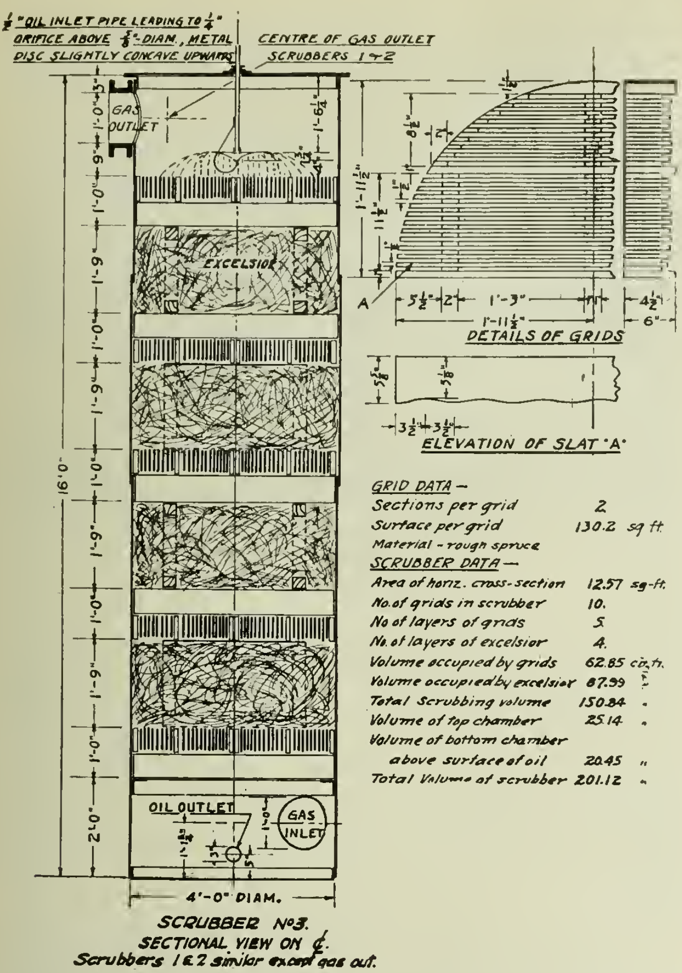

Figure No. 2.—Details of Scrubber Packing for CS_2 Removal.

The equipment for treating the wash oil is shown in figure No. 3. From the feed tank the oil enters the continuous still through an orifice in the oil inlet nozzle under a constant head provided by the feed tank. Passing downward through the column it is heated by the steam coils in sections 3, 2 and 1 in succession. The vapours which are driven from it by the heating pass upwards through sections 3, 4 and 5 to the vapour outlet at the top. A small quantity of steam is admitted near the oil level in section 3 to assist in quickly removing the vapours from contact with the oil, and to control the temperature at the vapour outlet.

Sections 3, 4 and 5 act as a short fractionating column. After passing from the top of the column the vapours go to the worm condenser in which they are liquefied. The condensate flows to a separator which divides it into two parts, water and benzol.

Three hours per day of one man's time are required to check temperatures, etc., and to handle the benzol produced, which, without any rectification, is retailed as a fuel for automobiles and motor boats.

Facts Concerning the Type of Oil Used

Just one type of oil has been investigated. It is a straight distillate from "Pennsylvania Crude" and is known by the trade name of "No. 1 Pale Paraffin." It has the following properties:—Specific gravity, (by Westphal balance), at 60°F. 0.8831, at 66°F. 0.8790, at 72°F. 0.8740; freezing point 25°F., flash point 310°F.; viscosity 60°-70° Saybolt at 100°F.; mean molecular weight, 250; colour, pale yellow with a greenish fluorescence; sulphur content 0.25 per cent.

After passing through the system several times the colour changes to a dirty brown, but the same greenish fluorescence remains. There is no marked change in the specific gravity through use. The molecular weight, however, of conditioned oil after several months in the system increases to 300, and there is a small increase in its content of sulphur.

No investigations have been made at Halifax to determine the reasons for the change in colour, the increase in molecular weight, the difference in the behaviour of the oil towards benzol which is indicated by the change in the slope of the graphs in figure No. 4, or the increase in sulphur nor to determine whether the molecular weight of the conditioned oil varies between heat treatments.

About 800 Imperial gallons of oil are needed for continuous operation. To make up for losses due to leaks and stoppages, with consequent overflows, quantities of about 400 gallons each are put into the storage tank for renewed oil from time to time. During 1924, 2,000 gallons were added in this way. The price of the oil is roughly twenty-two cents per Imperial gallon. After each addition of fresh oil there is an increase in the capacity of the scrubbers to remove benzol from the gas which is readily apparent from the reduction of the luminosity of the flame from an open burner; there is also an increase in the capacity of the scrubbers to remove carbon-sulphur compounds, but there is insufficient evidence to indicate its relationship to the quantity of fresh oil which is added. This increased capacity is only evident during the first trip through the system after the addition.

Carbon-Sulphur Compounds Encountered

Before proceeding further, it may be well to assemble a few facts concerning the carbon-sulphur compounds found in coal gas and their presence in it.

After the removal of sulphuretted hydrogen[3] there remains in coal gas a quantity of sulphur in combination with carbon alone or with carbon and hydrogen. In general, five-sixths[4] of the total exists as carbon bisulphide. Of the rest, 60-70 per cent exists as thiophene, whilst it seems probable that a portion is accounted for by ethyl and methyl sulphides and mercaptans.[5]

The physical and chemical properties of carbon bisulphide can be readily learned from any good book of physical and chemical properties, but data concerning thiophene is not so readily obtainable and is therefore given here in considerable detail.

All benzol[6] (from coal) which has not been purified by freezing and filtering off the crystals with subsequent repeated washing by H_2SO_4 contains an interesting compound, C_4H_4S, named thiophene, which was discovered by V. Meyer. Thiophene resembles benzol very closely in chemical and physical properties, and for this reason cannot be separated from it except by repeated treatment with sulphuric acid which dissolves thiophene more readily than it does the hydro-carbon.

For the following physical constants of thiophene the writer is indebted to Professor H. J. Creighton, D.Sc., of

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[3] It should be kept in mind that sulphuretted hydrogen is easily removed by passing the gas through iron oxide, (bog iron ore or manufactured equivalent), in suitable containers where the absence of oxygen permits reaction between the iron oxide and the sulphuretted hydrogen, which may be indicated thus,—

$$Fe_2 O_3 (nH_2O) + H_2S \longrightarrow Fe_2S_3 + H_2O$$

also, that the entire removal of all the sulphuretted hydrogen is simply a matter of adequate facilities.

[4] Proc., Amer. Gas Institute, vol. 3, p. 1051.

[5] Modern Gas Works Practice, Meade, (Benn Bros., Ltd., 1921), p. 610.

[6] Organic Chemistry, W. H. Perkins and F. Stanley Kipping, (J. B. Lippincott, 1907), p. 310.

Swarthmore University, who has very kindly given the results of work performed in his laboratory:—boiling point, (corrected), 84.25-84.26; density d_4^{25} 1.05837; refractive index, N_D^{25} 1.52513.

Temperature deg. C.	Vapour Pressure mm. Hg.
5.	26.4
10.	37.0
15.	50.0
20.	66.3
25.	86.3
30.	105.1
35.	128.8
40.	154.3
45.	185.5
50.	225.0
55.	275.0
60.	346.
65.	420.
70.	499.
84.25	760.

There are two classes of organic compounds derived from hydrogen and sulphide[7], of which

Ethyl hydro-sulphide C_2H_5SH

Ethyl sulphide $(C_2H_5)_2S$

are samples. The organic hydro-sulphides or sulphydrates are usually called mercaptans on account of their property of combining readily with mercuric oxide to form crystalline compounds. No data on the physical properties of these compounds were collected.

For the purpose of this paper all carbon-sulphur compounds other than CS_2 will be considered as C_4H_4S. The error involved in this should be small because the sulphur in the compounds other than the two just mentioned is probably less than 5 per cent of the total and the physical properties of the compounds containing it not excessively different from those of C_4H_4S. Furthermore, the ratio of sulphur as CS_2 to sulphur other than as CS_2 will be assumed at 5 to 1 in conformity with what has been recorded at other places. It would be interesting and perhaps enlightening to know just how closely this generally accepted ratio applies to gas from Cape Breton coals. Because of lack of time and facilities at Halifax no tests were made and no information was available from any other source. Also, as a convenience in writing, and to indicate that it is difficult to remove from a city's gas supply, and to distinguish it from sulphur as H_2S which is easy to remove, the total sulphur as CS_2, C_4H_4S, etc., may be called "fixed sulphur."

[7] Organic Chemistry, W. H. Perkins and F. Stanley Kipping, (J. B. Lippincott, 1907), p. 186.

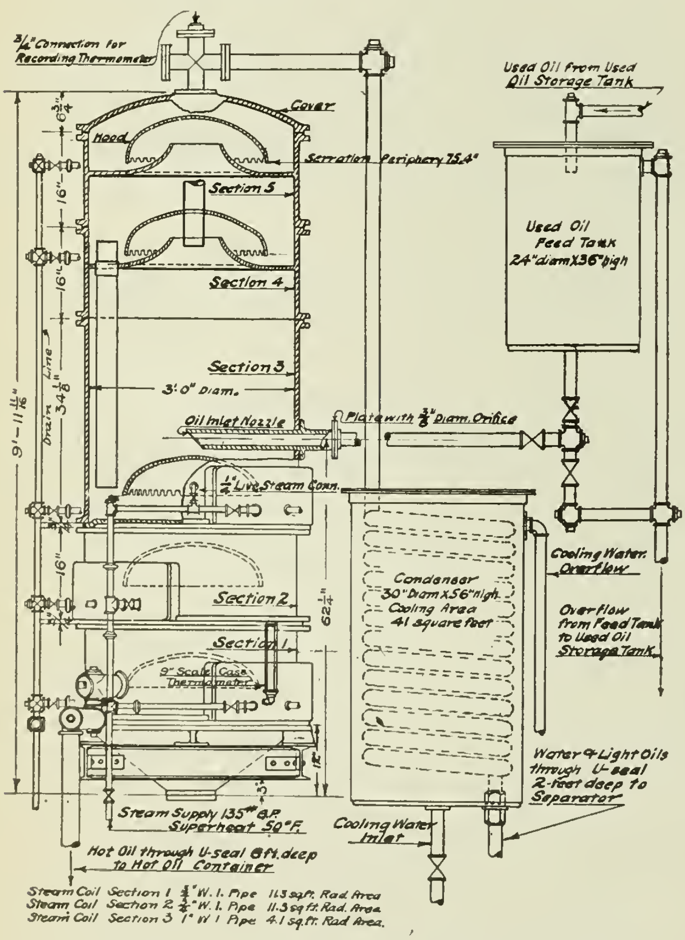

Figure No. 3.—Apparatus for Treating Wash Oil.

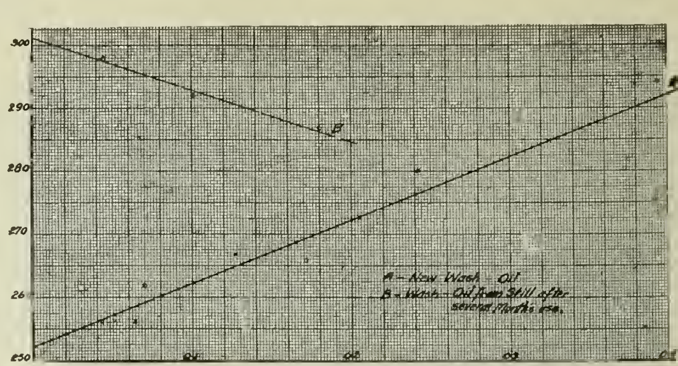

Figure No. 4.

Relation of Sulphur Quantities in Coal and Gas

Sufficient information has been collected for the inclined coal carbonizing retorts at the Halifax gas works to show that *on the average* there is a definite relation between the sulphur in the coal and the fixed sulphur in the gas. This relation is not apparent for individual or spot tests but is apparent where the average of daily tests for fixed sulphur in the gas is available over a period of, say, two weeks during which a coal of a known sulphur content was used. The data compiled in table No. 1 are representative, and plotted on figure No. 4a give points which lie close to a smooth curve.

The direct inference to be drawn from the data and curve is that the mean quantity of fixed sulphur to be found in the effluent gas from a given type of gas making equipment under ordinary operating conditions is a function of the quantity of sulphur present in the original coal rather than of the type of compound in which it exists there.

As a matter of general interest rather than of connection with this paper, the similar data and curves for horizontal retorts and continuous vertical retorts which were compiled for another purpose are given in tables Nos. 2 and 3 and figure No. 4a.

It seems scarcely necessary to point out that where high sulphur coals are to be used inclined slot retorts should not be considered, and that among the three types mentioned continuous vertical retorts are much preferable.

If it is acknowledged that the upper limit of fixed sulphur which can be allowed in the gas supplied by a public utility company or corporation is about 35 grains per hundred cubic feet it can be learned from figure No. 4a and the data in tables Nos. 1, 2 and 3 that the coal from which it is made must not contain more than 2 per cent of sulphur for continuous vertical retorts, 1.2 per cent for horizontal retorts and 1 per cent for inclined slot retorts.

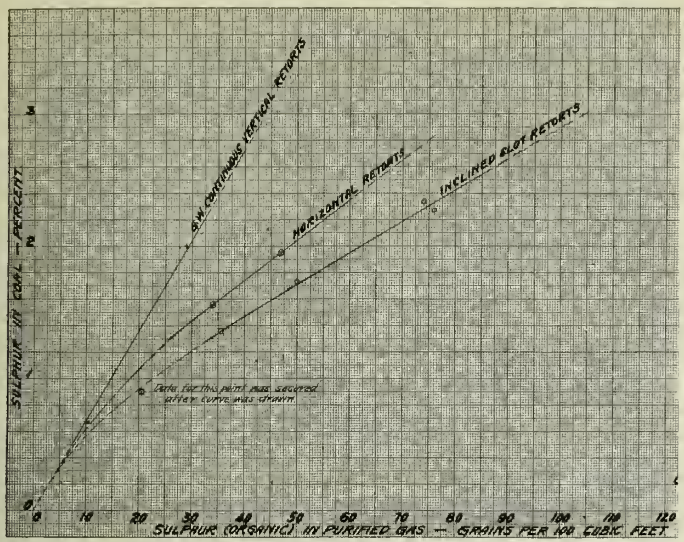

Figure No. 4a.

It may be taken as axiomatic that the ideal gas would contain no sulphur; but, as long as the original coal contains sulphur, there will be some sulphur in the finished gas from all coal gas works unless some means is used to remove it.

The cost of producing an ideal gas must be balanced against the economic good to accrue from it. Wherever coals containing less than 1 per cent of sulphur are available there seems to be little need or desire to attempt it. Wherever coals containing more than 1.8 per cent are the only ones available the production of a suitable gas becomes a problem such as has bothered the gas company at Halifax for years.

Reasons for Removing Some of the Fixed Sulphur

The products of combustion of a gas containing 45 grains of fixed sulphur per 100 cubic feet when burned in an unvented appliance may be objectionable to a sensitive olfactory organ.[8]

Halifax experience indicates that odour complaints traceable to the quality of the gas practically disappear when the sulphur is kept below 35 grains per 100 cubic feet.

Claims have been made at Halifax that the products of combustion of a gas containing 50 grains of fixed sulphur per 100 cubic feet are injurious to plants and stain silverware. These are hard to establish, but are generally believed.

At the instigation of public utility commissions and other regulatory bodies, investigations of the deleterious action of the products of combustion of fixed sulphur have been conducted for the purpose of establishing the maximum permissible quantity.

The Board of Commissioners of Public Utilities of Nova Scotia have placed the limit at 35 grains per 100 cubic feet after examining the available data on the subject and the rulings of other similar bodies. They have prescribed a penalty equivalent to a fine of $600 per month for every month in which 35 grains is exceeded three times or 45 grains is exceeded once.

Solutions of Sulphur in the Oil and the Gas

The solution of sulphur in the oil is very dilute. It will presently be shown that a concentration of 40 grains of sulphur in one molecular form per Imperial gallon of oil is a generous maximum. Expressed by ordinary mathematics, this means less than 40 parts in 60,000 or one part in 1,500. Expressed in the terms of physical chemistry, it means 0.00003 molecular per cent when the sulphur exists as CS_2 and the molecular weight of the oil is taken at 300.

The chief compounds in which the sulphur exists in the gas, CS_2 and C_4H_4S, are not active chemically, as is witnessed by their behaviour towards sulphuric acid. The oil possesses little chemical activity. These facts added to the diluteness of the solution seem to warrant treating the solution as closely approaching the ideal. Support for this is found from the experiments of Wilson, Wylde and Davis[9] on the lowering of the vapour pressure of benzol by an oil solute in which they found a deviation from the laws of the ideal solution of less than 2 per cent for a 10 per cent molecular concentration and infer that the deviation decreases as the solution becomes more dilute.

The concentration of the sulphur in the gas is also very dilute, and it is therefore inferred that the vapours of the carbon-sulphur compounds may be considered as obeying the perfect gas laws.

On the assumption that the perfect gas laws apply to the sulphur vapours in the gas and that the solution formed, when the oil absorbs carbon-sulphur compounds from the gas, is ideal, that is, the carbon-sulphur compounds are absorbed by the oil without any change in volume, temperature or composition of any of the constituents, the process can be examined and explained by the application of three fundamental laws of physical chemistry, Raoult's law of vapour pressure lowering, Dalton's law of partial pressures and the distribution law for dilute solution.

Raoult's law of vapour pressure lowering as it applies to this discussion may be stated thus:—

> "The partial pressure of any molecular species above an ideal solution is equal to its vapour pressure as a pure liquid at the same temperature and pressure multiplied by its molecular fraction in the solution."[10]

Dalton's law of partial pressure stated in words is,—[11]

> "In a mixture of gases, each gas exerts the same pressure as it would exert if it were alone present in the volume occupied by the mixture."

Because equal volumes of all gases at the same temperature and pressure contain the same number of molecules,[12] and the mean kinetic energies of the molecules of all gases are identical at the same temperature,[13] it follows that this law may be stated thus:—

$$p = \frac{PV}{100}$$

in which p is the partial pressure of constituent A in a mixture of gases, P is the total pressure in the container of the mixture and V is the percentage by volume of the constituent A in the mixture.

The distribution law for dilute solutions says,—[14]

> "When any molecular species in dilute solution is in distribution equilibrium between two immiscible solvents the ratio of its mole fractions in the two solvents is always equal to a constant whose value is characteristic of the species in question and of the two thermodynamic environments which respectively exist in the two solvents."

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(8) Proc., American Gas Institute, vol. 3, p. 1050.

(9) Measurement of the Relative Absorptive Efficiencies of Gas Absorbent Oils, R. E. Wilson and H. S. Davis—Ind. and Eng. Chem., vol. 15, 1923, pp. 947-950.

(10) Principles of Physical Chemistry, Washburn, (McGraw-Hill, 1915), p. 144; (11) ibid. p. 26: (12) ibid. p. 22: (13) ibid. p. 21: (14) ibid. p. 148.

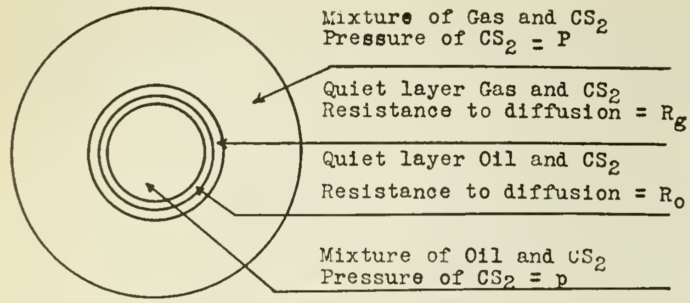

Figure No. 5.

Ratio of the Sulphur in the Gas to the Sulphur in the Oil at Equilibrium

The ratio of sulphur, (one molecular form), in grains per 100 cubic feet of gas, to the sulphur (same molecular form) in grains per Imperial gallon at equilibrium, which will be referred to in the future as R, may be found from the following equation which is developed on the laws of Raoult and Dalton:—

$$R = \frac{0.1808\, Pm_o}{(460 + T)\, D_o} \qquad (1)$$

In it, P = vapour pressure of volatile sulphur compound in question at temperature T.
m_o = mean molecular weight of the oil.
T = temperature in degrees Fahrenheit.
D_o = density of the oil at temperature T.

The specific gravity of the oil varies so slightly between the temperatures of 40° and 80°F. that the value of R will not be affected by more than one one-hundredth of one per cent if D_o is taken as constant at 8.85 pounds per Imperial gallon. Equation (1) then becomes,—

$$R = \frac{0.0204\, Pm_o}{(460 + T)} \qquad (2)$$

By substituting the corresponding values of T and P from the vapour pressure curve for CS_2 in figure No. 6 and giving several values to m_o the curves in figure No. 7 have been plotted to indicate how R for CS_2 varies with the temperature and the molecular weight of the oil, assuming that oils can be obtained of differing molecular weights but of the same density of 8.85 pounds per Imperial gallon.

Similarly, the curves for R referred to C_4H_4S as plotted in figure No. 8 have been developed.

Methods of Expressing the Efficiency of the Scrubbers

There are two methods of expressing the efficiency of the scrubbers; as the ratio of the sulphur transferred to the quantity originally present in the gas, and as the ratio of the sulphur transferred to the maximum quantity transferable under the governing conditions.

For the sake of convenience, the efficiency as determined by the first method may be called the efficiency of reduction, efficiency B or shortly E; and that by the second method as the efficiency of transfer. When the latter is determined by the capacity of the oil for absorbing sulphur from the gas it may be called efficiency A or shortly E_a; when it is determined by the capacity of the gas to give up sulphur to the oil it may be called efficiency C or shortly E_c.

The significance of thus defining the methods for determining the efficiencies of a scrubbing system is apparent from the following examples. When the scrubbing system is removing sulphur from a gas containing 50 grains sulphur per 100 cubic feet using an oil which contains 5 grains of sulphur per Imperial gallon at the rate of one gallon per hundred cubic feet flowing counter-current to the gas, and at equilibrium the sulphur in 100 cubic feet of gas is twice the quantity in one Imperial gallon of oil, the maximum quantity of sulphur which 100 cubic feet of gas can deliver is 50 minus 5 by 2 equals 40 grains; but the maximum quantity of sulphur which one gallon of oil in contact with the inlet can hold is 50 divided by 2 or 25 grains per Imperial gallon and the maximum quantity of sulphur which can be transferred to one gallon of oil is 25 minus 5 equals 20 grains. If this quantity, (20 grains), is transferred by the system the efficiency of transfer E_a is 1.00 or 100 per cent. At the same time the efficiency of reduction, E, will be 20 divided by 50, equals 0.40 or 40 per cent.

On the other hand, should equilibrium be reached when the sulphur in 100 cubic feet of gas is one-half the quantity in one Imperial gallon of oil, the maximum quantity of sulphur which one Imperial gallon of oil can hold in contact and in equilibrium with the inlet gas is 50 by 2 equals 100 grains; but the maximum quantity which the gas can deliver is 50 minus 5 by 0.5 equals 47.5 grains. If this quantity, (47.5 grains), is transferred by the system the efficiency of transfer E_c is 100 per cent, and it follows that the efficiency of reduction E_b is $\frac{47.5}{50}$, which equals 0.95 or 95 per cent.

Reference to the curves for R in figures Nos. 7 and 8 show that the equilibrium ratio of 2 corresponds to R for S as CS_2 when using an oil of molecular weight 250 at 51

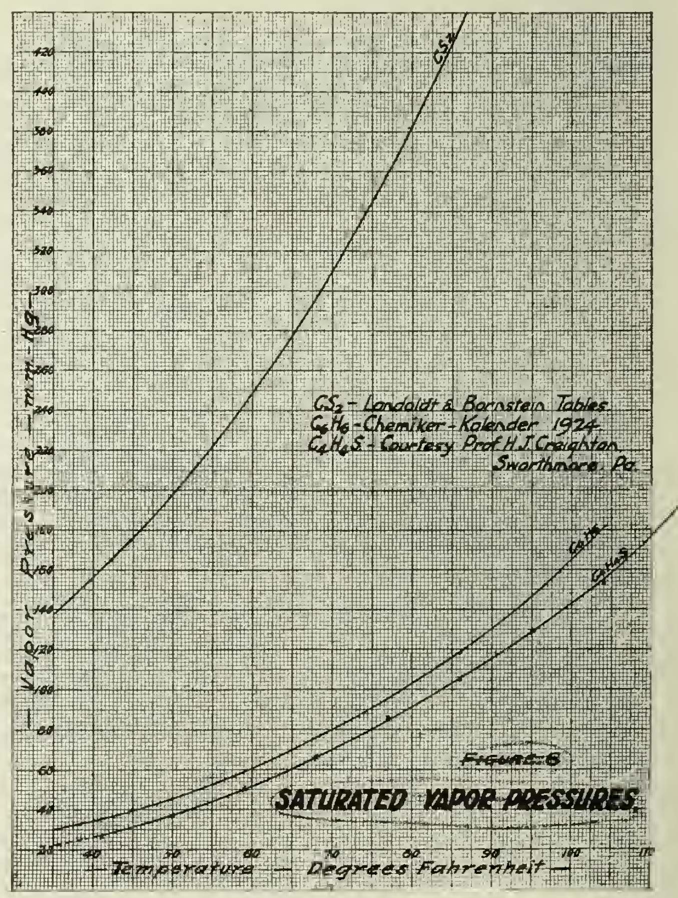

Figure No. 6.

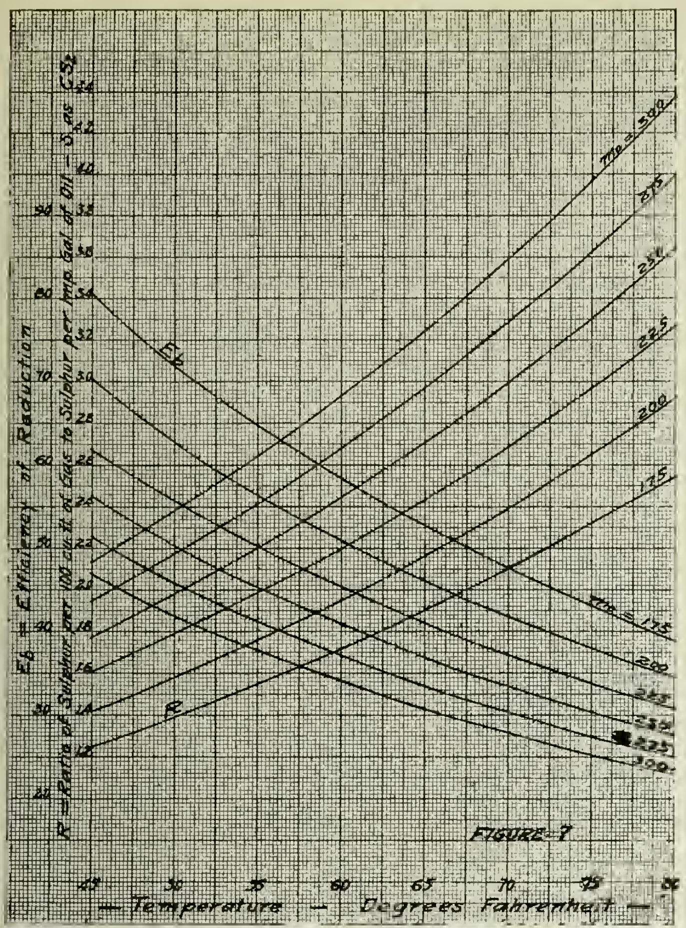

Figure No. 7.

degrees F. and that the ratio of 0.5 corresponds to R for S as C_4H_4S when using an oil of molecular weight 250 at 59½°F.

It follows that the transfer of CS_2 to the oil is limited by the capacity of the oil to accept it and that the transfer of C_4H_4S to the oil is limited by the capacity of the gas to give it up. Therefore, all symbols referring to sulphur and used in conjujnction with E^a will infer that the sulphur exists as CS_2, but used in conjunction with E_c will infer that the sulphur exists as C_4H_4S.

Maximum Efficiencies of Reduction

In figure No. 7 are curves showing how the efficiency of reduction (E_b) for a system, using oil which contains no CS_2 or other volatile sulphur compound at the rate of one Imperial gallon per hundred cubic feet of gas to remove sulphur from a gas which contains CS_2 only, will vary with the same variables that affect R. Points on these curves are found by letting G equal the quantity of sulphur in one hundred cubic feet of the original gas. Then $\frac{G}{R}$ is the maximum quantity of sulphur which can be transferred from one unit of gas to one unit of oil, and

$$E_b = \frac{G}{R} \div G = \frac{1}{R} \text{ or } \frac{100}{R} \text{ per cent} \qquad (3)$$

Similar curves have been prepared for thiophene and are shown in figure No. 8.

Further study of the method of developing the curves in figures Nos. 7 and 8 will show that the numerical value of the ratio R for sulphur as CS_2 is the minimum number of Imperial gallons of oil per 100 cubic feet of gas which is necessary to remove all the sulphur present in the gas at a given temperature; also, that for temperatures below 70°F. and with oils having mean molecular weights of less than 300 one gallon of oil is theoretically capable of dissolving more thiophene than 100 cubic feet of gas can carry; and that, other things being equal, the lower the temperature and the smaller the molecular weight of the oil the greater the quantity of sulphur which will be removed from the gas by a given quantity of oil.

Mathematical Treatment of the Action in the Scrubbers

The action which takes place in the scrubbers may be visualized as a two-film resistance to diffusion through two surface layers of molecular thickness under a driving potential which is caused by a difference in pressures or concentrations. It is analogous to the resistance of a copper wire to the flow of electric current caused by the difference between the electric potentials at two points in a wire.

Suppose that CS_2 vapour, for instance, is diffusing from a concentrated mixture with gas into a dilute solution inside a drop of oil suspended in the gaseous mixture, as in figure No. 5 (after Whitman and Keats).[15] Denoting the pressure of CS_2 in the gas by P and its pressure in the drop by p then the driving pressure of the diffusion is P-p. p is the equilibrium or back pressure of CS_2 above a solution of concentration X, the concentration being determined from the solubility of CS_2 in oil at the temperature of the drop, (i.e., P and p must be measured in the same units and referred to the same phase).

The general equation for absorption will be

$$W = \frac{\triangle p}{R_g + R_o} = k'A\ (P\text{-}p) = k'aV\ (P\text{-}p) = KV\ (P\text{-}p)$$

where W = units of material absorbed per minute.
$\triangle p$ = driving pressure in units of pressure or concentration.
R_g = resistance of gas layer to diffusion.
R_o = resistance of oil layer to diffusion.
k' = overall conductance of oil layer and gas layer per unit area.
a = area of films per unit of volume.

Then, $\frac{1}{R_g + R_o} = k'aV$

and A = total area of films.
P = units of pressure or concentration of CS_2 in gas.
p = units of pressure or concentration of CS_2 in gas which will be in equilibrium with the solution in the oil.
V = volume of apparatus in cubic feet.
K = coefficient of absorption in units of material absorbed per cubic feet per minute per unit difference of pressure or concentration equals $k'a$.

To adapt the general formula to this particular application of it, let
Q = quantity of gas scrubbed per minute in hundreds of cubic feet.
G = quantity of sulphur in inlet gas in grains per hundred cubic feet.
g = quantity of sulphur in outlet gas in grains per hundred cubic feet.

[15] Rates of Absorption and Heat Transfer Between Gases and Liquids, W. G. Whitman and J. L. Keats, Ind. and Eng. Chem., vol. 14, p. 186.

Then the quantity of sulphur transferred per minute will be $Q\ (G-g)$.

In addition, let

G_o = quantity of sulphur in the gas in grains per hundred cubic feet which will be in equilibrium with the sulphur in the inlet oil.

g_o = the same for the outlet oil.

Then $G - g_o$ = force available to drive sulphur from the gas into the oil at the inlet to the scrubbers.

And $g - G_o$ = force available to drive sulphur from the gas into the oil at the outlet of the scrubbers.

Because the driving potential of the interaction is directly determined by the distance from equilibrium and the rate at which energy or matter is transferred from gas to liquid or vice versa in any definite system decreases as equilibrium is approached, the use of the smaller logarithmic mean difference in concentration is advocated by Whitman and Keats when either one of the above terms is less than half of the other. The equation applicable to this case will then be

$$Q\,(G-g) = KV\,\frac{(G-g_o)-(g-G_o)}{\log_e \dfrac{G-g_o}{g-G_o}} \qquad (4)$$

in which K is the number of grains of sulphur transferred from the gas to the oil per minute per cubic foot of scrubbing volume per grain per hundred cubic feet difference between the mean concentration of the sulphur in the gas being scrubbed, and the concentration of the sulphur in a theoretical gas containing that quantity of sulphur which will be in equilibrium with the mean quantity of sulphur in the scrubbing oil.

Whitman and Keats claim that this treatment for liquid-gas reactions as summed up in equation (4) has been checked by experimental data from various types of laboratory and commercial equipment and has been found to apply in all cases studied.

Equation (4) indicates that the quantity of sulphur which will be transferred per minute is directly proportioned to the active scrubbing volume and the mean driving potential. These are functions of the equipment, i.e., are primarily decided by the design of the container in which the reaction takes place and by the selection of the oil.

Some Factors Influencing K

In the case of tower scrubbers the scrubbing volume is a constant quantity, and it is obvious that the coefficient K should be high when the material with which the towers are packed presents a large area of surface per unit of volume. At the time the towers at Halifax were erected the scrubbing volume was packed entirely with the wooden grids. Later some grids were removed and wooden excelsior substituted, (see figure No. 2), but there is nothing among the data collected to show that the effectiveness of the scrubbers was increased. It may be that they had excess capacity at the beginning and that the change in the filling simply served to increase something which was already large enough.

When the scrubbers were erected pale paraffin oil, as previously described, was recommended by the Imperial Oil Company for our purpose. It possessed the desirable factors of availability, comparatively low price, low volatility, fairly low freezing point and low viscosity. Some other oil of lower molecular weight might prove more suitable.

The most important variables of operation of the tower scrubbers are temperature, rate of flow of oil and gas velocity. Of these, temperature is the only one which affects the potential term. Any change in it will change the equilibrium pressure over the oil and therefore the driving potential. This is completely allowed for in the potential term and does not affect K, the specific coefficient per unit of potential.

The effect of temperature on K will be produced chiefly through its effect on the oil, by changing its viscosity and surface tension and thereby the resistance of the oil film to the transfer of the carbon-sulphur compounds. No laboratory tests were made at Halifax to determine how the viscosity varied with the temperature.

No means are available for controlling the temperature of the gas as it enters the scrubbers, but no abrupt changes are encountered. The pipe through which it flows after leaving the purifiers runs underground for over sixty feet and emerges just below the inlet to the oil scrubbers. In general, the temperature varies with the time of year from 40°F. in February to 75°F. in August. By the use of the cooling coils between the scrubbers, (figure No. 1), the average temperature of the oil can be kept within one or two degrees of that of the gas with maximum differences of about plus or minus 6 degrees.

The velocity of the gas past the liquid surface has shown the most marked effect on K in all cases studied by Whitman and Keats. High gas velocity exerts a brushing or tearing action on the surface of the film of oil, reducing its effective thickness and thus decreasing its resistance to diffusion, but the good to be obtained from high velocities must be weighed against the cost of obtaining it. At Halifax, no pressure was available to produce high velocities

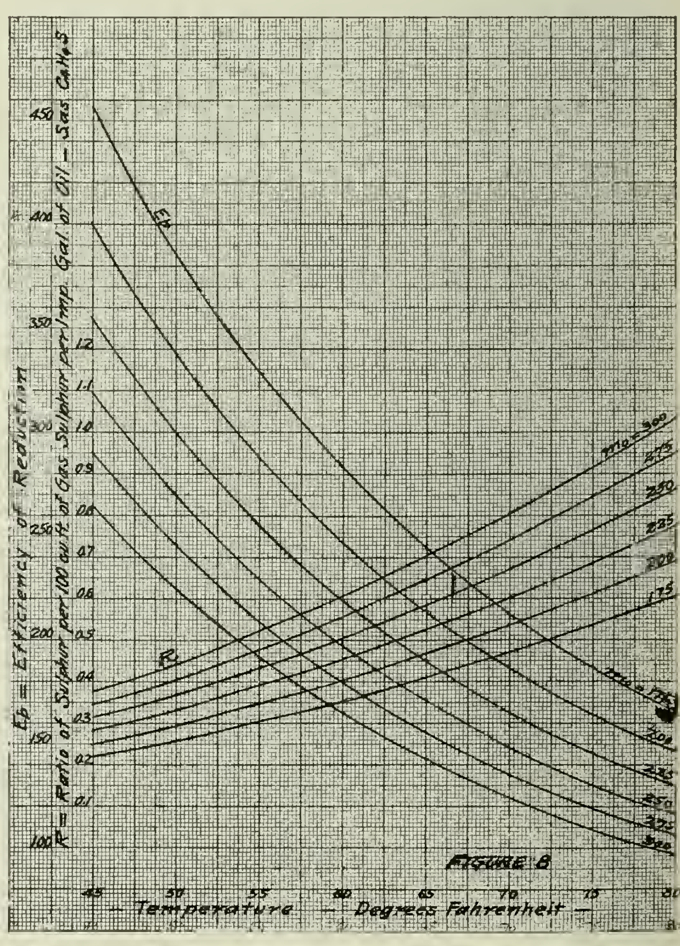

Figure No. 8.

and other considerations demanded that the pressure drop across the scrubbers be kept as near zero as possible. Actually, the velocity of the gas through the scrubbers is continually changing between a minimum of 160 cubic feet per minute or 13 cubic feet per minute per square foot of cross-sectional area, and 220 cubic feet per minute or 17 cubic feet per minute per square foot of cross-sectional area, with an average of about 180 cubic feet per minute or 14 cubic feet per minute per square foot of cross-sectional area.

Increases in the rate of flow of the oil will increase the area of contact of the oil, and therefore K, until the rate is reached which is necessary to keep the entire packing surface wet. Beyond this limit further increases will merely cause a thicker layer with relatively little increase in surface of contact.

After the scrubbers were first installed at Halifax the rate of flow of the oil was varied from 25 to 150 gallons per hour. The data obtained were very indefinite due to the effect on the results of other variables which could not be prevented from changing at the same time. Better results appeared to come when the rate of flow of the oil was 100-120 gallons per hour or about 10 gallons per 1,000 cubic feet of gas. This rate has been maintained since, with the exception of one test when the rate was raised to 150 gallons per hour. Unfortunately, other changes were made at another point in the system at the same time. The results of the increase were disappointing and the previous rate was again adopted. This is mentioned later in connection with the effect of the oil rate in the scrubbers to the efficiency of reduction (E_b).

Further Mathematical Treatment of Scrubbing Action

Pursuing the assumption that the solutions of sulphur in the gas and the oil are ideal, equation (4) may be changed to—

$$Q\,(G-g) = KV\,\frac{E_a\,(R-n)\,(G-Rg_1)}{R\,\log_e \dfrac{R-nE_a}{1-E_a}} \quad \dots\dots\dots (5)$$

or to,—

$$Q\,(G-g) = KV\,\frac{E_c\,(R-n)\,(G-Rg_1)}{n\,\log_e \dfrac{n\,(1-E_c)}{n-RE_c}} \quad \dots\dots\dots (6)$$

by using an elementary procedure, (in which the processes of simple algebra seem somewhat intricate because of the large number of symbols involved), to apply the laws of Raoult and Dalton. In these equations

n = the quantity of oil used in Imperial gallons per 100 cubic feet of gas.

g_1 = the initial quantity of sulphur in the oil in grains per Imperial gallon,

while the other symbols represent the quantities or ratios to which they have been assigned previously.

From the definitions of E_a and E_c and the conclusions drawn from figures Nos. 7 and 8 it is readily apparent that equation (5) applies to the transfer of CS_2 and (6) to the transfer of C_4H_4S.

By further algebraic simplification, the following equations may be evolved

$$Q = KV\,\frac{R-n}{n\,\log_e \dfrac{R-nE_a}{1-E_a}} \quad \dots\dots\dots\dots\dots\dots (7a)$$

$$Q = KV\,\frac{R-n}{n\,\log_e \dfrac{n\,(1-E_c)}{n-RE_c}} \quad \dots\dots\dots\dots\dots\dots (7b)$$

Equations (7a) and (7b) show clearly that K, E_a and E_c are entirely independent, theoretically, of the quantities of sulphur carried by either the gas or the oil; that K is a function of E_a or E_c whenever Q, V, R and n are constant, i.e., the same variables which affect K also affect E_a or E_c, and when E_a or E_c are constant K is a constant.

From the foregoing paragraphs, it seems clear that in a given system when Q, V, the efficiency of transfer, (E_c or E_a), and the temperature are constant, K will be a constant and therefore $G—g$ or the quantity of sulphur transferred from each 100 cubic feet of gas is directly proportional to the potential term. Granting this to be true, then in a system of three units in series through which the flow of oil is counter-current to that of the gas, the quantity of sulphur which is transferred in one unit is proportional to the mean driving potential in that unit and the quantity which is transferred by the system is proportional to the mean driving potential through the system. If the three units are identical in all respects the time of contact of the gas with the oil in all of them will be the same. Thus, when the driving potentials at the inlet to the system and outlet from the system are known it is possible to find the driving potentials at the inlets to the second and third units by using the exponential curve and its equation in figure No. 9. First locate the ordinates to the curve which correspond with the driving potentials at the inlet and outlet of the system. The abscissa between the ordinates of these two points may be considered to represent the time which it takes a unit quantity of gas to pass through the system. A third of it will represent the time for the passage of one unit of gas through each scrubber. The ordinates from the third points will represent the driving potentials at the inlets to scrubbers two and three. Knowing these and ($G—g$) for the system it is an easy matter to find the percentage of ($G—g$) and the percentage of the original sulphur in the gas which is transferred in each scrubber.

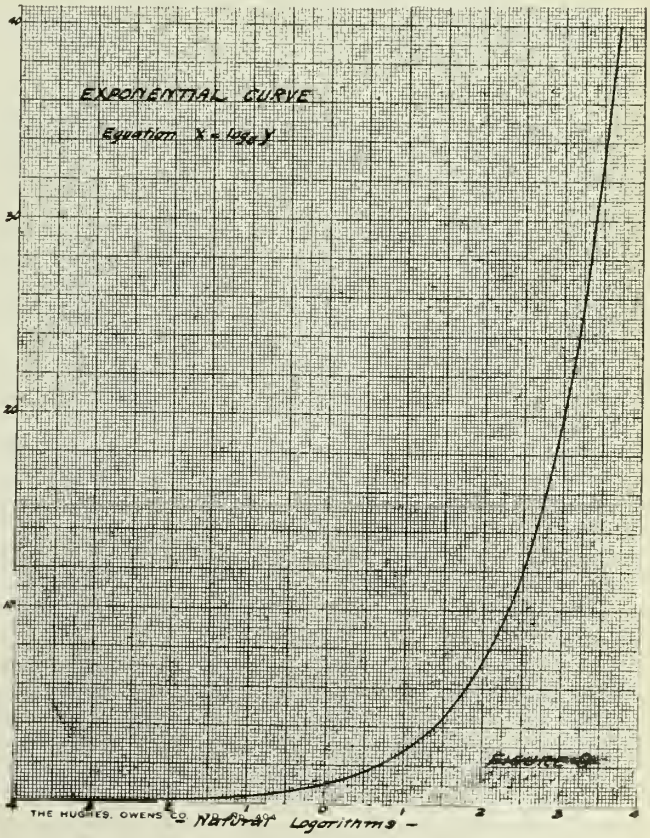

Figure No. 9.

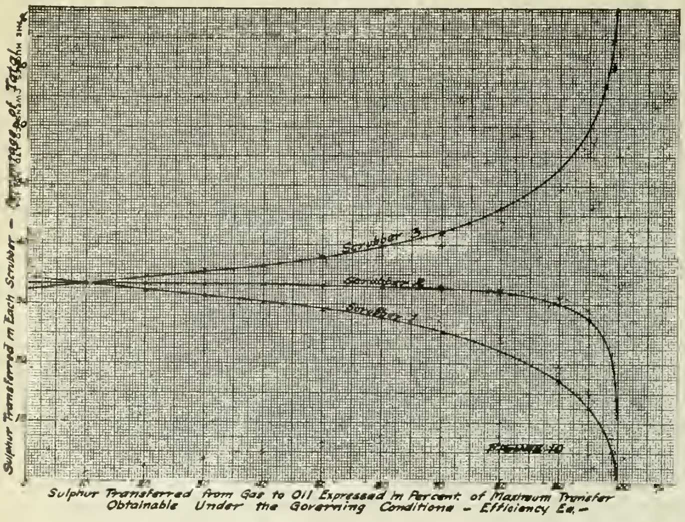

Figure No. 10.

Under the assumptions predicated, it may be shown that for sulphur as CS_2

$$G - g_o = (1 - E_a)\ (G - Rg_1) \quad \ldots\ldots (8)$$

$$g - G_o = (1 - \frac{n\,E_a}{R})\ (G - Rg_1) \quad \ldots\ldots (9)$$

$$G - g = n\,E_a\ (\frac{G}{R} - g_1) \quad \ldots\ldots (10)$$

$$E_b = \frac{n\,E_a\ (G - Rg_1)}{RG} \quad \ldots\ldots (11)$$

also for sulphur as C_4H_4S

$$G - g_o = (1 - \frac{RE_c}{n})\ (G - Rg_1) \quad \ldots\ldots (8a)$$

$$g - G_o = (1 - E_c)\ (G - Rg_1) \quad \ldots\ldots (9a)$$

$$G - g = E_c\ (G - Rg_1) \quad \ldots\ldots (10a)$$

$$E_b = E_c\ (1 - \frac{Rg_1}{G}) \quad \ldots\ldots (11a)$$

From the above equations it is apparent that when G, R, g_1 and n are constant, $G—g$ and E_b for the system and each scrubber will vary with E_a and E_c, as the case may be.

To illustrate, let G equal 50 grains sulphur as CS_2, g_1 equal 5, n equal 1, R equal 2 while E_a is varied from 0 to 99.75. This value of R, referred to figure No. 7, fixes the temperature at 46°F., if the molecular weight of the oil is 300. Using the properties of the exponential curve and the equations given above for sulphur as CS_2, sufficient points may now be calculated for plotting the curves shown in figures Nos. 10 and 11.

From these figures Nos. 10 and 11 it is apparent that, in the case of sulphur as CS_2, equilibrium between the sulphur in the gas and the sulphur in the oil is approached in the first scrubber and the greatest transfer occurs in the third scrubber of a series of three scrubbers, numbered in the direction of flow of the gas. The reason for this is that one gallon of oil per 100 cubic feet of gas is insufficient to absorb all the CS_2 which is present.

If, however, the sulphur occurs as thiophene and the same conditions maintain the value of R will be 0.39, (see figure No. 8), and the equations for sulphur as C_4H_4S should be applied. The calculations and curves derived from their use will show that equilibrium between the sulphur in the gas and the sulphur in the oil is approached in the third scrubber and that the greatest transfer will occur in the first scrubber, occurrences exactly opposite to those found for sulphur as CS_2. The reason for this is that one gallon of oil per 100 cubic feet of gas is more than sufficient to absorb all the C_4H_4S which can be present.

Solvent Effect of Absorbed Benzol

In practice, it is found that a considerable quantity of benzol is removed at the same time as the sulphur. It may amount to 0.02 Imperial gallons per hundred cubic feet of gas. The effect of its presence in the oil may be studied by assuming that it is a second solvent used in conjunction with the oil and that the distribution law for dilute solutions applies to the mixture of the two solvents. There may be some error in this because the benzol is miscible with the oil in all proportions, yet such a study will illuminate one way, perhaps the chief, in which it may affect the transfer.

The oil entering the system after treatment in the heating column, (figure No. 2), may bring with it a small quantity of benzol of which no notice need be taken for its effect is allowed for in the mean molecular weight of the treated oil when the latter is determined by the " freezing point " method. Of the benzol, which is picked up by the oil during its passage through the scrubbers and is removed during its passage through the heating column, none is present at the gas outlet oil inlet end of the scrubbers. At the gas-inlet-oil-outlet of the scrubbers this benzol will be present in the oil to the maximum extent.

As the benzol is removed from the gas and its quantity in the oil grows larger it is always in intimate contact with the oil. It is therefore probable that, assuming the application of the law, at all times the quantity of sulphur carried by the mixture is divided between the oil and the benzol in the proportion demanded by the law. At the same time the law demands that the pressure of the sulphur from each solution be proportional to the quantity of sulphur in the gas above it. The ratio of the sulphur in the gas to the sulphur in the oil at equilibrium is found by equation (1). This is a general equation applying to dilute solutions, therefore the value of R for CS_2 and benzol can be found by letting m equal 78 and D_o equal the density of benzol. The densities of benzol and oil are so nearly equal that R for CS_2 and benzol at a given temperature may be found with sufficient accuracy for this study, by taking R at the given temperature for CS_2 and oil from any curve in figure No. 7, multiplying it by 78 the molecular weight of benzol, and dividing the product by

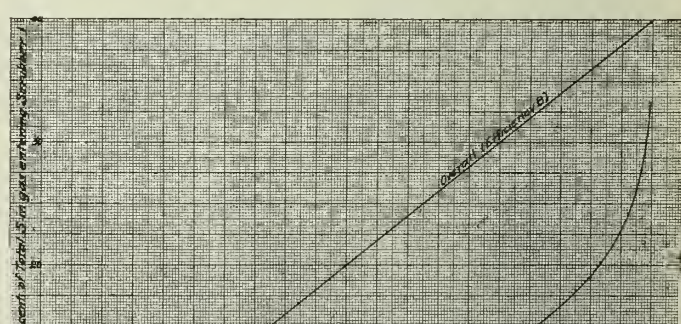

Figure No. 11.

the molecular weight of the oil marked on the curve. Similarly, the value of R at a given temperature for thiophene, (molecular weight 84), and benzol may be found from the curves in figure No. 8.

In the case where the sulphur exists as CS_2 it has been shown that equilibrium between the sulphur in the gas and the sulphur in the oil is approached as the oil reaches the gas inlet oil outlet end of the scrubbers. At this point the benzol is present in its greatest quantity. The sulphur as CS_2 in the mixture will be divided between the oil and the benzol in such a way as to have the back pressure from each proportional to the forward pressure of the sulphur as CS_2 carried by the gas entering the scrubbers. Thus, the capacity of the benzol to absorb sulphur as CS_2 can be added to the capacity of the oil and equation (10) can be used to determine the transfer of sulphur to each solvent by referring n, R and g, first to oil and then to benzol, the actual quantity of sulphur which the scrubbers can be expected to remove being the sum of the two values found for $G—g$.

In the case of the transfer of sulphur as C_4H_4S the effect of the presence of benzol in the oil must be studied in a different manner. It has been mentioned that equilibrium between the sulphur as C_4H_4S in the gas and sulphur as C_4H_4S in the oil is approached as the gas reaches the gas-outlet-oil-inlet of the scrubbers; also, that none of the quantity of benzol of which the effect is being studied is present at this point. In addition, it is readily seen that the gas which is leaving the system cannot have its content of sulphur as C_4H_4S reduced below that quantity which is necessary for equilibrium with the quantity of the same kind of sulphur which is carried by the entering oil. Therefore the quantity of sulphur as C_4H_4S which can be transferred to the oil-benzol mixture is limited. According to this distribution law for dilute solutions this quantity will be divided between the oil and the benzol and its back pressure will be less than that of the same quantity from its solution in oil alone. The mean potential difference through the scrubbers is thereby increased and a higher efficiency of transfer may be expected for sulphur as C_4H_4S than for sulphur as CS_2.

For the purpose of determining the quantity of sulphur as C_4H_4S which is transferred in the scrubbers, equation (10a) may be used

$$G - g = E_c\,(G - Rg_1)$$

When the driving potential at each end of the scrubbers must be known in order to find the quantities of sulphur which each unit may be expected to remove the following procedure may be used.

For sulphur as CS_2 it has been assumed that the oil and benzol may be treated as separate solvents which obey the laws of dilute solutions. The driving potential forcing sulphur from the gas into each of them must be the same at the gas-inlet-oil-outlet and an equation which gives its value for one of them is all that is needed. Equation (8) gives the value of the potential difference $G—g_o$ for oil. At the gas-inlet-oil-outlet the driving potential will be found from the equation

$$g - G_o = g - Rg_1$$

because G_o equals Rg_1. In this equation g must be found by subtracting from G the sum of the quantities of sulphur as CS_2 transferred to the oil and the benzol.

For the sulphur as C_4H_4S the effect of the presence of benzol has been translated into an increase in efficiency. Therefore the potential difference at the gas-outlet-oil-inlet may be found by the equation (9a). The potential difference at the gas-inlet-oil-outlet depends on the application of the distribution law, and may be found from the following equation

$$G - g_o = G - R\left\{\frac{R_1}{Rn_1 + R_1n}\right\}\left\{(n - E_cR)\,g_1 + E_cG)\right\}$$

in which

R = the ratio between the quantity of C_4H_4S per hundred cubic feet of gas and the quantity of C_4H_4S per Imperial gallon of oil at equilibrium.

R_1 = the same ratio for C_4H_4S and benzol.

n = the number of gallons of oil per hundred cubic feet of gas.

n_1 = the number of gallons of benzol per hundred cubic feet of gas.

It may be well to record here under the definitions of the above symbols that the quantity of sulphur as C_4H_4S in one gallon of the oil which opposes 100 cubic feet of gas will in future be termed g_2 and may be found from the equation,—

$$g_2 = \frac{R_1}{Rn_1 + R_1n}\,(ng_1 + G - g)$$

Application of Theory

There are a number of reasons for believing that the average results of the operation of the oil scrubbers will agree more closely with theoretical predictions than will the results of individual tests covering periods of hours.

To begin with, a number of the variables of operation are not under the control of the operator and others are but nominally so. Equations (5), (6), (7a) and (7b) together with equation (1) show that the quantity of sulphur transferred from one hundred cubic feet of gas to the oil in one minute is dependent on eleven different things, Q, K, V, E_a or E_c, P, m_o, T, D_o, n, G and g_1. In addition, the accompanying absorption of benzol adds another variable. At Halifax, Q is under no control; V and D_o may be considered as constants since the selection of the equipment and the oil; K is dependent on E_a or E_c; T controls P and influences K but is very hard to control itself; G is under no control; n cannot be kept constant because of the uncontrollable variations in Q; g_1 is determined by the treatment given to the oil between trips through the scrubbers; and m_o suffers changes the nature and extent of which are not known. Q varies in cycles covering three or four hours, depending upon the rate at which gas is being delivered from retorts, from a maximum just after a series of retorts has been freshly charged to a minimum when the next series is emptied. It also varies with the number of retorts charged per hour, etc. T varies with atmospheric conditions as the scrubbers are out of doors, from a low point in the early morning to a high point in the afternoon, the limiting temperatures depending upon the time of year. n is a composite rate found by dividing N Imperial gallons of oil per minute by Q hundreds of cubic feet of gas per minute. N can be kept constant by the use of the control valves, therefore n must vary inversely as Q. G varies from minute to minute and hour to hour with the conditions in the retorts in much the same way as Q.

Referees' sulphur tests which have been used almost exclusively for determining the concentration in the inlet and outlet gases give results which probably have errors of plus or minus 0.5 grains per hundred cubic feet.

Having in mind the information contained in the last two paragraphs it is suggested that actual average results which differ from the theoretical are to be expected and that differences as high as 15 to 20 per cent will not prove that the theory does not hold or needs a correction factor.

One way in which the application of the theory can be disproved is to show that the sulphur transferred from the gas to the oil does not retain the form it possessed in the gas. This will probably require a method combining physics and chemistry and exceptional accuracy of execution, for the change in the concentration of the sulphur in the oil while it passes through the scrubbers has been shown to be very small. The difficulty of locating less than 30 grains of CS_2 or C_4H_4S in 62,000 is not insurmountable, but it requires most careful work.

The best argument in favour of the theory is the way in which it can be used to interpret the results of operation.

The log sheet[16] for scrubbing units for the month of March 1924 indicates that on the eighth a change was made in the operation of the apparatus for treating the wash-oil between trips through the scrubbers which increased the production of benzol by about 30 gallons per day. From experience, it is known that such a change does not reach its full effect on the quantities of sulphur left in the treated oil until it has been maintained for several days and the oil has passed through the system several times. For this reason the oil which passed through the system on the tenth would be very similar to that which was in use previous to the ninth. Examining now the results of the parallel tests for total sulphur which were run on the gas at the inlets of scrubbers Nos. 1 and 2 it is seen that the first shows that the gas picked up 0.8 grains. The following tests show that as the benzol decreased due to troubles in the oil-heating column the efficiency "B" of number one scrubber decreased. This progression tends to prove that there is a relation between the quantity of benzol produced and the condition of the treated oil and between the benzol produced and the quantity of sulphur transferred from the gas to the oil.

Referring again to the tenth of the month, it is seen that the efficiency "B" of scrubber one is minus 2.5 per cent while the overall efficiency of the three scrubbers is plus 5.0 per cent, and the total fixed sulphur in the entering gas is 32.3 grains per 100 cubic feet. Such results would be expected if E_a equals 0.95, E_c equals 0.998 and an oil of molecular weight 300 containing 7 grains of sulphur in the form of CS_2 and 18 grains in the form of C_4H_4S is being used at the rate of 1.1 Imperial gallons per 100 cubic feet of gas to wash gas in which 5/6 of the surplus occurs as CS_2 and 1/6 as C_4H_4S when the temperature of both gas and oil is 50°F. and benzol is being simultaneously absorbed at the rate of 0.010 Imperial gallons per 100 cubic feet of gas. If the equations given in the theoretical discussion are properly applied to the foregoing data it will be found that for a gas originally containing 30 grains of fixed sulphur the efficiency of reduction for the first scrubber will be minus 2.7 per cent[17] and the overall efficiency 4.7 per cent. Such calculations and in addition those for a 60-grain gas were fully worked out for the original copy of these notes but must be left out here in order to keep this paper within reasonable bounds. Furthermore, sufficient values of E_b were calculated to permit the plotting of the lower curve in figure No. 12. About it are plotted the results, expressed as efficiencies "B," of the tests for total sulphur, made on the gas at the inlet and outlet of the series of scrubbers up to and including the first test on the tenth. It is notable that only one point is much above this line. For this one departure there is a reason, the addition of 400 gallons of new oil with consequent dilution of the volatile sulphur compounds in the wash oil on the same day.

The results of the examination of the empirical data according to theory coupled with the recorded results of operation as discussed in the last paragraph indicate rather definitely that for purposes such as this the sulphur in the gas must be considered to exist in at least two forms. It would be difficult to explain reasonably the negative transfer in scrubber one if the sulphur were considered to exist as CS_2 only.

The efficiencies of the scrubbers after the change in the operation of the heating column on the ninth are in general higher. To indicate, in a comparative manner at least, just how much the change affected the quantity of sulphur in the oil a second curve is shown in figure No. 12, which was located by the same method as the first after changing the quantity of benzol produced to 0.015 Imperial gallons, the quantity of thiophene sulphur in the wash oil to 10 grains and the quantity of carbon bisulphide sulphur to 4 grains. It passes through the points indicating the efficiencies shown by the individual tests made after the tenth. In many cases these efficiencies are not to be considered correct in themselves. They have been found, (or estimated), by using a value for the sulphur in the inlet gas, which was not obtained by test, but was assumed because it appears to fit in with the tests made on the gas at other points in the scrubbers coupled with the results of tests for sulphur made on the gas in the street mains. Where the quantity of sulphur in the inlet gas was falling over a period of days such efficiencies are

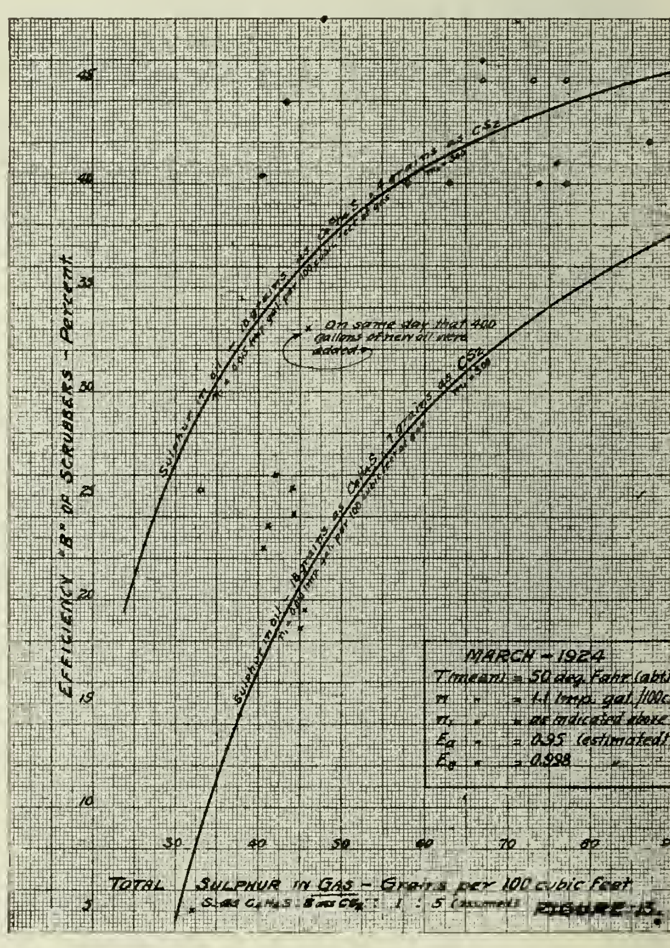

Figure No. 12.

(16) See table No. 4.

(17) In establishing this value it was assumed that E_c equals 0.90 because those factors which act to increase the positive transfer are then in the opposite direction.

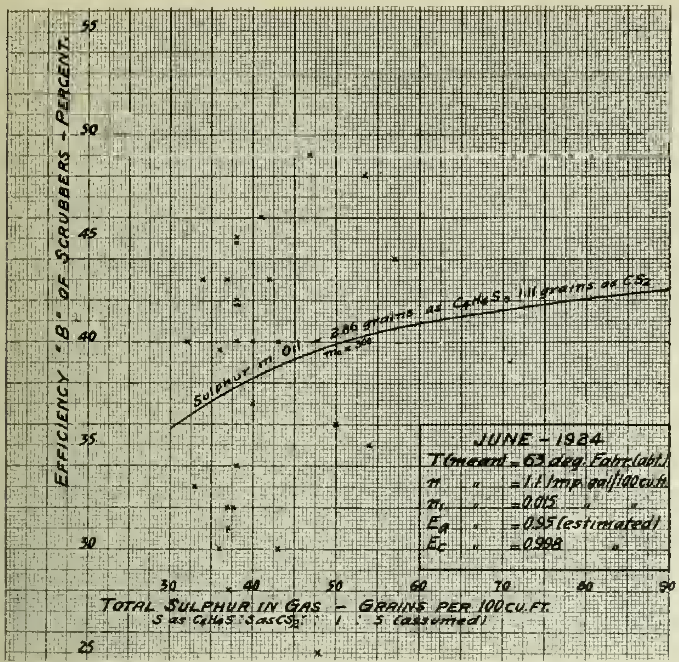

Figure No. 13.

probably low; where the quantity of sulphur in the inlet gas was rising over a period of days they are probably high, other things being equal.

The sulphur data on the curves indicate the extent of the reduction in the sulphur content of the treated oil which was accomplished by the unrecorded change in the operation of the heating column which resulted in the increased production of benzol. A reduction would be expected. The similarity between the properties of benzol and thiophene shows that it is scarcely possible to remove one from the oil without the other, and the comparison of the vapour pressure curves, (figure No. 6), indicates that the benzol will be completely removed before the thiophene, while the CS_2 will precede the benzol.

Considering the manner in which some of the efficiencies "*B*" were found, together with the number and variety of the notations under the heading "Remarks," it was felt that this study of the month's operation did little more than point to the heating column as a place where investigation might bring results.

Following this lead, during the months of April, May and June more attention was given to the treatment of the oil between trips through the scrubbers. The consequence was very pleasing when examined in the light of the previous inference that the mean results of the operation of the scrubbers will approximate more closely those predicted by the projected theory than any particular test. In figure No. 13 the daily values of efficiency "*B*" for the month of June are plotted against the corresponding quantities of sulphur in the inlet gas. The curve, which passes through the points, indicates in a general way average efficiency "*B*" for the month. (It might be argued that the curve could have many directions and still represent the average E_b, but laboratory accuracy was impossible and what has been evolved was considered next best.)

The change in the sulphur content of the oil indicated by the difference between the 18 grains as C_4H_4S and the 7 grains as CS_2 on the lower curve in figure No. 12 and the 2.86 grains as C_4H_4S and the 1.11 grains as CS_2 on the curve in figure No. 13 represents the result of maintaining a fairly close watch on the temperature at the vapour outlet of the heating column and of gradually reducing the rate at which the foul oil was permitted to enter the column.

The study of the relation of the efficiency "*B*" of the scrubbers to the operation of the heating column is summed up in figure No. 14, which shows graphically how the rate of flow of oil through the heating column influences the sulphur content of the oil, the quantity of benzol removed from the gas and the efficiency "*B*" of the scrubbers. It is important to remember the temperatures and rates in the upper part of the figure when studying the curves; also, that only the points where the "E_b" curve and the "benzol produced" curve cross the 175 Imperial gallons per hour ordinate have been fixed by actual mean results of operation. With the exception of these points, all the curves are perhaps more diagrammatic than correct. It was not found possible to keep everything else constant while the rate of flow of oil through the heating column was varied; therefore, the curves are built up from a mixture of data, experience and assumptions based on a theory which has not been proven to apply exactly but which has been very useful in explaining and directing.

In connection with the operation of the heating column there are two things to be considered, the removal of the sulphur from the oil and the production of a benzol product ready for immediate sale. A rate of flow of the oil through the heating column of 175 Imperial gallons per hour or less coupled with a temperature between 202° and 204°F. at the vapour outlet seems to serve both purposes fairly well. The condition of the oil has been described. The resulting benzol product is almost water white and 90 per cent of it will distill over at 212°F. Higher temperatures give the benzol product a yellow tinge and more odour. Lower temperatures, like higher rates, leave more sulphur in the oil and decrease the quantity of benzol made. There are insufficient data, however, for a diagram like figure No. 14 with temperature at the vapour outlet as the base.

From what has been written, it has perhaps become apparent that other things being equal the quantity of benzol produced is a rough indication of the efficiency with which the column removes the sulphur from the oil.

Influence of Oil Rate in Scrubbers on E_b

The logsheet for March shows that the rate of flow was increased from 110 to 115 Imperial gallons per hour to 150 to 160 Imperial gallons per hour on the twenty-eighth of March. At the same time the rate of flow of oil through the heating column was decreased and an increased production of benzol was obtained. Allowing the changes a day to make itself felt. The following data are

	Inlet Sulphur	Outlet Sulphur	E_b Per cent
March 30	40.5	27.9	41.1
" 31	43.4	24.5	43.5
April 1	42.	20.	52.
	46.	22.	52.

worthy of note because they show a decided increase in efficiency "*B*" over what had occurred previously. It is unfortunate that the two changes in the operation of the system were made at the same time, because the one to which the change is due in whole or greater part cannot be distinguished.

As to continue the increased rate would necessitate making some permanent and expensive changes in piping, etc., it was abandoned on April 2nd in favour of the old rate of 110 to 115 Imperial gallons per hour, but the slower rate was maintained through the column. Immediately the efficiency "*B*" became lower. This indicates that decreasing the oil flow through the scrubbers did decrease the efficiency "*B*."

The comparison of the equation for sulphur as CS_2

$$(G - g) = n\, E_a \left(\frac{G}{R} - g_1\right)$$

with the equation for sulphur as C_4H_4S

$$(G - g) = E_c\, (G - R\, g_1)$$

shows that an increase in the quantity of oil can have no effect on the quantity of sulphur as C_4H_4S which is transferred, because *n*, the quantity of oil per 100 cubic feet of gas, does not appear in the second equation at all. Whatever increase in the efficiency "*B*" comes from the increase in oil must be due to the transfer of additional CS_2. Theoretically, when an oil which has a molecular weight of 300 is being used to remove sulphur from a gas containing 50 grains under the conditions described in figure No. 16, (except that *T* equals 53°F.), it is only necessary to increase the rate of flow of oil to about 2 Imperial gallons per 100 cubic feet of gas in order to attain the 75 per cent reduction of the original sulphur in the oil which Mr. E. L. Hall claims is possible.[18] At Halifax, this rate in the scrubbers would mean 210 gallons per hour through the heating column, which is somewhat too large for good operation, (see figure No. 14).

As has been mentioned before, there is no proof that a higher rate of oil will not be advantageous at Halifax from the standpoint of the reduction of the sulphur compounds. On the other hand, the evidence that it will has all been given in the few paragraphs immediately preceding. There is no data for a discussion on its economy.

Influence of Temperature on E_b

When the efficiencies "*B*," as shown by a number of parallel tests made on the inlet and outlet gases at the scrubbers during April 1924, are arranged according to the time of day during which they were made they appear as follows:—

	Day Per Cent	Night Per Cent
	43.7	42.2
	50.2	47.0
	35.7	39.3
	44.4	48.5
	42.5	47.1
	38.5	42.1
Average......	42.5	44.4

These show that the mean efficiency "*B*" at night is about 2 per cent better than the mean efficiency during the day under the conditions maintaining at that time. This is what might be expected. It could be predicted by the projected theory as it is known that the mean temperature in the scrubbers during the night at the time of year is 3° to 4° lower than during the day. According to the theory it should be about 2 per cent, and the mean value as found above is 1.9 per cent.

What Becomes of the CS_2 and C_4H_4S Which Is Driven from the Oil ?

In August 1924, when the gas at the inlet to the scrubbers contained about 25 grains sulphur and the mean reduction accomplished by the scrubbers was about 5 grains, benzol was being made at the rate of about 25 gallons per day. A sample of this benzol was analyzed for sulphur and found to contain 0.98 per cent by weight. Assuming that 280,000 cubic feet of gas were washed and that the benzol weighs 8.8 pounds per gallon the total quantity of sulphur given up to the oil by the gas is 280,000 ÷ 100 × 5 = 14,000 grains, and the quantity of sulphur contained by the benzol is 8.8 × 7,000 × 0.0098 × 25 = 15,000 grains. These figures are sufficiently close to show that the sulphur removed from the gas will be found in the benzol under ordinary conditions.

Effect of the Process on the Heating Value of the Gas

On several days in January 1924, tests were made to determine the effect of the process on the heating value of the gas. As only one calorimeter, (Junkers type, manufactured by the McDonald Meter Company), was available, parallel tests could not be run. Two meters were employed, one connected to the test pipe leading to the gas main at the inlet to the scrubbers and one to the test pipe leading to the gas main at the outlet of the scrubbers. The procedure was to keep a meker burner going full blast at outlet of the free meter while the gas passing through the other was being tested. Tests were run alternately, first on the inlet gas and then on the outlet gas, with the following results:—

Average B.T.U.'s per Cubic Foot.

	Inlet	Outlet	Loss	Number of Tests
January 15	500	462	38	10
" 16	528	492	36	10
" 17	536	506	30	10
" 18	523	492	31	7

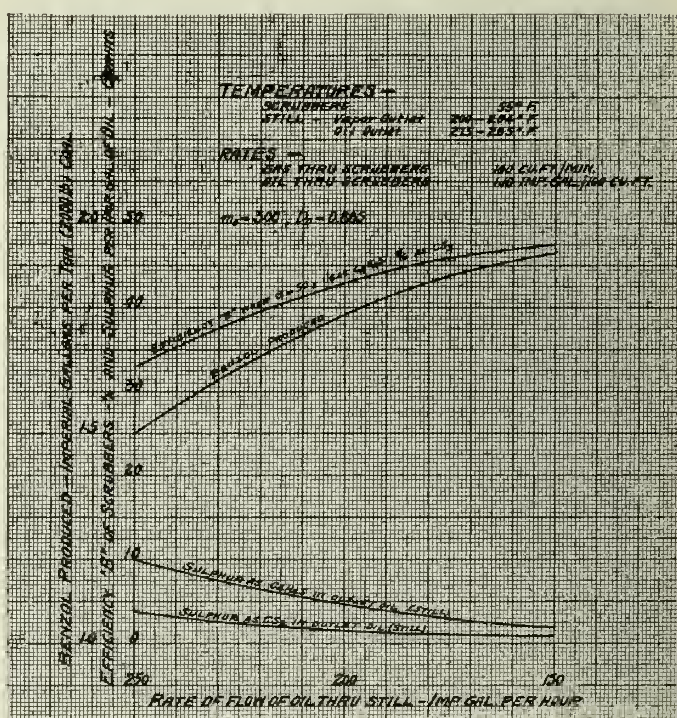

Figure No. 14.

(18) Proc., Amer. Gas Assoc., 1923, p. 1198.

Cost of the Process per Thousand Cubic Feet of Gas Washed

The cost of the operation of this system for a year may be seen from the following figures, which are based on the best average conditions obtained during the experimenting of 1924:—

	Total
Supervision, laboratory, etc.	$ 250.00
Labour, 730 hours at 40 cents	292.00
Steam, 3,504 M. lbs. at 60 cents	2,102.40
Water, 4,015 M. gals. at 12 cents	481.80
Oil, 2,000 gals. at 22 cents	440.00
Electric power, 12,000 kw. hr. at 1.5 cents	180.00
Repairs	50.00
Total operating cost per year	$3,796.20
Benzol credit, 10,950 gals. at 20 cents	2,190.00
Net operating cost	$1,606.20

On the assumption that the whole of the gas made during 1924, 96,000,000 cubic feet was washed, the costs per thousand cubic feet will be:—

Total operating cost	3.95 cents
Net operating cost	1.66 cents

Tests Used

For finding the quantity of sulphur carried by the gas the Referees' apparatus and the gravimetric method described in the Gas Chemists' Handbook of the American Gas Association was used throughout.

For finding the quantity of sulphur carried by the oil various methods were tried, with all of which it was extremely difficult to obtain check analyses on the same sample. Aspirating the products of combustion from a mixture of oil and benzol burned at a miniature burner, which admitted air under a slight pressure to the centre of the flame, through a 10 per cent solution of $NaOH$ with the subsequent gravimetric determination of sulphur as $BaSO_4$ was just as successful as the Parr sulphur bomb method. Neither gave checks which were within the limits of the change in the sulphur content of the oil due to the addition of sulphur from the gas. The oxygen bomb method employing a bomb having a capacity of 300 cubic centimetres and oxygen at 40 atmospheres was not available.

Conclusion

The records of the operation of the oil scrubbing equipment at Halifax show definitely that it removes carbon-sulphur compounds from the gas and that the efficiency of removal (E) fluctuates widely.

The reason for the fluctuating efficiency is obscured in the number of the variables which influence the transfer of sulphur from the gas to the oil, but it is thought that further investigation of the operation of the heating column, with the end in view of obtaining greater uniformity in the rate of flow of the oil through it and more uniform temperature conditions, will bring improvement. This study may indicate that its design should be changed or that it is too small.

The records also show that, for the rates of flow of oil used in scrubbers, the greatest transfer of sulphur always occurs in scrubber No. 3 and the least in scrubber No. 1, and that the gas on leaving scrubber No. 1 may contain more sulphur than when it entered, at times when the temperature conditions through the scrubbers cannot be blamed. The explanation lies in the existence of at least two volatile sulphur compounds in the gas which are soluble in the oil.

In general, the quantity of sulphur in the gas at the outlet of the scrubbers can be kept below the standard of 35 grains per hundred cubic feet, when the quantity of sulphur in the gas making coal is less than 1.5 per cent, if the mean temperature of the gas and the oil in the scrubbers is below 60°F., the mean rate of flow of the oil through the scrubbers is about 1.10 Imperial gallons per hundred cubic feet of gas, the mean temperatures of the heating column are 202°-204°F. at the vapour outlet and 275°-285°F. at the oil outlet, and the mean rate of flow of oil through the heating column is not greater than 175 Imperial gallons per hour.

Because higher gas velocities tend to produce greater efficiencies of transfer, it is probable that the scrubbing units will maintain a high efficiency of transfer on daily outputs up to 400,000 cubic feet per day. On the outputs higher than this their efficiency may be limited by the area of the packing.

The described theory, which has been very useful in predicting and explaining the occurrences in the scrubbing units and thereby of great assistance in the development of the process in use at Halifax, has been built on the mathematical treatment of absorption processes, advocated by Professor W. K. Lewis[19] and Professor W. G. Whitman,[20] in conjunction with the elementary laws of physical chemistry. This theory has not been proven to apply with the accuracy demanded by a chemist, but from the standpoint of the mechanical engineer its application is good. It explains the fluctuation of the efficiency (E_b) of the removal of the sulphur from the gas, the comparatively very large transfer of sulphur which occurs in scrubber No. 3, and the occasional negative transfers occurring in scrubber No. 1.

It has served to establish that in connection with the transfer of sulphur from the gas to the oil the sulphur must be considered as existing in at least two forms which for convenience and with reason have been considered as CS_2 and C_4H_4S; and that the efficiency of transfer, as defined, is the real measure of the efficiency of the scrubbing units; and that the efficiency of transfer is uniformly high, probably well over 90 per cent under ordinary conditions of operation; and that the solutions of the sulphur compounds in both the gas and the oil obey closely, if not exactly, the elementary laws for dilute solutions. By means of it, equations have been derived which can be used to predict what the performance of the process will be under given conditions.

Unless the values of R which have been used for both CS_2 and C_4H_4S are proven to be so much too high that values less than 0.80 can be assumed for the efficiencies of transfer, (E_a and E_c), it is probably apparent that there is nothing to be gained from recirculating the oil in any one or all the scrubbers.

The development of methods for the accurate and rapid determination of the small quantities of sulphur as CS_2 encountered in the gas, and the smaller quantities of sulphur which, as this study seems to prove, are carried by the oil from the heating column, appears to be a necessity before E_a, E_c, R and K can be evaluated, or much further progress can be made in building up a complete set of rules for the operation of the system at Halifax, and in finding the degree of accuracy with which the projected theory applies.

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[19] Proc., Amer. Gas. Assoc., 1923, p. 1143.

[20] Ind. and Eng. Chem., vol. 14, p. 186.

Table No. 1—Inclined Slot Retorts, Halifax, N.S.

Date	Kind of Coal	Purchased from	Sulphur in Coal per cent	Sulphur (Organic) in Purified Gas Grains per 100 cu. ft.
1919		Dominion		
July 24	No. 12 gas nut	Coal Co.	2.7	79
“ 25	“	“	2.6	85
“ 26	“	“	2.6	74
“ 27	“	“	. .	85
“ 28	“	“	2.6	79
“ 29	“	“	2.5	62
“ 30	“	“	2.1	73
“ 31	“	“	2.1	76
Feb. 1	“	“	2.3	71
“ 2	“	“	2.1	70
“ 3	“	“	2.1	68
“ 4	“	“	2.2	69
			Av. 2.33	74
1925				
Jan. 23	Princess run of mine	British Empire Steel Corp.		38
“ 26	“	“	....	36
“ 27	“	“	....	34
“ 28	“	“	....	33
“ 29	“	“	....	36
“ 30	“	“	....	33
“ 31	“	“	....	36
Feb. 1	“	“	....	38
“ 2	“	“	....	37
“ 3	“	“	....	33
“ 5	“	“	....	38
“ 6	“	“	....	36
“ 7	“	“	....	35
“ 8	“	“	....	34
			Av. 1.35	35.5
1926		British Empire		
Dec. 22	Princess nut	Steel Corp.	....	73
“ 23	“	“	....	72
“ 24	“	“	....	69
“ 25	“	“	....	83
“ 26	“	“	....	71
“ 27	“	“	....	74
“ 28	“	“	....	83
“ 29	“	“	....	85
			Av. 2.26	76
1927				
Jan. 11	Elkhorn coal	Nav. Coal. Co.	....	50
“ 12	“	“	....	50
“ 13	“	“	....	45
“ 14	“	“	....	46
“ 15	“	“	....	51
“ 16	“	“	....	48
“ 17	“	“	....	45
“ 18	“	“	....	47
“ 19	“	“	....	47
“ 20	“	“	....	51
“ 21	“	“	....	50
“ 22	“	“	....	51
“ 23	“	“	....	61
“ 29	“	“	....	50
“ 30	“	“	....	48
“ 31	“	“	....	52
			Av. 1.73	50
	Lorado	J. P. Routh		
June 16	4″ resultant	& Co.	....	22
“ 17	“	“	....	23
“ 18	“	“	....	19
“ 19	“	“	....	20
“ 20	“	“	....	19
“ 21	“	“	....	23
“ 22	“	“	....	19
“ 23	“	“	....	21
“ 24	“	“	....	20
“ 27	“	“	....	24
“ 28	“	“	....	22
“ 29	“	“	....	19
“ 30	“	“	....	22
July 2	“	“	....	17
“ 3	“	“	....	20
“ 4	“	“	....	16
			Av. 0.90	20.4

Table No. 2—Horizontal Retorts.

Date	Kind of Coal	Purchased from	Sulphur in Coal per cent	Sulphur (Organic) in Purified Gas Grains per 100 cu. ft.
1926		British Empire		
Oct. 9	Princess slack	Steel Corp.	....	34
“ 10	“	“	....	35
“ 11	“	“	....	34
			Av. 1.56	34
1927		British Empire		
May 11	Princess slack	Steel Corp.	....	53
“ 12	“	“	....	44
“ 13	“	“	....	44
			Av. 1.95	47

Table No. 3.—Continuous Vertical Retorts.

Date	Kind of Coal	Purchased from	Sulphur in Coal per cent	Sulphur (Organic) in Purified Gas Grains per 100 cu. ft.
1927		British Empire		
Mar. 15	Princess nut	Steel Corp.	....	29
“ 17	“	“	....	32
“ 19	“	“	....	31
“ 20	“	“	....	29
“ 21	“	“	....	29
“ 22	“	“	....	29
“ 23	“	“	....	31
“ 24	“	“	....	27
“ 25	“	“	....	25
“ 26	“	“	....	29
“ 27	“	“	....	28
			Av. 1.97	29
	Gas Works—Stamford, U.S.A.			
1927				
Apr. 28	American coal	....	....	9.8
May 3	“	....	0.66	....
“ 10	“	....	0.69	10.7
			Av. 0.675	10.3

Table No. 4—Log Sheet of Scrubbing Units—March, 1924

Day	Total Sulphur					Total Reduction	Benzol Made	Heat Value City Gas	Remarks
	In 1	In 2	In 3	Out 3	City Gas				
	Grains per 100 cu. ft.					per cent.	Imp. gal.	B.T.U. cu. ft.	
1	40.8	....	....	31.1	29.3	23.6	11	529	110–115 gal. per hr. in. No. 3 scrubber.
2	....	....	....	....	34.4	...	13	503	
3	40.4	....	....	31.3	39.4	22.5	12	502	
4	44.8	....	....	33.4	34.0	25.4	12	495	
5	40.2	....	....	30.5	32.2	24.1	11	470	
6	46.0	....	....	30.9	31.3	33.0	11	463	400 gal. new oil today.
7	44.7	....	....	36.4	33.5	18.6	11	465	
8	45.5	....	....	36.6	....	19.5	22	474	Cut in No. 3 cooling coil—10.30 a.m.
9	....	....	....	....	31.6	....	45	473	Continuous operation from 8 a.m. today.
10	32.3	33.1	....	....	30.7	† 5	47	476	99 gal. per hr. No. 3 scrubber.
	32.6	33.2	....	....	....	....	....	....	
11	33.2	31.9	....	....	24.8	†25	38	471	114 gal. per hr. No. 3 scrubber.
	25.4	27.4	....	....	....	....	....	....	Trouble with heating column in a.m.
12	....	....	....	....	23.9	....	28	475	Temp. top of column, 183° F.
	28.9	28.1	....	....	....	....	....	....	
13	*49	43.7	35.5	....	20.3	†38	50	461	Temp. top of column, 192° F.
	....	41.2	34.4	....	....	....	....	....	
14	*48	42.6	37.9	....	25.1	†48	53	456	Temp. top of column, 192°–202° F.
15	....	....	47.1	....	27.0	....	48	471	Started insulating column.
16	....	....	....	....	35.1	....	50	457	
17	*63	55.0	43.5	....	38.3	†40	40	471	
	....	49.9	46.7	....	....	....	....	....	
18	58	51.5	45.9	35.9	....	40	30	462	
19	*67	59.7	48.0	....	37.2	†45	45	468	Changed orifices Nos. 2 and 3 scrub. (2½ hr.)
20	*73	63.4	45.1	....	39.8	†45	50	469	400 gal. fresh oil: Fin. insulating.
	*67	57.4	52.0	35.9	....	†46	....	....	
21	*85	71.6	57.5	....	37.2	†56	40	473	
	*87	73.7	66.3	50.2	....	†42	....	....	
22	*83	70.7	59.3	....	42.3	†49	45	483	
	*77	66.4	57.9	42.4	....	†45	....	....	
23	....	66.8	52.5	....	....	....	40	492	Poor distillation and circulation.
24	*77	66.7	....	....	45.8	†40	20	484	
	*74	64.1	50.5	43.9	....	†40	....	....	
25	*76	65.1	49.2	....	44.7	†41	33	474	Poor control of flow of oil through heating column.
	72.7	63.7	....	46.4	....	36.2	....	....	
26	72.9	63.8	....	....	45.6	†37	41	477	
27	69.3	57.8	....	....	43.9	†37	55	470	Better conditions at heating column.
28	61.8	52.9	....	....	43.4	†30	100	471	Increased flow of oil through scrubbers to 150–160 gal. per hr. and reduced rate of flow of oil through heating column by an unknown amount.
29	52.4	48.2	....	....	40.0	†24	90	454	
	60.5	60.1	....	42.3	....	29.4	....	....	
30	40.5	39.9	....	....	27.9	†41.1	65	457	
31	43.4	38.2	....	....	24.5	†43.6	50	471	
Apr. 1	42	37	....	20	....	52	50	477	
Apr. 1	46	43	....	....	22	†52	....	....	Decreased flow in scrubbers to 115 gal. per hr. Apr. 2.

*Estimated values.

†Percentages not found by parallel tests at inlet and outlet of scrubbers.

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Western General Professional Meeting

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The Work of the British Aeronautical Research Committee

The rush of modern business does not usually allow an engineer sufficient leisure to enable him to follow the activities in specialized branches of the profession other than his own. For this reason, few engineers, not directly connected with aeronautics, have followed the excellent work being done under the guidance of the Aeronautical Research Committee in England and similarly under the National Advisory Committee for Aeronautics in the United States of America.

In 1909, the British Government appointed an Advisory Committee for Aeronautics " for general advice on the scientific problems . . . in aerial navigation," and organized a branch of the National Physical Laboratory for the purpose of investigating aeronautical problems.

About this time an explanation of the duties of the committee given in the House of Commons stated " it is no part of the duty of the Advisory Committee for Aeronautics either to construct or to invent; its function is not to initiate, but to consider what is initiated elsewhere." The organization of this committee has passed through a number of changes, but its functions to-day under the name of the Aeronautical Research Committee are substantially the same as when it was originally formed.

The main committee deals with such a wide range of highly specialized subjects that it has become necessary to handle the details of the investigations through sub-committees, e.g., Accidents, Aerodynamics, Airships, Elasticity and Fatigue, Engines, Light Alloys, Seaplanes, etc.

These sub-committees in turn divide their work among panels. For instance, the Aerodynamics Sub-committee has panels for design, scale effect, stability and control and vortex investigations.

Funds are provided for the payment of fees and expenses of members of the committees and panels, and members are selected from the eminent men in the various subjects and from representatives of the various government departments concerned.

A great many of the wonderful advances that have been made, during recent years, in aeronautics, have been due to the fact that the government and the industry have had the valuable and considered opinion of a thoroughly reliable consultative body to aid its researches.

The effect of this has not been limited to aeronautics, but has extended into many other branches. For instance, the need for better aviation engines and the large amount of research carried out towards this end has led to great improvements in the general practice of internal combustion engineering, and similarly the need for new and reliable materials for aircraft construction has led to improvements in the metallurgy of light alloys for other purposes.

For these reasons, the annual technical reports of the committee since 1909 contain a wealth of valuable information upon many subjects. The annual report for the year 1925-26 is no exception. It is absolutely indispensable to the aeronautical engineer, and its perusal is recommended to all scientists and to any engineer who seeks up-to-date information.

Leaving aside for the present the subjects which have special application to aerodynamics only, it is interesting to see what items are dealt with in this volume that may be of interest to engineers in other branches. From the heading " Materials," the following items have been selected:—

(a) Report on the use of artificial sources of light as a substitute in the weathering of fabric.
(b) High frequency fatigue tests.
(c) The behaviour of single crystals of aluminum under static and repeated stresses.
(d) Some mechanical tests of cast bars of Alpax, (a commercial silicon-aluminum alloy with valuable properties.)
(e) Second report on study of mechanical properties of silicon-aluminum alloys.

Similarly, under the heading " Engines " we find amongst others:—

(a) Closed vessel explosions of mixtures of air and liquid fuel.
(b) Notes on detonation temperatures in closed vessel explosions.
(c) Reports on dopes and detonation.

An important conclusion has been reached that a sleeve valve engine offers great possibilities for aircraft purposes, due to the fact that the absence of the hot exhaust valves reduces the tendency to detonation and allows the use of a higher compression than a poppet valve engine of the same size.

It will at once be appreciated that these articles are of considerable interest and value to engineers in many other branches.

Research in aeronautics has provided a sound footing upon which the development of new ideas can proceed, and this result has been shown during the year of the report under review in a remarkable degree.

The autogyro, which was invented by a Spaniard, Senor De La Cierva, was the subject of a good deal of research both in the form of models and full scale aircraft. The theory of the autogyro was developed by a member of the staff of the Royal Aircraft Establishment, and, from the information so obtained, improved autogyros have been constructed for test purposes.

A novel experiment carried out under the guidance of the Aeronautical Research Committee was that of the Hill tailless light aeroplane, which was designed by Captain G. T. R. Hill as an independent research worker, aided by grants from the committee. Full scale experiments show that this type of aeroplane possesses several inherent advantages, and that its performance is not inferior to the normal type of aeroplane. The construction of a larger experimental aircraft of this type has been recommended.

Since the beginning of aviation there have been numberless accidents due to the fact that when an aircraft reached a stalled position, due to loss of forward speed, it also became uncontrollable, with the result that if there was insufficient height for the aeroplane to regain flying speed during its uncontrolled dive following the stall, an accident occurred.

The subject of control when the aeroplane is in a stalled position has become one of the utmost importance, and has occupied the attention of the Aeronautical Research Committee during a number of years.

In the report mentioned, a good deal of attention has been given to the use of combined aileron and leading edge slots invented by Mr. Handley Page, the well-known aircraft designer. This device is now being developed under the Aeronautical Research Committee, and it has great possibilities towards overcoming the defects of control under stalled conditions. As a result of these tests, a number of aircraft for general service are now being fitted with controls of this type.

During the past eighteen years a number of aeronautical laboratories have been equipped with wind tunnels, and these have naturally varied considerably in design and method of operation, with the result that it has now become necessary to investigate the standardization of the results obtained from the different wind tunnels. A series of standard models have been constructed and circulated to the different aeronautical laboratories for test, and the results so obtained are all being compared with a view to obtaining a proper basis for comparison between the different laboratories. This work naturally takes a considerable amount of time, and results obtained on the standard models at the National Physical Laboratory and at the Royal Aircraft Establishment in England are given in the report. The variation in the results obtained between these two establishments is itself sufficient to indicate the necessity for these comparisons, and the results obtained by the other laboratories will be awaited with considerable interest.

With the proposed construction of an airship mooring mast in Canada, attention will be directed to the reports upon airship accidents when at the mast, and the investigations upon the wind forces likely to come upon an airship under these conditions.

Close connection with the work of the Aeronautical Research Committee has resulted in a high scientific standard in the aeronautical engineering profession, and it is considered that too much credit cannot be given to the far-sighted governmental policy which provided for the inauguration and continuation of the work of this committee.

Meeting of Council

Meeting of March 13th, 1928

A meeting of Council was held at 8 o'clock p.m. on Tuesday, March 13th, 1928. Vice-President J. H. Hunter, M.E.I.C., in the Chair and nine other members of Council being present.

A resolution passed at the Annual General Meeting requesting further support from the National Research Council in connection with the investigations on the deterioration of concrete in alkali soils was considered, and the Secretary directed to transmit it to the National Research Council with a request for favourable consideration.

The Secretary presented a brief report of his visit to the Maritime provinces, and submitted a number of suggestions made at the branch meetings attended there.

In this connection, it was decided that when members' fees are compounded the branches to which the members concerned are attached should receive a pro rata payment annually from the interest on the money invested, the payments to be transferred should a member move, and to terminate on his death.

In view of the suggestion made by the Halifax Branch that the further publication of Transactions should not be undertaken unless on the general desire of the membership, it was decided to suspend the publication of Transactions until the matter has been fully discussed and considered at the Plenary Meeting of Council to be held this year.

The Budget for 1928 was considered and approved.

An opinion from the Council's legal adviser was presented, advising that in connection with proposals for the amendment, repeal or introduction of By-laws, it is proper for the Council of The Institute, or a body of twenty or more corporate members, to withdraw a proposal after discussion at the Annual Meeting, provided that no amendment thereto has been made by the Annual Meeting.

Having regard to this opinion, and in view of the suggestions at the Annual General Meeting and elsewhere regarding Council's proposal for the amendment of Section 35 of the By-laws referring to the proposed increase in Members' fees, it was unanimously resolved that Council's proposal for the amendment of this Section be withdrawn and not sent out to ballot.

Consideration was given to the operation of the new prize scheme and the financial arrangements necessary to put this into effect.

The chairmen of the following committees were appointed, with a request that they submit suggestions for the membership of their committees as soon as possible:—

Gzowski Medal Committee.
Leonard Medal Committee.
Plummer Medal Committee.
Engineering Education.

The following committees were reappointed with the same membership as last year, except as noted:—

Board of Examiners and Education.

Canadian National Committee of the International Electrotechnical Commission,—The name of B. S. McKenzie, M.E.I.C., was added to this committee and that of H. A. Dupre, M.E.I.C., omitted.

Committee on International Co-operation.

Honour Roll and War Trophies,—The name of Brig.-General G. E. McCuaig, A.M.E.I.C., added.

Committee on the Deterioration of Concrete in Alkali Soils.

Committee on Biographies,—Professor P. Gillespie, M.E.I.C., having resigned from the chairmanship of this Committee, it was decided to request

J. M. R. Fairbairn, M.E.I.C., to accept this office, Professor Gillespie being retained as a member of the Committee.

Two reinstatements were effected and four resignations accepted.

The following elections and transfers were effected:—

Elections.

Associate Members	2
Juniors	5
Students	14
Affiliates	3

Transfers.

Associate Members to Member	1
Junior to Associate Member	1
Student to Associate Member	1
Student to Junior	4

Seventeen applications for admission and transfer were scrutinized and classified for the ballot returnable April 20th, 1928.

The Council rose at 11.45 o'clock p.m.

ELECTIONS AND TRANSFERS

At the Meeting of Council held on March 13th, the following elections and transfers were effected:—

Associate Members

ALLCHURCH, Harry, checking details, Montreal South Shore Bridge, with Dom. Bridge Co., Montreal.

KARN, Herbert Christopher, B.A.Sc., (Univ. of Toronto), elect'l, mech'l and general commercial engrg., engrg. dept., Can. Industries, Ltd., Montreal.

Juniors

ANDERSON, Viggo, B.Sc., (Royal Tech. College, Copenhagen), structural dftsman, Dom. Bridge Co., Montreal.

BECKER, Fred., B.A.Sc., (Univ. of Toronto), sales engr., C.G.E. Co., Winnipeg, Man.

DUBOIS, Marcel, M.Sc., (Mass. Institute of Technology), hydraulic dept., Dom. Engrg. Works, Montreal.

DUNLOP, Ronald William, B.A.Sc., (Univ. of Toronto), dftsman, Imp. Oil Refineries, Ltd., Calgary, Alta.

LAZENBY, Thomas William, ch. dftsman, E. Leonard & Sons, Ltd., London, Ont.

Affiliates

BANKS, Osborne Henry, teacher, London pub. schools, i/c constrn. work of 1st Signal Batt., London, Ont.

HURST, William, pres., Hurst Engrg. & Constrn. Co., Ltd., Winnipeg, Man.

SAUNDERS, Clare Britton, asst. city engr., Sault Ste. Marie, Ont.

Transferred from the class of Associate Member to that of Member

DEY, Victor Albert George, div. engr., C.P.R., Toronto terminals div., Toronto, Ont.

Transferred from the class of Junior to that of Associate Member

HOPPER, Garnet Henry, B.A.Sc., (Univ. of Toronto), heating engr., Taylor Forbes Co., Ltd., Toronto, Ont.

THOMPSON, Howard Grant, B.A.Sc., (Univ. of Toronto), dept. head on design, installation, service and sale of mechanical stokers, etc., with Affiliated Engrg. Co., Montreal.

Transferred from the class of Student to that of Associate Member

MORRISSETTE, Gordon Joseph, B.Sc., (McGill Univ.), mech. supt., Abitibi Power & Paper Co., Iroquois Falls, Ont.

Transferred from the class of Student to that of Junior

HINCHLIFFE, Joseph Edward, B.Sc., (McGill Univ.), dftsman with Can. Bridge Co., Walkerville, Ont.

LLOYD, David Stevenson, B.A.Sc., (Univ. of Toronto), welding engr. in engrg. service dept., Dom. Oxygen Co., Ltd., Toronto, Ont.

RIDDELL, William Forest, B.Sc., (Univ. of Man.), designing and estimating, Dom. Bridge Co., Winnipeg, Man.

ROWAT, G. H., B.A.Sc., (Univ. of Toronto), sales engr., Can. SKF Co., Toronto, Ont.

Recent Additions to the Library

Proceedings, Transactions, etc.

Presented by the Societies:

The American Society of Mechanical Engineers: Membership List, 1928.

The Society of Engineers: Transactions, 1927.

Reports, etc.

Department of Labour, Canada:

Annual Report, 1927.

Department of Trade and Commerce, Canada:

Bureau of Statistics: Summary of Trade of Canada.

Department of Mines, Ontario:

Bulletin 64, Preliminary Report on the Mineral Production of Ontario, 1927.

Ministry of Agriculture and Fisheries, Great Britain:

Report on an Investigation into the Desiccation of Sugar Beet and the Extraction of Sugar.

Air Survey Committee, Great Britain:

Prof. Paper 3, Simple Methods of Surveying from Air Photographs.

Department of Scientific and Industrial Research, Great Britain:

Advisory Council: Report of the Lubricants and Lubrication Inquiry Committee.

Engineering Research: Special Report 1. Properties of Materials at High Temperatures—I. Special Report 1. Properties of Materials at High Temperatures—II.

7th Interim Report of the Committee of the Institution of Civil Engineers: The Deterioration of Structures in Sea Water.

Department of Commerce, United States:

Bureau of Standards: Miscell. Publ. 79, Standards and Specifications in the Wood-Using Industries. Sci. Paper 567, Some Principles Governing the Choice and Utilization of Permanent Magnet Steels.

Bureau of Mines: Bulletin 277, Safety in Coal Mining, (Handbook). Tech. Paper 403, Hydraulic Classification.

The Association of Professional Engineers of Nova Scotia:

Syllabus of Requirements for Examinations for Registration.

Technical Books, etc.

Presented by D. Van Nostrand Company:

The World of Atoms, by Arthur Haas.

Presented by McGraw-Hill Book Company:

Pyrometry, by W. P. Wood and J. M. Cork.

Highway Materials, by E. E. Bauer.

The Western

General Professional Meeting

WILL BE HELD AT

VANCOUVER, B.C.

JUNE 7th, 8th, and 9th, 1928

Address of His Excellency Lord Willingdon

Delivered at the Annual Dinner of The Engineering Institute of Canada, at the Windsor Hotel, Montreal, February 15th, 1928

" Mr. President and Gentlemen:—

" May I thank you, sir, very sincerely for the kind expressions to which you have given voice in introducing my name to this distinguished gathering, a gathering which, I understand from you, represents an Institute of very large membership. I assure you, it was quite unnecessary to tell me that your members had a great feeling of loyalty to His Majesty the King and a great love for the British Empire. I feel, wherever I am in Canada, in whatever public gathering or assembly, that we are all fellow-citizens of the greatest Empire the world has ever known. But, gentlemen, I must admit to-night that I have discovered, during my short experience as Governor General of Canada, that I am often invited to these very pleasant and interesting gatherings of professional men in various parts of this country and that I am always expected to make a speech, and I always have the uncomfortable feeling when I rise to make that speech that my audience knows a great deal more of the subject about which I am supposed to speak than I can possibly know myself. That is my difficulty this evening.

" You gentlemen are all engineering experts. I really think that your profession is very disturbing to the peaceful life of the people of the world, from the fact that you are always introducing new appliances, new schemes and new inventions which are making life more rapid, more active and more hectic than it has ever been before. I look back,—yes, I am old enough to look back,—on those days, years ago, when the only form of conveyance, when you lived in the country, was a horse and carriage, and when anybody who lived more than twenty-five miles away from you could not possibly be called a near neighbour. Now, owing to your engineering science, there is no distance which can possibly prevent these neighbourly attentions; people rush at you in their Rolls Royces and their Ford cars; they descend upon you from the sky; you have but little chance for a peaceful moment in your family life.

" This state of things is very largely due to you and your confreres, but I do not think that I, individually, should put the entire blame upon the engineering profession for the many activities which I have had generally in my public life, during which I have been whirled about doing public service in all parts of the British Empire.

THE RT. HON. VISCOUNT WILLINGDON,
G.B.E., G.C.S.I., G.C.M.G., G.C.I.E., HON.M.E.I.C.,
GOVERNOR GENERAL OF CANADA.

" Gentlemen, may I now come to some slightly more serious matters? It has always seemed to me, in my life, that the engineers stand very much in the same position in relation to their country as a doctor to his patients, because in every country where the engineer's work is carried on you make that country more healthy, more prosperous, more happy and more liveable in every way. Think how water works and drainage systems in your great cities have made life much more healthy for the people who live in those cities. Consider your railways; I think it is perfectly true that if it had not been for these great railways which run from the eastern to the western limits of this great continent, there would have been very little chance of the successful issue of Confederation in this country, because the railways have brought the people of this country together in a way which would otherwise have been quite impossible. Consider your roads; consider those great harbours which have brought such prosperity to this country; consider your forests, for, after all, it is the engineers who have to develop those forests,—and perhaps I might just say here what has come into my mind, that when I was in the Presidency of Madras, India, and we were anxious to develop the great forests in that country, it was to Canada we had to come for a forest engineer and a lumbering engineer, who did great service for us in that far-distant part of the British Empire. Again, consider your mines, which are in only the first stages of development at the present time. It is the mining engineer who has developed the great prosperity of Canada in that particular respect.

" Then let us consider the electrical engineers, who, by their hydro-electric schemes and by their achievements in radio work, have made life for the people far more happy, far more cheery and far better in every way. That, I think, is very largely due to the engineering profession, and upon that I congratulate the engineering profession very warmly indeed.

"May I, for a moment, take you over to a country which I know very well, and one in which I lived for a good many years,—India. There, again,—and I speak rather from a more practical point of view with regard to India, because while I was there I was the executive head of the Public Works Department, and gratefully remember the wonderful services performed by the engineers in that Public Works Department in that particular province of Madras,—there, again, it was exactly the same thing; if you go to India, you will see a similar development of railways, harbours, roads and forests,—all accomplished by the engineering profession. But there is one matter in connection with India for which we all feel particularly grateful to the engineering profession,—and I am sure the Indian people feel this also,—and that is the matter of irrigation.

"You all know, of course, that India is a very dry country, with a very sparse rainfall, and that famine in the olden days took a tremendous toll of the population. I can assure you of this, that in all parts of that country now, through the skill of the engineers, literally millions of acres are now under control, through great irrigation schemes which have largely eliminated all of the troubles we formerly had in bringing down food supplies and resources to an area which was dried up owing to lack of rain.

"I have a very personal recollection with regard to my executive authority as head of the Public Works Department in the Madras Presidency. On more than one occasion when I went down to open a great water scheme, I really wore borrowed feathers, because I was always the fellow who was in the picture and had all the credit for what the engineers had done. I can remember on one particular occasion making a visit to an area at which there was a great irrigation scheme which it had taken five or six years to complete and which was to irrigate eight hundred thousand acres of land in a very dry area. All of the agricultural people in this area came to the particular rendezvous where the works were. They crowded in there by tens of thousands to see the 'Great Man,'—not the engineer,—pull the lever to lift up the shutter to let the stream of water flow down the canal, and when I did the necessary deed and pulled down the lever, the cries of all those tens of thousands of uneducated people went up,—not to Heaven,—but to Lord Willingdon, as being a sort of magician who had produced this amazing result of sending down the water which was to make them happy and safe from famine for all time. And I have a great feeling of gratitude to those engineers in Madras who accepted that situation with a smile, having themselves gone through all the wear and tear, and I can assure you that in that climate building a great irrigation dam is not a very comfortable thing. I hope you will be pleased to hear that we did recognize the excellent services these men had given us and gave them their proper reward.

"Now, gentlemen, I have but one more word to add, and it is this: Since I have lived in this country, I have had very many opportunities of observing and inspecting great engineering works which have been constructed and completed in this country, and I notice that many of them have been financed by, and much of the engineering work has been done by, those who have come from outside countries. This may be unavoidable in a young country such as this, but I sincerely hope that before many years have passed Canada will stand on her own feet, and that all of these vast engineering works, of whatever nature they may be, will be either financed by Canada or within the British Empire, and that the engineering profession of Canada may be given ample opportunity of developing all these great engineering works, in the best interests of their own people and of their own country and their own nation."

OBITUARIES

James White, M.E.I.C.

In the death of James White, M.E.I.C., which occurred at his home, 450 Wilbrod Street, Ottawa, Ont., on February 26th, 1928, Canada has lost a prominent government official and an outstanding public servant, and The Institute one who for many years took an active interest in its affairs. Although enjoying but indifferent health for some years past, he had continued active in his official duties almost to the last, and his death was sudden and unexpected.

The late Mr. White was born at Ingersoll, Ontario, on February 3rd, 1863. He received his early education at Atkin's Private School, Ingersoll, Ingersoll Public School and the Ingersoll Collegiate Institute, afterwards proceeding to the Royal Military College, Kingston, from which he graduated in 1883. In 1884 he joined the Geological Survey of Canada as assistant topographer, and in this capacity carried out surveys in the Rocky mountains and in various

JAMES WHITE, M.E.I.C.

sections of Ontario and Quebec. The ability and energy he displayed in this early work won him well-merited recognition, and in 1894 he was appointed geographer and chief draughtsman of the Geological Survey, a position he resigned in 1899 to become chief geographer of the Department of the Interior. In this capacity, he was actively identified with the work of the Alaskan Boundary Commission, and in 1906 conducted an investigation of rapid trans-Atlantic steamship service, (All-Red Line). In 1909, he was appointed secretary of the Commission of Conservation, of which body he later, in 1913, became assistant to the chairman and deputy head. While occupying this position, he was responsible for the publication, as reports of the Commission, of numerous works dealing with the natural resources of the Dominion. On the abolition of the Commission of Conservation, in 1922, he was appointed technical adviser to the Minister of Justice, a post that he held at the time of his death.

While serving in this capacity, he assisted counsel for the Dominion in the preparation of the British Case, and at the hearing of oral argument in 1925 before the British-American Pecuniary Claims Arbitrar Tribunal at Washington, D.C., in the claim presented by Great Britain on behalf of the Cayuga Nation of Indians against the United States Government. He was also entrusted with the preparation of the map evidence and other duties in connection with the Labrador boundary dispute between Canada and Newfoundland and assisted counsel at the hearing of this case before the Judicial Committee of His Majesty's Privy Council in London in 1926.

In addition to his departmental appointments, he had been since 1898 member of the Geographic Board of Canada and was elected chairman of that body in 1927. He had also served as chairman, since its inception in 1917, of the Advisory Board on Wild Life Protection, (Canada).

Mr. White's contributions to the technical literature of Canadian geography are many and important. He was the editor of the Canadian sections of numerous geographies and geographical works, particularly those published in Great Britain and the United States. He was responsible for the publication of an eight-sheet map of Canada, on a scale of 35 miles to one inch. He was the author of "Altitudes in Canada," (1901); "Dictionary of Altitudes in Canada," (1903); and of the revised editions of both these works, (1915-16); "Place-Names in Quebec," (1910); "Place-Names, Northern Canada," (1910); "Place-Names, Thousand Islands," (1910); "Boundaries and Treaties," (1913). He was also author of "Atlas of Canada," (1906), a work which he regarded as his most important technical contribution. This important work was revised in 1915 by J. E. Chalifour, his successor in the office of chief geographer, and secured jointly for its co-authors the Roquette gold medal of the Geographical Society of France.

A devoted and tireless worker, Mr. White was actively connected with numerous institutions, to the interests of which he devoted a great deal of his time. His first connection with The Institute was in the year 1888, when he was elected an Associate of the Canadian Society of Civil Engineers. The following year he was transferred to the grade of Associate Member, but in January 1891 resigned from the Society and was subsequently re-elected a Member on April 19th, 1906. He was made a Life Member on March 25th, 1925, and served on the Council during the years 1917 to 1919 inclusive. He was a Fellow of the Royal Geographical Society; Fellow of the Royal Society of Canada; and member Champlain Society. He served as vice-president, Sections C and E, of the British Association for the Advancement of Science in 1924, and was president, Section 4, of the Royal Society of Canada, 1924.

He was a member of the Royal Military College Club and of the Authors' Club, (London).

Mr. White's forty-four years of meritorious service with the Canadian government are an unbroken record of valuable and devoted work of a practical and scientific nature. His passing is a national loss.

Francis Ashley Hibbard, M.E.I.C.

The death of Francis Ashley Hibbard, M.E.I.C., which occurred at Sherbrooke, Que., on February 28th, 1928, has removed one whose associations with The Institute dates back to the year of the establishment of the Canadian Society of Civil Engineers.

The late Mr. Hibbard was born at Montreal, Que., on January 23rd, 1853. He commenced work at his chosen profession at an early age, when, in July 1871, he occupied the junior positions of chainman, rodman and draughtsman on the Northern Colonization Railway and later on the Montreal and City of Ottawa Junction Railway. In 1874 he was appointed to the position of assistant engineer on construction, Montreal, Portland and Boston Railway and the following year resident engineer in charge of grading of road from Stanbridge to Frelighsburg. The next year he was engaged as engineer-in-charge and transitman on surveys of the then proposed railway line from St. Jerome to Ste. Agathe, in the province of Quebec, making plans, profiles and estimates on this work. He returned to the Montreal, Portland and Boston Railway in 1877 as resident engineer and superintendent of construction. Upon completion of this work, he was engaged on many important works of railway construction and location, such as the Pontiac Pacific Railway system and the Montreal and Western Railway, now parts of the Canadian Pacific Railway system, also as chief engineer of the Chastiquay and Northern Railway, now part of the Canadian National Railways. In 1885, Mr. Hibbard was appointed locating engineer, and later engineer in charge of construction, of the

FRANCIS ASHLEY HIBBARD, M.E.I.C.

Alexandria bridge over the Ottawa river between Ottawa and Hull. Later he was offered and accepted several responsible positions on location and construction work for several lines in the United States, but returned to Canada to become assistant district engineer for the Northern Transcontinental Railway.

For several years failing health had compelled him to relinquish his active work, and he had resided during his retirement in Sherbrooke, Que.

Mr. Hibbard joined The Institute as a Member on June 13th, 1887, and was made a Life Member on September 27th, 1921.

Arthur Willard Wilbur, A.M.E.I.C.

Arthur Willard Wilbur, A.M.E.I.C., assistant engineer in the Saint John office of the Department of Public Works of Canada, died at the Saint John Infirmary on Thursday, February 23rd, 1928.

The late Mr. Wilbur was born at Dorchester, N.B., on March 5th, 1883, receiving his early education at the high school at Dorchester and in 1901 he entered the University of New Brunswick, graduating with the degree of B.A.I. in 1905. Shortly after graduation he became attached to the staff of the maintenance department of the Intercolonial Railway and in August of the same year he received the appointment of assistant engineer in the Department of Public Works of Canada with offices at Chatham, N.B. In 1921, when the Saint John and Chatham districts of the Public Works Department were combined, Mr. Wilbur was transferred to the headquarters in Saint John. His work with the department took him over the greater part of the province where his kindly and obliging disposition made for him many friends by whom he will be greatly missed.

Mr. Wilbur joined The Institute in 1921 when he was elected an Associate Member on March 22nd of that year. He was also a member of the Association of Professional Engineers of the Province of New Brunswick.

Gordon Wilson Brown, S.E.I.C.

Deep regret is expressed at the untimely death of Gordon Wilson Brown, S.E.I.C., which occurred at Peterborough, Ont., on February 28th, 1928, as a result of an electric shock received while engaged in the test department of the Canadian General Electric Company. At the time of his death he was taking the students' course with the company.

The late Mr. Brown was born at Falmouth, N.S., on November 15th, 1905, and completed his junior matriculation in 1922 and graduated from Nova Scotia Technical College with the degree of B.Sc. in 1927. During the summers of his university course he was engaged on surveying, first with the Highway Department of the province of Nova Scotia and later with the Avon River Power Company. After going to Peterborough he became interested in the activities of The Institute and was admitted as Student on January 20th of this year.

PERSONALS

G. C. Reid, A.M.E.I.C., of Halifax, N.S., is at present at The Pas, Man., in connection with the Flin Flon branch of the Canadian National Railways.

J. S. Bryant, S.E.I.C., is located at Aldermac, Que., with the Towagmac Exploration Company. Mr. Bryant graduated from McGill University with the degree of B.Sc. in 1927.

M. Nathanson, S.E.I.C., has been appointed junior engineer with the Radiore Company of Canada and is located at Rouyn, Que. Mr. Nathanson graduated from McGill University in 1926 with the degree of B.Sc.

Maurice Polet, A.M.E.I.C., has been appointed Consul for Belgium in Edmonton, Alta., with jurisdiction over the province of Alberta. Mr. Polet is a native of Belgium, and received his education at the University of Louvain.

M. J. Spratt, A.M.E.I.C., who until recently has been with the C. D. Howe and Company, Port Arthur, Ont., is now on the staff of the construction department of the Saskatchewan Pool Elevators, Limited, Regina, Sask. Mr. Spratt graduated from McGill University in 1922.

W. J. Bishop, A.M.E.I.C., is located at The Pas, Man., on Residency No. 3 of the Flin Flon branch of the Canadian National Railways. Mr. Bishop was for a number of years with the National Transcontinental Railway and later with the Temiskaming and Northern Ontario Railway.

D. C. Macpherson, S.E.I.C., has been transferred by the Dominion Bridge Company, Limited, from the new construction of the Chateau Laurier Hotel in Ottawa to the field staff of the company engaged on the Royal York Hotel in Toronto. Mr. Macpherson graduated from Queen's University with the degree of B.Sc. in 1924.

D. Newton Culver, S.E.I.C., who graduated from Queen's University last year, is with the Bell Telephone Company of Canada, transmission division of engineering department, at Montreal. Mr. Culver spent one summer of his university course with the Bell Telephone Company and the summers of 1925 and 1926 with the Hydro-Electric Power Commission of Ontario.

Lt.-Col. K. M. Perry, A.M.E.I.C., resigned from the permanent force of the Canadian Militia on January 1st, 1928, and has resumed engineering practice with headquarters in Montreal. Col. Perry is a graduate of McGill University, from which he received the degree of B.A. in 1906 and B.Sc. in electrical engineering in 1908. He was formerly G.S.O.1, Military District No. 4, at Montreal.

J. T. Watson, A.M.E.I.C., formerly chief engineer, light and power department, city of Lethbridge, Alta., is now with the East Kootenay Power Company at Coleman, Alta. Mr. Watson was appointed to the position which he has just left in 1916, prior to which he was for five years superintendent with the Western Electric Company, Red Deer, Alta.

Morley G. Taylor, S.E.I.C., of Parrsboro, N.S., is at present located at Maracaibo, Venezuela, with the Venezuela Power Company, Limited. Mr. Taylor graduated from Nova Scotia Technical College in 1927 with the degree of B.Sc. in electrical engineering. Following graduation, he was for a short time with the Nova Scotia Tramways and Power Company at Halifax, and was subsequently sent to Venezuela by the Montreal Engineering Company.

Ed. Hughes, A.M.E.I.C., has left the Granby Mining, Smelting and Power Company, Limited, and is resident engineer on Residency No. 5 of the Flin Flon branch of the Canadian National Railways, with headquarters at The Pas, Man. Mr. Hughes is a native of North Wales and received his engineering education at the University of Alberta. He has had extensive experience in railway location and construction work and on mine surveying in western Canada.

C. Arthur Scott, A.M.E.I.C., formerly assistant engineer, Department of Works, Toronto, Ont., has accepted an appointment with the special contract department of The Robert Simpson Company, Limited, Toronto. Mr. Scott graduated from the University of Toronto in 1909. During the summers of his university course he was engaged on various works with the roadway department of the city of Toronto, and immediately following graduation he was appointed chief clerk and estimator with the same department. The following year he became assistant engineer in charge of maintenance, surveys, draughting and estimating and, with the exception of the period of his service overseas, has remained with the Department of Works, Toronto, ever since.

K. L. Dawson, A.M.E.I.C., has been appointed sales manager of the Nova Scotia Tramways and Power Company, Limited, Halifax in charge of the sales of the company's several services in addition to his former duties as superintendent of the company's gas department. Mr. Dawson is a native of Nova Scotia and received his degree of B.Sc. in civil engineering from the Nova Scotia Technical College in 1917. He joined the staff of the Nova Scotia Tramways and Power Company in 1917 as assistant superintendent of the gas department and remained in this capacity during the period while Messrs. Stone and Webster were managers of the company. Mr. Dawson has taken an active interest in the affairs of The Institute and has been secretary of the Halifax Branch for a number of years and represented that branch on Council during the year 1927. At the recent Annual Meeting he presented a paper entitled "Notes on Removal of Carbon-Sulphur Compounds from Coal Gas by Oil Washing."

BOOK REVIEWS

Highway Materials

By Edward E. Bauer, B.S., C.E., First Edition, New York, McGraw-Hill Book Company, 1928, 6 x 9 in., 353 pp., tables, figs., $3.50.

This book, more especially written for university students, will also be of great value to practising engineers interested in road work.

It contains up-to-date and complete data relating to the inspection, the various tests and fundamental qualities of highway materials.

The work is divided into four parts. The first one deals with the standard definitions of terms relating to such materials as are used in highway work and then with their production, standard tests and specifications.

In the second part will be found a description of the qualities required of the materials used in each type of pavement, together with typical specifications as generally adopted by practising engineers.

The third part deals with the important question of the sampling of road materials. The careful selection of samples to be used for laboratory tests is of the utmost importance if we want such tests to be of real practical value.

The fourth part is devoted to the description of the most modern methods of testing. The practices followed by the writer are those specified by the American Society for Testing Materials. For those tests not specified by the A.S.T.M., the suggestions of the various bulletins of the United States Department of Agriculture have been adhered to.

Altogether, the book will be found very useful, not only to students in highway engineering, but also to every highway engineer, as it is an excellent compendium of the most recent practice followed in the use, sampling, testing and specifications of road materials.

Alex. Fraser, A.M.E.I.C.,
Chief Engineer, Department of Roads, Quebec, P.Q.

Heating and Ventilation

By C. W. Brabbée, McGraw-Hill Book Co., New York, 1927, First Edition, Buckram, 9 x 6 in., 332 pp., charts, figs., $6.00.

This is a translation of the German work on Heating and Ventilation by Dr. R. Rietschel, which has been revised by C. W. Brabbée for application to American practice and to suit American equipment in general.

It includes the general principles of heating and ventilation, and shows the requirements for such and the methods used in the design. It describes also the different types of heating apparatus and systems. An interesting piece of equipment not used to any extent in this country is a cast iron sectional heater for utilizing the exhaust gases from Diesel engines.

The work contains little original matter, but re-states a number of well-known principles and is partly based on the contents of equipment catalogues. An interesting feature is a collection of charts on hot water heating systems, both gravity and forced circulation and on high, low and vacuum heating systems.

E. A. Ryan, M.E.I.C.
Consulting Engineer, Montreal.

Applied Magnetism

By T. F. Wall, New York, D. Van Nostrand Company, 1927. Buckram, 7½ x 10 in., 262 pp., figs., $6.00.

This book gives, in the first six chapters, a short but very interesting and timely review of the subject of magnetism. Chapter vii outlines the electron theory of magnetism and chapter viii explains the author's method for generating very intense magnetic fields.

The second part of the book treats of magnetic testing and discusses the application of magnetic methods to the testing of steel products in an effort to correlate the magnetic and mechanical properties.

The book as a whole might be considered as an essay on the subject treated. The matter is well presented, and the treatment is stimulating, but the cost of the book is out of all proportion to the amount of material presented.

C. V. Christie, M.E.I.C.,
Professor of Electrical Engineering, McGill University.

Permanent-Way Materials Plate-Laying and Points and Crossings

By W. H. Cole, revised by Col. Sir G. Hearn, London, E. & F. N. Spon, Ltd., Buckram 7½ x 5 in., 245 pp., figs., diagrs., tables, $3.00.

This book deals primarily with British practice in regard to permanent way, but makes numerous references to practice in other countries. The first edition appeared in 1885, and its quality is indicated by the fact that in forty-three years a total of eight editions have been absorbed and a ninth is now in demand.

The gauges of track in various countries are cited. There is a discussion of stresses in track and of the relative merits of bull-head, double-head and flat bottom rails. Spacing of sleepers (ties) and depth of ballast and the reasons therefore are noted together with some remarks on the elements of cost of track.

The design of rail sections, fish plates, chairs and keys is discussed. Fastenings for flat bottom rails, anti-creep appliances and check (guard) rails and their fastenings are noted. Cast iron, steel and concrete ties and some of their users are cited. The conditions which a sleeper (tie) should fulfill are listed.

The manufacture of iron and steel is described and the manufacture and testing of rails, fastenings and steel sleepers (ties) are discussed. The essentials of plate laying (track laying) and the organization, tools and machines necessary or desirable therefore are noted. Train resistance, particularly that due to curvature, and both the theory and practice of super-elevation on curves are cited.

The duties of the Permanent Way Inspector and of his subordinate supervisory forces are noted. Maintenance of way tools and work are discussed and the solution of certain field problems is demonstrated. The organization for and method of renewing track materials is outlined. The practice and theory of point (switch) and crossing (frog) design and installation are dealt with and the layout of turnouts and crossovers under different conditions of alignment are developed.

British practice in regard to signalling and interlocking is recorded and the book closes with eight tables in regard to track materials and track work and a statement of standard and recommended dimensions, and additions to standard dimensions on account of curvature, as applied to Indian Railways.

The book is well condensed and is unquestionably of value to those dealing with British permanent way. Practice on this continent varies so greatly from British practice, however, that the chief value of the book here lies in its presentation of practice relatively little known in this country. As one may best understand his own problems by viewing them in the light of different practices, those who are concerned in the design and use of track materials in this country will find the time spent in reading this book to have been well invested.

J. E. Armstrong, A.M.E.I.C.,
Assistant Engineer, Canadian Pacific Railways, Montreal, Que.

The World of Atoms

By Arthur Haas, D. Van Nostrand Company, New York, 1928. Buckram, 9½ x 6 in., 137 pp., figs., $3.00.

In ancient Greece Democritus taught about a world of atoms, but his teaching found little experimental support until the discovery of radio-activity by Becquerel in 1896, soon followed by the discovery of radium by the Curies and of the disruption of radio-active substances by Rutherford. The disruption or disintegration of radio-active substances gave a key to the riddle of the atom, leading to other discoveries in rapid succession, and giving a great stimulus to scientific research. The result has been that during the last thirty years research in physical laboratories has tended to go more and more into this interesting field, until at the present time scientific journals devoted to physics are filled with researches on atomic physics to the exclusion of almost all other lines of investigation.

This book gives not only a clear and connected account of practically all that has been done and is being done in this field of endeavour, but also covers an elementary account of certain principles in physics and chemistry which are necessary to an understanding of this subject. Thus we have a book which while comprehensive is nevertheless easy to read, at least in the major portion. A minor part of the book, however, especially the last chapter, will require careful study.

A noteworthy point is the concise and clear-cut way in which the author makes all his statements without any needless verbiage. He states, for instance, that atoms disintegrate, forming new elements. He does not allow this, however, to lead to any ambiguity as to the nature of an element, it being plainly stated that an element is a substance which cannot be further decomposed by chemical means. Similarly this changing of one element into another leads to the possibility of changing the baser metals into gold, and the question arises: Can we turn mercury into gold by means of powerful electric discharges, as has been stated to have been done? He answers that it has been proved that the artificially prepared gold is always contained as an impurity in the mercury from the very beginning, and, furthermore, the atomic weight of this so-called artificially prepared gold is the same as that of ordinary gold, which would not be true if the gold were actually prepared artificially. In another place he states that the greatest experimental physicist of the 19th century was Michael Faraday—high praise indeed for an English physicist from an Austrian. Great appreciation is also given to the work of Sir Ernest Rutherford, formerly a Professor at McGill University. In a chronological summary at the end of the book, in which twenty-six important advancements are listed in this field of science, two of the twenty-six are referred to Rutherford and a third to Rutherford and Soddy, who was also a Professor at McGill University.

The book should be very interesting to the general reader who desires an understanding of our present knowledge of the world of atoms. For those who already have a good knowledge of the subject, the book will well repay reading, as it gives a very complete account of what is known of this subject condensed into the space of 133 pages. Much less prominence is given to Bohr's theory of the Atom and of Spectra than is usual in books of this character, but space is found for later theories, such as that of De Broglie on Wave Mechanics and of Schroedinger on the new Atomic Mechanics.

The translation is by Dr. Uhler, an associate Professor at Yale University, himself an active research worker along these lines, and of no mean reputation. That he should have thought well enough of the book to make a translation is of itself a high recommendation.

W. B. Cartmel, M.E.I.C.,
Engineering Department,
Northern Electric Company, Limited.

Properties and Testing of Magnetic Materials

By Thomas Spooner, 1st Edition, New York, McGraw-Hill Book Company, 1927. Buckram, 6 x 9½ in., 385 pp., figs., tables, $5.00

This book is a very valuable addition to the literature dealing with magnetic materials, and is written by one who, as research engineer of the Westinghouse Electric and Manufacturing Company, has had the most direct contact with the varied problems of a magnetic nature, which are met in the design and construction of all types of electrical apparatus.

Little space has been given to the discussion of magnetic theories, but the aim of the author has been to provide, in convenient form, that information on magnetic properties which should be included in the working knowledge of all men who are engaged in the design of electrical machinery or who are attempting to teach this subject in the universities.

Methods of test are described which are suitable for the commercial inspection of magnetic materials and for research investigations, together with a critical examination of their accuracy and limitations.

The various chapters are followed by a comprehensive list of references to the literature dealing with the subject matter of the chapter. This book should be on the desk of every electrical designer and in every technical library. The author and the publishers are to be congratulated on the production of a book containing such a wealth of information in such small compass and written in such an interesting way.

C. V. Christie, M.E.I.C.,
Professor of Electrical Engineering,
McGill University.

Water Channels

By George Higgins, Crosby, Lockwood & Sons, London, 1927. Cloth, 8½ x 11 in., 135 pp., figs., plates.

This treatise deals with problems met with in design of channels, particularly with irrigation channels. Flow in natural channels is entirely outside the scope of the work, and is not considered by the author.

Four formulae for computing flow in channels are considered briefly, viz., those of Bazin, Kutter, Barnes and Manning, the author favouring the use of Bazin's formula, for the solution of which he gives some excellent diagrams. A discussion follows on the most suitable size, shape and slope of a channel for a given service, after which, flow in circular and egg-shaped channels is considered. There is a very full discussion of flumes of lintearia section. An excellent feature is a study of the movement of solids in water following the methods suggested by R. G. Kennedy.

About half the text is taken up with a discussion of off-takes from canals, control works and devices for controlling and measuring the supply drawn from a canal. Brief descriptive notes drawn from many sources are given of control works in operation.

A casual examination leads one to conclude that the text is poorly proportioned as regards the amount of space devoted to the various subjects considered. This would be a correct view if the book was considered as a complete treatise on channel flow. However, it is evident that the author is treating a number of special subjects as he has covered them in practice, and is giving the reader the benefit of his special experience in the design of irrigation channels.

The plates collected at the end of the text comprise a series of diagrams for use in design of channels. They are generally clear and of such a size as to be useful.

J. J. Traill, M.E.I.C.,
Hydraulic Department,
Hydro-Electric Power Commission of Ontario.

EMPLOYMENT BUREAU

Situations Wanted

Electrical Engineer

Electrical engineer, 27 years of age University of Toronto graduate, six years diversified experience, two years Westinghouse engineering course, inspection of electrical equipment, industrial construction and maintenance, testing and research; at present employed in United States; wishes to return to Canada. Available on reasonably notice. Apply box No. 231-W, The Engineering Journal.

Metallurgical Engineer

Graduate in metallurgical engineering desires position. Experience: three years laboratory, one year plant executive. Speaks Spanish. Apply box No. 233-W, The Engineering Journal.

Situations Vacant

Young engineer with several years experience to spend part time on machine design work and remainder on survey work in connection with large newsprint mill in province of Quebec. Apply, stating salary expected, to box No. 188-V, The Engineering Journal.

Chief Draughtsman

Growing Canadian steel fabricating company, one thousand tons per month, permanent position. State age, experience and salary. Apply to box No. 189-V, The Engineering Journal.

Company's Corporate Name Changed

The Dominion Insulator and Manufacturing Company, Limited, announces the change of its corporate name to Canadian Ohio Brass Company, Limited. The change is one of name only as the company will continue without alteration its business of manufacturing O-B products in Canada. Mr. Merrill W. Manz, who has been associated with this company in Canada and with the Ohio Brass Company in the United States, has been appointed manager of the factory and sales with headquarters at Niagara Falls, Ont.

Canadian Trade Index

The fourth annual issue of the Canadian Trade Index, a copy of which has just been placed in the library of The Institute, contains this year the added feature of a special section dealing with exports, which has been supplied by the Department of Trade and Commerce at Ottawa. This volume, which has shown steady growth from year to year, provides as its main feature a dependable list of the articles made in Canada and the names of the manufacturers making them.

A new bulletin has just been issued by the Reliance Electric and Engineering Company of Cleveland, Ohio, which is known as bulletin No. 202, illustrating and describing the new direct current type "T" heavy duty Reliance motor, with ball and roller bearings, and giving full information as to its various applications. A copy can be obtained from any of the branches of the *Northern Electric Company, Limited.*

Modern Building Regulations for Reinforced Concrete

*F. R. McMillan**

Toronto Branch, March 15th, 1928

The purpose of a building code is to prescribe such regulations for the design and construction of buildings as are needed to safeguard the lives of occupants of buildings or of the public at large, and to insure sanitary conditions in buildings open to the public for residence or business purposes.

In theory, the preparation of a code should be simple, requiring only the statement of those general principles which govern safe design and construction, and such rules as are necessary for fire-safety, proper sanitation, etc.

In practice, however, it is not so simple. There are so many different materials of construction requiring special conditions to avoid unfair discriminations; so many matters of design in which the judgment of the engineer must play an important part; and so many minor details, the omission of which would necessitate special rulings or interpretation, that a simple code calling only for the exercise of good engineering, as desirable as such a code would be, is not sufficient.

In the case of reinforced concrete construction, the problem is even more complex than for the older forms of construction. This is due in part to the newness of the art, but principally to two other factors which are not present to any considerable degree in the older forms of construction. These factors are:—The various ways or systems of construction made possible by the adaptability of reinforced concrete and the rapidly accumulating and extensive test data relating to all phases of the art. With these special conditions superimposed on those of the general nature previously mentioned, the preparation of a set of regulations for the use of reinforced concrete becomes a task of some importance.

In presenting on this occasion the proposed Standard Building Regulations for Reinforced Concrete of the American Concrete Institute and the Concrete Reinforcing Steel Institute, it is not done in any sense with the feeling that it is the last word in building code provisions; in fact, those of us who have been closest to its preparation realize more fully than others the full significance of its limitations. It is presented, however, with the feeling that it represents a serious attempt, involving several years of effort on the part of properly qualified bodies, to provide a set of regulations that will be in accord with the advances in the art, and, at the same time, not too difficult to apply or enforce.

A bit of history will not be out of place. These building regulations had their beginning in the work of the Joint Committee on Specifications for Concrete and Reinforced Concrete. This committee, which was organized in 1919, consisted of twenty-five members representing the following organizations:—American Society of Civil Engineers, American Railway Engineering Association, American Society for Testing Materials, American Concrete Institute and Portland Cement Association.

This committee, after a very extended study of the field of concrete and reinforced concrete, issued its first report in 1921. This report, which was modified in the light of the very thorough public discussion, and resubmitted in 1924, marked a distinct advance in the design of reinforced concrete. It was the first authoritative document to attempt to control the quality of the concrete for the purpose of design and to fix the design stresses as a percentage of the ultimate strength. While some controversy was raised by certain of the provisions in the Joint Committee specifications, the report has received a wide recognition and has profoundly affected practice.

Following the appearance of the 1924 Joint Committee report, the Committee on Reinforced Concrete Building Design and Specifications of the American Concrete Institute was commissioned by the Board of Directors of the Institute to prepare a set of building regulations based upon it. Such regulations were submitted in 1925, and, with some modifications, were adopted in 1927 as a Tentative Standard of the Institute.

About the time of the adoption of the 1927 Tentative Standard by the American Concrete Institute, the Concrete Reinforcing Steel Institute adopted a similar set of regulations which were in substantial agreement with those of the American Concrete Institute in most of the essential items, but quite different in form and in many of the lesser items. Both of these documents were being put forth as suitable bases for building codes for cities and towns.

Because of the essential similarity of the two regulations in all major items and because of the desirability of having a single document, to be jointly offered as a basis of a code, the committees of the two organizations arranged a joint meeting to consider the possibility of a single report that would better serve the purpose than either of the two existing reports. Following this first meeting there was a series of meetings, from which developed the joint proposed regulations which is the subject of this discussion. This joint production, in the opinion of both committees, is a distinct improvement over any of the former documents and furnishes a modern set of building regulations for reinforced concrete.

From this brief sketch it will be seen that these regulations are not a mere incident in committee activities, but rather the result of careful study by many individuals, with the definite purpose in view of providing building regulations that would embody the recognized advances in reinforced concrete design and construction.

In spite of the long study leading up to this code and the care taken in its preparation, its limitations and shortcomings are freely admitted. The committees hope to strengthen and improve this report wherever possible, but they entertain no hope that it will be their privilege to write the first perfect building code.

It may well be the purpose for this occasion to point out some of the more important features in which this set of regulations differs from what has generally been the practice. This will be done in order, beginning with the first important difference in chapter 2.

Load Tests (Section 202)

The right to require a load test on the completed floor system in case of doubt concerning any feature of the construction has generally been provided in building regulations. The usual requirement has been a test with a superimposed load of twice the live load plus the dead load, with no stipulation as to the length of the time the test load should remain in place. This code requirement is a superimposed load one and one-half times the live load plus one-half the dead load to be held in place twenty-four hours, with the further provision that within twenty-four hours after the test load is removed the slabs or beams shall show a recovery of at least 75 per cent of the maximum deflection during the twenty-four hours under load.

Inspection (Section 203)

The architect or engineer is responsible for the inspection of the construction under these regulations. Inspection records must be kept showing many details in the placing of concrete and the reinforcement.

Concrete Aggregates (Section 205)

The quality of the aggregates is covered by the usual requirements as to cleanliness and the presence of undesirable characteristics, but a departure has been made from the usual practice in that definite percentage limits are given for the various deleterious materials. Grading of the aggregate is not covered under the quality specification, for under the other provisions of the code this resolves itself into a question of economy and not of quality. This is a basic improvement, for the many attempts to control quality of concrete through careful grading requirements with fixed proportions, while resulting in excellent concrete in individual cases, have in the main added to the cost and delayed the general recognition of the fundamental principles of concrete mixtures.

Quality of Concrete (Section 301)

In respect to the requirements covering the quality of concrete, the advance from the former practice is probably the most pronounced. In this code, full recognition is given to the definite dependence of the concrete strength upon the quantity of mixing water. Two methods of arriving at the quality of concrete are provided:—

(1) On the basis of definite water-cement ratio strength relation in accordance with the established values for average materials.

(2) By specific test to determine a water-cement strength relation for the particular materials to be used.

Under this latter method, with certain follow-up tests which are required, concrete of any desired strength may be used. This feature is of real advantage, as it will extend considerably the usefulness and economy of reinforced concrete construction.

With the water-cement ratio fixed by one of these two methods, the proportions of cement and aggregate and fine to coarse aggregate are fixed by the requirements of consistency and placing; this leaves open other opportunities for economies in the selection of materials and in the plant and methods of handling.

* Director of Research, Portland Cement Association, Chicago, Ill.

Unit Stresses in Concrete (Section 306)

Unit stresses in concrete are in accord with the recommended specifications of the Joint Committee in all respects except one. The exception occurs in the use of shearing stresses in excess of 0.09 of the ultimate strength of the concrete. The use of shearing stress greater than this will require special certification on the part of the designing engineer that he has personally supervised the placing of the reinforcement and the concrete in all members in which these higher stresses are used, and that in all respects the provisions of the code have been fully met.

Unit Stresses in Reinforcement (Section 307)

The unit tensile stress in reinforcement has been raised from the 18,000 lbs. per sq. in. allowed by the Joint Committee to 20,000 lbs. per sq. in. This stress applies alike to intermediate grade of billet steel and to rail steel reinforcing bars. Billet steel bars of structural grade and hard grade, which are not contemplated as standard materials when present stocks have been exhausted, are provided for by a footnote in the code at values of 18,000 lbs. per sq. in. for the former and 20,000 lbs. per sq. in. for the latter.

Slight revision has been made over the Joint Committee requirements in the provisions for stress on structural steel or cast-iron sections in composite columns. These provisions allow a flat unit stress on the steel or cast-iron sections, instead of a unit stress reduced for slenderness, as was the case in the Joint Committee provisions. Slenderness is taken care of under the new provisions by the long column formula applied to the composite column as a whole. This is a much more logical and more easily applied method.

Mixing, Placing and Details of Construction (Chapters 4 and 5)

Provisions in these chapters are substantially in accord with the recommendations of the Joint Committee. Such changes as have been made are in the direction of simplification in the text and greater suitability for building code purposes.

Design Assumptions (601)

Design assumptions with but one change are in accord with the recognized practice as typified by the Joint Committee specifications. This change is in respect to the value of n, the ratio of the modulus of elasticity of steel to that of concrete. This is made a direct function of the strength instead of using a series of step values, such as 15, 12 and 10, each to apply to a certain group of concrete strengths, as has been the custom in the past. In this code

$$n = \frac{30,000}{f^1_c}$$

This is a particularly desirable improvement where advantage is to be taken of the opportunity for using concrete of any desired strength. It also simplifies the preparation of design tables and diagrams for concrete of any strength.

Moment Calculations (Chapter 7)

For the usual cases of equal spans and uniform loads, these are in accordance with the Joint Committee recommendations, except that the negative moment required at the end supports of series of spans only slightly restrained is slightly less than in former provisions.

Sections have been provided for ribbed floor construction and floors reinforced in two directions. Neither of these subjects were covered by the Joint Committee. The committee is not satisfied with the provision in its code covering floors reinforced in two directions. It hopes during the present year to develop a more rational treatment than that contained in the report.

Shear (Chapter 8)

Shearing unit stresses are essentially in accord with the provisions of the Joint Committee, except for the provision covering stresses in excess of 0.09 of the ultimate strength of the concrete, as previously mentioned. The provisions relating to the design of web reinforcement, however, have been materially altered and clarified in the manner of presentation.

Bond and Anchorage (Chapter 9)

This chapter is in general accord with the provisions of the Joint Committee, except that where special anchorage is provided, bond stresses to be used are obtained by doubling the values specified for ordinary anchorage. In the Joint Committee report these values were obtained by a formula that was not simple to apply, but which gave values not greatly different from those obtained under the revised provision.

Flat Slabs (Chapter 10)

As in the case of the shear and bond, these provisions, though of the same material effect as those of the Joint Committee, have been considerably revised in respect to the manner of presentation. There has also been added a set of coefficients directly applicable to the 4-way slab with dropped panels for the special case where the diameter of the column capital is 0.225 times the average span length of the panel. These coefficients are in accord with the general provisions and their addition merely simplifies the solution for this particular type of construction.

Columns and Walls (Chapter 11)

In the matter of columns, change in the provisions covering composite columns has already been referred to. In addition to this some clauses have been added to provide for a positive loading of the metal section in columns of this kind, and to provide better details at the base of the column.

There has also been a slight change in the formula for computing the load on combination columns. These are columns with structural steel sections encased in concrete but without the spiral and longitudinal reinforcing required in the composite columns. The loads allowed are materially less than for the latter.

The provisions for design of spiral columns are the same as in the Joint Committee report. These have evoked much comment. Engineers who have not given special study to the matter have wondered why the permissible unit stress on the concrete is made a function of the amount of longitudinal reinforcement, also why the ratio of spiral reinforcement bears a fixed relation to the ratio of longitudinal reinforcement. These two questions are readily answered by a consideration of the inter-action of the concrete and the embedded steel.

During the period of hardening of the concrete when the column begins to dry out there is a shrinkage of the concrete that is resisted by the longitudinal reinforcement, with the result that the steel is under some compression independent of that due to the load. Combined with this condition, which is not recognized in the older forms of column formulæ, there is a further increase in steel stress due to the fact that under continued load concrete takes on a slight permanent deformation, thus giving a value of n, (the ratio of the Modulus of Elasticity of the Steel to that of the Concrete), somewhat higher than that used in the ordinary computations.

The formula of the Joint Committee was built up to give recognition to these two independent phenomena. While this purpose is not readily apparent from the form in which the formula appears, the formula does indicate the advantage which results from using higher ratios of longitudinal reinforcement. This is in accord with the basic considerations just referred to in which the limiting condition is the stress in longitudinal steel. Both the analysis of the problem and available test data indicate the soundness of this method of treatment. Incidentally, the values obtained by the use of this formula do not greatly differ from those obtained by the formula which has been in effect in a number of cities for many years. It has the advantage, however, of being on a more logical basis and indicates more accurately the direction in which true economy in column design lies.

The requirement that the spiral reinforcement be always 25 per cent of the longitudinal is to insure an increasing amount of lateral reinforcement with increasing loads and unit stresses. The only purpose of the lateral reinforcement is to supply a factor of safety against sudden collapse, as no test data have shown the lateral reinforcement to have any major influence on the column stresses under working loads.

In this chapter on concrete columns and walls, there has been added a section covering the design of monolithic walls. The provisions in this section are based on the provisions in the Seattle code, which are the result of considerable experience in this type of construction.

In conclusion, reference was again made to the vast amount of research and engineering study which has been given to concrete and its combination with steel. No other building material has had the benefit of such intensified study, and yet the practice of the art is far behind present knowledge. Naturally, practice must lag somewhat behind the ever-advancing knowledge, because building regulations are an obvious necessity and they cannot be amended at the conclusion of every new experiment. It is important, however, that from time to time our building codes be revised to bring them in line with the recognized advances. It is believed that the "Proposed Standard Building Regulations for Reinforced Concrete" which we have been discussing will admirably serve this purpose at the present time.

BRANCH NEWS

Border Cities Branch

R. C. Leslie, Jr.E.I.C., Branch News Editor.

The Welland Canal

Alex. J. Grant, M.E.I.C., newly-elected vice-president of The Institute and engineer-in-charge of the Welland canal, was the speaker of the evening at the meeting of the branch on March 9th. The dinner was held in the ballroom of the Prince Edward hotel, and a good crowd attended. Well over a hundred persons were present, including the Mayors of Windsor, Walkerville, Ford City and Ojibway, O. E. Fleming, K.C., of the Deep Waterways Association, visitors from Detroit and members of the Border Cities Branch.

Mr. Grant's lecture was most instructive and interesting. He outlined the history of canals in Canada from the earliest times, tracing the development of the Great Lakes system of navigable waterways up to this latest huge undertaking, the Welland canal. A great difference was noted between the first Welland canal opened in 1816 with forty wooden locks, 110 by 22 by 8 feet, and the new canal begun in 1913 with seven locks, 859 by 80 by 30 feet, having lifts unprecedented in a canal of this size. Three flights of twin locks give a lift of 140 feet, as against a maximum rise of 85 feet in the Panama canal. The guard lock at Port Colborne is 1,300 feet long and will accommodate two large vessels at one time.

Slides were shown illustrating the various features of the project at different periods in its construction. The huge steel gates were of great interest, as were also the wooden ones, whose timbers, of Douglas fir, were brought all the way from the Pacific coast. Nine hundred thousand board feet of this timber have been used, many pieces having a cross-section as large as 50 by 40 inches and a length of 60 feet. The method of placing concrete in the locks and the steel forms for the same were shown and explained. The syphon which is to make the Chippawa creek under the canal consists of six 22-foot diameter barrel tubes with vertical end shafts.

Numerous movable bridges have been and are being built over the canal. The type which is being used most is the vertical lift bridge. There are also some rolling lift bascules, one of which is a double leaf structure. The clearance provided under the vertical lift bridge is 120 feet at high water, which is more than ample to meet the requirements of both lake and ocean navigation companies.

Seven million three hundred thousand tons of shipping had passed through the Welland canal in 1927, and, in answer to queries about the possibilities of trade development which might result from full utilization of the St. Lawrence, Mr. Grand expressed the opinion that a comparatively short length of time should see an annual tonnage of at least twenty-five millions.

After Mr. Grant's address, O. E. Fleming, K.C., spoke briefly from the viewpoint of a Deep Waterways Association official, and expressed the hope that the St. Lawrence canalization would follow soon after the completion of such an important link in the chain of lake to ocean waterways as the Welland canal. Mr. W. Molitor, of Detroit, who has been connected with various canal projects, including the Panama, expressed admiration for the manner in which the Welland work has been handled, and, in closing, called upon the gathering to extend its appreciation to Mr. Grant for his very fine lecture.

Calgary Branch

W. H. Broughton, A.M.E.I.C., Secretary-Treasurer.
W. St. J. Miller, A.M.E.I.C., Branch News Editor.

At the meeting of the branch held on February 16th, J. D. Baker, plant superintendent of the Alberta Government Telephones, Edmonton, addressed the members on "Development in Long Distance Telephony."

Development in Long Distance Telephony

The speaker started out with a brief history of telephony, in which he recalled the fact that last year was the fiftieth birthday of the telephone. He stated, however, that the greatest developments had occurred in the last fifteen years and improvements are taking place very fast at the present time. To illustrate this, Mr. Baker stated that when in New York recently he learned that the United States Bell Telephone System found the research work in connection with telephony had become so great that they had deemed it advisable to form a subsidiary company to look after this work. He was privileged to be shown through the laboratory building of this company, in which some 3,200 scientists, experts in various lines, were engaged in experimental work in connection with telephony.

He recalled that twenty years ago there existed in Alberta only one long distance line, namely, between Calgary and Edmonton, and even it was none too satisfactory. Now it is possible to talk to any part of the continent and to Central America. The carrying of photographs by wire is now an everyday affair in the United States and could be made so here at any time if the demand arose. Mr. Baker stated that television also will soon be an established fact.

The speaker showed a number of lantern slides of oscillographs to illustrate voice modulations and frequencies and described how by continuous experimental work the tones of low and high frequencies can now be filtered out of sound waves travelling over a circuit to make conversation clear.

Repeaters are now inserted in the line about every 500 miles to amplify the sound waves by which means it is possible to carry on conversations over very long distances. Mr. Baker stated that in a very short time a Canadian all-red line from the Atlantic coast to the Pacific coast would be an established fact.

At the present time it would be quite feasible to carry on a conversation between Calgary and London, England, but no demand for this service has yet arisen. This would cost about $90 for a three-minute call.*

A short interesting description was given of the organization called into play for transmitting the programme from Ottawa to all parts of Canada on the first of July last. An all-Canadian route was used, although United States companies co-operated by organizing an alternative line in case anything went wrong on the Canadian hook-up. All telephone and telegraph companies in Canada joined together to make this possible, and some 9,000 miles of telephone lines and about 4,000 miles of telegraph lines were used.

The speaker mentioned that there are at present in the province of Alberta some 27,000 miles of pole lines and 170,000 miles of telephone wire. There is now about $25,500,000 invested in the Alberta Government Telephone System, and Mr. Baker gave it as his opinion that it is the most up-to-date of any system serving a similar area. He formed this opinion after having had the privilege of looking over the lines of the greatest corporation of this kind in the world, the American Telephone and Telegraph Company.

The lecturer concluded with a demonstration of the filtering out process of objectionable sound waves by means of specially prepared phonographic records, the phonograph being hooked-up to an amplifier and thence to several types of loud speakers. This practical demonstration caused considerable interest amongst those present, and was cleverly arranged by the speaker.

Mr. Baker handled this highly technical subject in a manner which made it clear to those present, and a very interesting discussion followed.

The Significance of Water in Oil Field Operations

The speaker of the evening at the meeting of the branch held on March 1st was T. G. Madgwick, petroleum engineer of the Department of the Interior. Mr. Madgwick's subject,—"The Significance of Water in Oil Field Operations,"—was well chosen at this time when drilling and prospecting for oil in this province has reached such an important phase in determining the extent and value of our natural resources. The probability of encountering water is always one to be faced in the search for oil, and, although so far our known fields have not suffered to any appreciable extent in this respect, such knowledge as he gave out is valuable should such a contingency ever occur.

He pointed out that one great menace that water invasion of an oil or gas field offers is that of trapping a large part of the oil still underground, and also the resultant effect of driving the oil to neighbouring properties. The occurrence of water means increased cost of pumping when emulsion is formed, followed by the necessity of dehydration. He illustrated and explained what actually constitutes an impervious formation, and showed his audience by means of slides the travel of water through underground strata. He defined an impervious bed as one whose pores are so fine as to present such frictional resistance as will stop anything but infinitesimal movement through them. An anticlinal fold, he explained, was a good trap in the path of subsurface water flow.

The paper was of a highly technical nature, and such sentences as this were not infrequent,—"The conditions of deposition tend to lenticularity parallel to the former shore line which are often parallel to the axis of the geo-syncline,"—which had more or less to be taken for granted by the engineer who was not fortunate enough to be a geologist also.

With further reference to water occurrence, the speaker mentioned that water is the primary factor in the accumulation of oil and gas, especially on the plains of western Canada, where one is liable to find around the margin of the pool being developed a practically inexhaustible body of edge water. He went on to explain that it was the alterations that we introduce into the equilibrium of

* Since this address, a ten-minute experimental conversation has been clearly transmitted.

nature that is the principal cause of the water trouble that affects so many fields. He explained the plugging of wells, showing many methods sometimes thoughtlessly adopted that would prove detrimental to neighbouring drill holes. Sometimes an oil well will become flooded with top water, but this should be more easily remedied. That careful and systematic cementing at the proper level, and in the proper way, would always repay the operators was the theme of a large part of Mr. Madgwick's paper. He also advocated the absolute necessity, and to the advantage of all concerned in drilling for gas or oil, that all waters encountered must be sampled and analyzed. He stressed the importance of this if we are ever going to deal successfully with water problems.

The speaker concluded by mentioning methods of dye and other fluid detectors for passage of water, and stated that a strict adherence to legislation in drilling operations would always pay in the long run. The discussion following Mr. Madgwick's address was interesting, several important points being well explained.

Annual Meeting

The annual meeting of the Calgary Branch was held on Saturday, March 10th, at which there was a good attendance. The secretary-treasurer's report for the year ended showed that a number of very interesting addresses had been given of a high standard, at which the average attendance was good.

Reports of the several conveners of committees were then received, all of which were passed and accepted with satisfaction. A brief ceremony then followed at which the secretary, H. R. Carscallen, A.M.E.I.C., and the branch news editor, W. St. J. Miller, A.M.E.I.C., each received a beautifully engraved silver cigarette container, "in recognition of services rendered." I would like it to go on record that, for my own part at least, I was completely taken by surprise, and, chiefly for the benefit of those members of the branch who were unable to be present, I wish to express my sincere appreciation for both the prompting thought and the valued gift.

Following the report of scrutineers J. J. Hanna, A.M.E.I.C., and M. H. French, A.M.E.I.C., Chairman F. K. Beach, A.M.E.I.C., announced the result of the ballot count:—

Chairman	Thos. Lees, A.M.E.I.C.
Vice-Chairman	F. J. Robertson, A.M.E.I.C.
Secretary-Treasurer	W. H. Broughton, A.M.E.I.C.
Executive Committee	F. M. Steel, M.E.I.C.
	B. Russell, M.E.I.C.
	O. H. Hoover, A.M.E.I.C.
Auditors	J. J. Hanna, A.M.E.I.C.
	F. C. Tempest, A.M.E.I.C.
Ex-officio	S. G. Porter, M.E.I.C.
	P. J. Jennings, M.E.I.C. (councillor)
	F. K. Beach, A.M.E.I.C. (past-chairman)
	H. R. Carscallen, A.M.E.I.C. (past secretary-treasurer)

Past-Chairman F. K. Beach, A.M.E.I.C., gratefully acknowledged the assistance of the executive through the past year, and handed over the duties to the vice-chairman, F. J. Robertson, A.M.E.I.C., in the unavoidable absence of the newly-elected chairman, Thomas Lees, A.M.E.I.C.

A motion of thanks to the retiring chairman, secretary and executive was proposed by S. J. Davies, A.M.E.I.C., and cordially received by all present.

Hamilton Branch

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

A meeting of the branch was held at the Hamilton Technical Institute on Friday, February 17th, at which L. W. Gill, M.E.I.C., occupied the chair.

The minutes of the last meeting were read and approved, following which it was moved by J. C. Nash, A.M.E.I.C., seconded by J. E. Grady, A.M.E.I.C., and carried, that last year's Nominating Committee, composed of A. H. Munson, A.M.E.I.C., W. B. Ford, A.M.E.I.C., A. R. Hannaford, A.M.E.I.C., Alex. Love, A.M.E.I.C., and E. H. Darling, M.E.I.C., be re-elected.

Major Hugh Lumsden, M.E.I.C., introduced the speaker, R. M. Smith, A.M.E.I.C., deputy minister of highways of the province of Ontario.

Highways in Ontario

(Reported by the Secretary)

Mr. Smith said that there were four types of highways being built in the province of Ontario, gravel, traffic bound macadam, concrete and asphalt. He reviewed the development of highways, beginning with the concrete highway from Toronto to Hamilton in 1915. This was constructed 18 feet wide and with expansion joints every 35 feet. The mix was 1:1½:3 and the thickness 8 inches in centre and 6 inches at edges. At that time, United States specifications had to be depended upon. Now, however, the department has developed its own specifications. Pavements are standardized at 20 feet in width, concrete being laid thicker at the edges than the centre, viz., 10 and 7 inches, and no expansion joint is required. The pavement, although laid as a 20-foot slab, is divided into two 10-foot strips by metal plate, with the consequence that a crack develops along the centre, no transverse expansion joint being used. The mix, which is 1:1½:3, is richer than generally used in the United States. The department requires that the aggregate remain in the mixer only one minute, however, while the American specifications generally ask for one and a half minutes. It is felt that the richer mix is justified and that in the long run a cheaper job is secured. In any case, it is interesting to note that the cost of concrete pavements to the province of Ontario is approximately $10,000 per mile less than the same class of pavement laid on the other side of the international boundary.

The Ingersoll-Thamesford highway, built in 1924, cost only $20,000 per mile. While screened material was used, no washing was required. The next year washed and screened gravel or crushed stone was used on all work. This, while slightly increasing the cost per mile, made for greater uniformity in construction, with the result that a demand was created for this type of construction. Up to the present time, 577 miles of concrete roads on Ontario Provincial Highways have been completed.

As a comparison between the old type of concrete design and the new, an examination of the Burlington Beach highway, which has been down four years, should be made. This pavement shows practically no cracks. The Toronto-Hamilton highway developed cracks in the second year, which, while partly due to its being paved immediately after grading, was principally due to the fact that design was not correct.

It has been found that concrete tends to creep. For this reason, a 6-inch expansion joint behind the ballast wall is provided in every case where bridges are located on concrete highways.

Penetration macadam is built by placing a 3¾-inch layer of loose 2-inch stone on an old macadam base. This is then slightly rolled and filled with asphalt or tar, after which the road is thoroughly consolidated. Many miles of this type of road have been successfully constructed in the province of Ontario. While it has some advantages in that it requires a minimum supply of equipment and is fairly cheap to construct, it has also some disadvantage in that it requires the road to be closed during construction. The life of the pavement is also open to question.

Having these conditions in mind, the department undertook the construction of what has been classified as asphaltic mixed macadam. The aggregate in this pavement consists of crushed stone, varying in size from 2 inches to dust, mixed with asphalt approximately 4½ per cent by weight and having a penetration of 77 to 83. The surface is applied by the ton and is laid in such depths as may be sufficient to carry the traffic. The surface of the road when completed is slightly rough and has many of the riding qualities of a gravel road.

In connection with the construction of asphaltic roads, it is rather interesting to note the change in specifications since work of this nature was first started on the provincial system in 1919. At that time, Ontario accepted, as with concrete, specifications in use in the United States. It was found, however, that an asphalt penetration of approximately 40, while suitable for their requirements, was much too hard when used in Ontario with the changing climatic conditions. The Hamilton-Galt road is typical of the early construction. This road has many hair cracks which, it is believed, were largely caused by the fact that the asphalt was too brittle. In any case, the construction of asphalt roads during the last few years with the increased penetration seems to provide a much improved surface. Up to the present time, 263 miles of asphaltic pavement have been laid.

The transportation problem of to-day is very greatly changed from the days of macadam. The slow-moving vehicle at that time with the steel tire assisted, if anything, in compacting and preserving the macadam road as then designed. The rubber-tired vehicle of to-day, with its speed, affects the surface in just the opposite way from the steel-tired vehicle of olden times. Consequently, macadam pavement has more or less become obsolete. While it can be used and is used on township and county roads where traffic is slight, it does not recommend itself for provincial highways.

In addition to the various types of pavement mentioned above, the department has been experimenting with what has been classified as "Poor Man's Pavement." This is simply a matter of treating gravel surface with tar or asphalt, with a view to providing a dustless road and at the same time conserving the gravel or stone. The policy of the Department of Highways of Ontario is to construct this type in many sections where pavement of a higher type will eventually be laid.

In the bridge construction being undertaken, the department confines itself to concrete and steel, depending entirely on the type of foundation which can be secured; the concrete arch predominating where first-class shale or rock foundations is obtainable; the steel structure being used where any uncertainty exists. The concrete bridge constructed at Caledonia last season is typical of the type of construction the department recommends. This structure, approximately 700 feet in length, built in nine spans, was started on July 8th and completed November 15th, rather a record, the speaker felt, in construction of this kind. The department has also under construction at this time what is known as the Hog's Hollow bridge at the north entrance to Toronto. This structure is of steel with concrete sub-structure. It is 1,225 feet in length, has a 54-foot floor with two 6-foot sidewalks and is of sufficient weight to carry street railway lines.

Up to the present time nearly $175,000,000 has been spent. A trip through the province of Ontario will indicate that tremendous improvement has been made during the last ten years. The opening of the highway into the north is serving a section where there are 20,000,000 acres of fertile clay belt. A mining area of third importance in the world is being provided with an outlet. This road is serving the tourist traffic which has been demanding a highway to the Ontario mining district for many years.

Aside from the development in Northern Ontario, the changing conditions in Old Ontario are astonishing. There has been a tremendous increase in tourist traffic. During 1926, 1,290,000 vehicles came into Ontario via Ontario ports. During 1927 this was increased by more than 20 per cent.

There has been a great improvement from an industrial point of view, the opening of highways for winter traffic tending to improve conditions materially in this regard.

After a brief discussion, the meeting closed with a vote of thanks moved by E. H. Darling, M.E.I.C., which was carried with applause.

Regular Meeting, March 9th, 1928

(*Reported by H. E. Treble,* S.E.I.C.)

A regular meeting of the Hamilton Branch was held in the auditorium of the Hamilton Technical Institute on Friday evening, March 9th, when the members of the branch were the guests of the Canadian Westinghouse Apprentice Club at their fortnightly meeting, the occasion being a lecture and film presented by the Carborundum Company of Niagara Falls, describing the manufacture of carborundum and aloxite. E. F. Connolly, (B.A.SC., Toronto), president of the Apprentice Club, occupied the chair.

In welcoming the guests, Mr. Connolly referred to the visit of the club to the meeting of The Engineering Institute a short time ago, "When they heard the splendid address given by Mr. F. I. Ker, on the St. Lawrence Deep Waterways. This gathering together of the younger and of the more mature of the engineering profession should be of mutual benefit."

L. W. Gill, M.E.I.C., chairman of the branch, was then invited to say a few words. After thanking the club for its invitation, he went on to explain the organization of The Institute with its branches from the Atlantic to the Pacific. He explained that there are four grades of members, and he urged upon his hearers the value of membership in The Institute, especially to those young men who were heading toward the profession, and recommended that they take an interest in their profession.

Carborundum and Aloxite

F. A. Bowman, advertising manager of the Carborundum Company, was greeted with applause as he rose to address the meeting. Referring to the salesmen and sales engineers of the company present with him, he explained that not being a technical man he had brought his technical advisers with him and any questions asked would be taken care of to the best of their ability.

"I see," he said, "you are a body of serious deep thinking gentlemen, and thus the story of the invention and development of carborundum will be of great interest to you."

It was discovered in 1893 by Edward Goodrich Acheson, who had been associated with Edison in the development of the incandescent lamp filament. Mr. Acheson dreamed he could find an abrasive which would improve upon the natural products of emery and sandstone. He worked in Monongahela, Pa., in a ramshackle shop with the crudest of apparatus, including a small dynamo which supplied his electric power. One day he was experimenting with an electric arc in a small bowl such as plumbers use. In the bowl he had placed some clay and crushed coke and had packed it around a piece of carbon to which was fastened a wire leading from one pole of his dynamo. The heat generated by the electric current fused the two ingredients in the bowl, and when the carbon was withdrawn the trained eye of Mr. Acheson discovered some minute crystals adhering to it. These tiny jewel-like bits were found to be amazingly hard and sharp. It almost induced the hope that here had been found a way to make synthetic diamonds, but a few simple tests soon dispelled this idea. The fact remained that they were second only to the diamond in hardness and that they were destined to revolutionize the grinding world.

The inventor experimented again and managed to collect enough of the material to fill a small vial. This tiny vessel he tucked in his pocket, and, having determined to call the new material carborundum, he journeyed to New York. The possibilities of the new abrasive as a substitute for diamond dust for jewel polishing appealed to him, and accordingly Mr. Acheson interviewed several diamond experts, and after some persuasion they were induced to give the new material a trial. The results were successful, startlingly so, and accordingly Mr. Acheson got his first order for carborundum and the price paid was 40 cents per carat or $880 per pound.

That was the beginning of the commercial career of carborundum, and to-day there are thirty large electric furnaces instead of the one little plumber's bowl and the crude carborundum sells for practically ten to twelve cents per pound.

Carborundum is the trade name given to silicon carbide. This chemical transformation is brought about in the following way:—The element carbon is supplied by crushed coke and the element silicon by sand. These two materials are mixed in certain proportions and loaded into an electric furnace. A little sawdust is added to the mixture to make it porous so that certain gases which form in heating the material can escape, and a little salt is also added to drive out certain impurities.

The electric furnace is rectangular in shape, built of fire brick, about 20 feet long, 7 feet wide and 6 feet high. At each end of the furnace are large carbon rod electrodes to which the electric current is brought through large cables. The furnace bed is filled with the mixture of sand, coke, sawdust and salt, the power is turned on and a heat of approximately 4,060°F. is generated due to the high resistance of the materials between the electrodes. At the end of thirty-six hours the sides of the furnace are taken down, the thick outer crust of slag is removed and the masses of carborundum crystals are revealed.

These crystal masses are taken from the furnace and crushed or broken into individual crystals under iron wheels. The grains or powders thus produced are carefully washed free from all foreign materials and are then dried in immense rotary driers. From the driers the grains are sent to the sifting room, and, much after the manner in which flour is bolted, are sieved through silk screens into grits or sizes corresponding to emery. The graded grains and powders are then mixed with certain bonding materials such as spar, mixtures of clay, rubber and other materials, and are fashioned into the various sharpening stones and grinding wheels, in moulds placed in great hydraulic presses. The moulded shapes are then loaded into fire clay "saggers" or holders and are placed in kilns and for a week are baked at a heat of about 2,500°F. After coming from the kiln the wheels are dressed to the desired sizes, and, after rigid inspection and certified speed tests, are ready to leave the factory.

Carborundum has several predominating characteristics. It is unequalled in its degree of hardness and sharpness. The diamond may be harder, but not sharper. It is also slightly brittle, so that when it comes in contact with the material to be ground it breaks, forming new crystal surfaces and thus new cutting edges. It is also insoluble in any re-agent such as acids or alkalies and is not affected by temperature except at a heat greater than that at which it is formed. Thus, in its various grades and binders, carborundum may be used for cutting, polishing, rubbing or any process in which an abrasive may be used.

For those processes requiring a tougher crystal than that of carborundum there has been developed the abrasive called aloxite. This is made in an electric furnace similar to that used for carborundum from two materials, bauxite clay and coke.

The moving pictures showed the United States and Canadian plants, the process of manufacture and many of the almost innumerable ways in which the abrasive is used in industry. Many questions were asked between the reels and after, by the interested audience, and at the conclusion of the showing a vote of thanks was accorded to Mr. Bowman and his colleagues on the motion of H. E. Treble, S.E.I.C., secretary of the Apprentice Club.

Executive Meeting, March 12th, 1928

A meeting of the Executive Committee of the Hamilton Branch was held on March 12th in the office of W. F. McFaul, M.E.I.C. L. W. Gill, M.E.I.C., chairman of the branch, presided, and there were five other members present.

One application for transfer was considered and recommended.

Plans for a meeting early in April were discussed, also for a dinner-meeting to be held in May.

It was announced that the annual joint meeting with the Toronto Section A.I.E.E. would be held on April 27th in the Westinghouse Auditorium. At this meeting, G. E. Stoltz, of the Westinghouse Electric and Manufacturing Company, will speak on "General Power Application."

Toronto Dinner, March 15th, 1928

The members of the Hamilton Branch were the guests of the Toronto Branch at dinner on March 15th, 1928, and at their meeting afterward at which F. R. McMillan, director of research, Portland Cement Association, was the speaker. The hospitality of the Toronto Branch was much appreciated.

Lethbridge Branch

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

Manufacture of Coke from Alberta Coals

On January 21st, a well-attended meeting was addressed on a subject of more than special interest to Lethbridge people, that of "The Manufacture of Coke from Alberta Coals."

The speaker, Edgar Stansfield, M.E.I.C., honorary secretary of the Scientific and Industrial Research Council of Alberta, exploded the report,—common in the west,—that Alberta had not any coking coals by illustrating tests he had made of various coals from all parts of the province, also those made from imported coals in Winnipeg and other places, showing that coke produced from some of the Alberta coals was excellent in quality and compared very favourably indeed with that from imported coals.

Quotations from provincial statistics showed that, to date, upwards of a million tons of coke had been manufactured in Alberta from its own coals.

Mr. Stansfield stated that the fuel situation was such an important one that it was one of the foremost problems facing the federal government to-day. The Dominion Fuel Board in 1922 recommended the installation of coking plants throughout the "acute fuel area" with the idea that Canadian coals would be used. Unfortunately for Alberta and Nova Scotia, however, American coal secured the market on account of cheaper transportation.

American interests have for some time been looking over the prairie provinces for plant locations. Gas for cooking and lighting would be manufactured to supply the larger centres and the coke sold in the neighbouring territory. Such companies would naturally select American coal for their enterprises, with the result that a further cut would be made into the Alberta trade.

The speaker dwelt at some length on the federal assistance given to coking plants using up to 70 per cent of Canadian coals.

Referring to the necessity of eliminating the smoke nuisance in the larger cities, Mr. Stansfield mentioned that in London, England, the annual deposit of soot amounted to 55,000 tons, creating a material damage of about £4,000,000. In Pittsburgh, it was estimated that from 600 to 2,000 tons of soot was deposited per square mile. London, however, is improving in this respect and scientists declare that within a few years smoke and soot will practically be evils of the past.

Prior to the lecture, the usual community singing was indulged in and very enjoyable violin and piano selections by Mr. and Mrs. Geo. Brown and vocal solos by Mr. G. Frost were thoroughly appreciated by the members.

The meeting closed with a hearty vote of thanks to Mr. Stansfield and to the Research Council.

The Manufacture of Pottery

At the regular bi-monthly meeting held on February 4th, the speaker of the evening was Mr. Charles Pratt, of the Medalta Potteries, Medicine Hat. Following the dinner and business routine, community singing was enjoyed, as also were vocal solos by Messrs. F. Mills and H. Moore.

In opening his subject on the manufacture of pottery, Mr. Pratt stated that in the region of the Nile, evidences had been found in tombs of the period 5000 to 3000 B.C. of vases of terra cotta; likewise, all over the world explorations showed that the earliest tribes were moulding clay into vessels of many descriptions.

Records of chinaware date back to 2000 B.C., but the finest examples of pottery ever seen were made at the time of the Ming dynasty, which began in 1368.

John Wedgewood of England, probably the most outstanding ceramist of present times, developed the factory system of the division of labour, earlier potters having carried their work out individually. England has been fortunate in the possession of deposits of some of the finest china clay ever discovered. The United States, though not having the same grade of fine clays, has made rapid advancement in the pottery industry, made possible through sufficiently high tariffs to encourage local developments.

In Canada, all whiteware is imported, not a single piece being manufactured in this country, but a considerable quantity of stoneware is being produced which holds its place in competition with imported products.

At the plant in Medicine Hat, natural gas is used as fuel, this giving a very dependable and steady heat. The speaker followed the various processes of the manufacture, showing a thorough mastery of his subject, and at the close was accorded a hearty vote of thanks.

Development of Oil in Alberta

The bi-monthly meeting of the Lethbridge Branch was held on February 18th, in the form of a joint meeting with the Association of Professional Engineers of Alberta. The Professional Engineers held their district annual session during the afternoon of the same day, and combined with the members of the Lethbridge Branch of the Institute for the evening meeting. The meeting was preceded by a dinner at which about seventy-five members and guests were present.

The guest of the evening was Mr. T. J. Madgwick, petroleum engineer, of the Department of the Interior. Mr. Madgwick gave a highly interesting illustrated address on the "Development of Oil in Alberta." Coming from the University of Birmingham, England, Mr. Madgwick has been for the past two years with the Dominion Government, stationed in Calgary, and has given the oil structure in Alberta an extensive study. His remarks were most optimistic as to the future of the oil industry in that province, and in the course of his remarks he stated that it is no exaggeration to say that the province of Alberta contains the greatest undeveloped area underlain by known deposits of oil and gas in the world, and, judging by the results of the prospecting and development to date, certainly the most promising.

The members were entertained during the meeting by a delightful musical programme by Messrs. Lawrence, Teague and Meldrum, supported by the Rainbow orchestra, and to well received humorous monologues by Mr. P. Gaynor.

Paints and Varnishes

Southern Alberta flax produces the highest grade of linseed oil known, said W. A. Church, manager of the Alberta Linseed Oil Company, of Medicine Hat, in the course of his address before the Lethbridge Branch on Saturday, March 3rd. During the discussion which followed, it came out that the flax grown in this region was equal to the best Russian flax and superior to that grown in the Argentine and other warm countries. Mr. Church's address was on "Paints and Varnishes," and revealed the great strides made in the manufacture of these products.

Speaking on varnishes, Mr. Church said they are complex mixtures and combinations of organic matter, consisting chiefly of gums, oils, volatiles and oxidizing agents. The gums supply hardness and gloss; the oils contribute elasticity, flowing qualities, tenacity and weather resistance; the volatile matter acts both as a solvent and also reduces the viscosity of the mixture to a point where it can be conveniently applied with a brush or a spray-gun, and the oxidizing agents promote the oxidization, or, in other words, the drying of the film. Generally speaking, these four groups of materials are admixed, or fused together, under great heat.

The gums, of which there is a considerable variety, are the resins of trees. Kauri gum is the fossilized resin of the kauri tree, found only in New Zealand deep in the earth; it is an extremely hard gum and is used in varnishes of the highest grade; it has a melting point of about 550°F. Then we have the gums from the Congo, East Indies, Straits Settlements and from many other parts of the world, most of which are bush gums, that is to say, they are the exudations from living trees; lastly, there are the humble resins from Georgia, Louisiana and other southern states. The melting points and other characteristics of these different gums vary within a wide range, and in the design of a varnish formula, gums are selected which will furnish the particular characteristics which the varnish is required to possess.

The chief oils are linseed oil and tung oil. Soya bean oil, perilla oil, menhaden fish oil, rape seed oil and many other oils are also used to a lesser extent.

Paints are usually made by grinding a mixture of pigment and oil through millstones to an extremely fine state and until each particle of pigment is "whetted" or covered with oil. The mixture is then known as paste, and, within the memory of many of us, it was customary to sell paint in paste form to be subsequently thinned out by the user by the addition of oil and turpentine. Nowadays paint is largely sold in a ready mixed form, although the sale of white lead in a paste form still continues to the same degree as in the past.

The body and covering power of a paint is dependent upon the amount and nature of the pigment it contains in suspension, and, as a rule, the finer the subdivision of these particles, the greater will be the body and covering power; thus, it is most important that paint should be thoroughly and carefully ground in the manufacturing process.

In addition to the true pigments, which have been briefly referred to in the foregoing, there are the extenders, such as barytes, silica, whiting, etc. These materials when admixed in oil or varnish are not opaque, but faintly translucent, and consequently they do not impart hiding or covering qualities to the film. At one time they were looked upon simply as adulterations, although there is a school of thought at the present time which believes that these materials, provided they are used in limited quantities, do tend to compact the mass and thus prolong the life of the paint.

Paints on exposure over a period of years may chalk, crack, blister or flake off, and the original colour may also change or even completely disappear. A high-class durable paint for outdoor use should wear well over four years, retain its colour and chalk only to a moderate degree so that on washing down a good surface remains for repainting.

A lengthy discussion took place after the paper, and Mr. Church was asked to describe the making of linseed oil, the difference between boiled and raw oil and other intimate matters.

The meeting was well attended by Lethbridge engineers, Affiliates of the branch and visitors, who enjoyed the music of the Rainbow Orchestra during lunch. Following the lunch, community songs, a violin solo and a vocal solo by Messrs. Vallance and King respectively were enjoyed.

Moncton Branch

V. C. Blackett, A.M.E.I.C., Secretary-Treasurer.

The regular monthly supper-meeting was held in the Y.M.C.A. on February 22nd, at which G. C. Torrens, A.M.E.I.C., chairman of the branch, presided.

Immediately following the supper, the members were favoured with several delightful solos by Mrs. Harold N. Price.

A. S. Gunn, A.M.E.I.C., referred to the recent election of F. O. Condon, M.E.I.C., and F. L. West, M.E.I.C., to the respective offices of vice-president of Zone D and councillor for Moncton Branch, and moved that the congratulations of the meeting be tendered these gentlemen This was seconded by J. G. Dryden, A.M.E.I.C., and carried unanimously. Mr. Condon replied briefly, expressing his appreciation.

The chairman then introduced Mr. E. W. Jeffrey, sales engineer, Northern Electric Company, Halifax, N.S., who addressed the branch on the subject of "Illumination."

Illumination

Until quite recent years, very little progress had been made in the science of illumination. The oil-filled stone jar of the ancients, with its wick of dried moss, was practically the same in principle as the modern kerosene lamp. The invention of the Edison incandescent lamp in 1896 marked the beginning of a new era. The carbon lamp was hailed as a wonderful discovery, as indeed it was. At the same time, it was very inefficient. The next forward step was the coming of the tungsten light in 1907. This lamp, although very efficient, was very fragile, and four years of experiment were necessary to overcome this defect.

Mr. Jeffrey described in detail the manufacture of the tiny tungsten filament, which, it is interesting to note, has a strength nine times that of steel. Tungsten possesses the peculiar property of retaining, or returning to, when cold, the shape into which it was moulded when hot. Thus, a length of filament wire may be moulded hot, afterwards cooled, then stretched straight and wound on a spool. Later, when removed from the spool and the tension released, the wire springs back into the shape required of the filament and it is then ready for insertion in the electric light bulb.

Objections have been made to electric lighting on account of the glare. Frosting the outside of the globe has not been found a satisfactory remedy. The amount of light was reduced and the frosting was easily soiled and scratched. Recently the problem has been solved by frosting the inside of the globe. Not only is the amount of light given off practically the same as that of the clear globe, but there is also an actual reduction in cost.

By means of a demonstration set, the effects produced by direct, indirect, coloured and insufficient lighting were graphically shown. In some of the states of the United States, factories are now required by law to conform to a given standard of lighting. In this connection, Mr. Jeffrey humorously remarked that in certain shops where improved lighting had been found necessary, tools were found that had been lost for ten years.

On the conclusion of the address, Mr. Jeffrey was tendered a vote of thanks, on motion of G. E. Smith, A.M.E.I.C., seconded by B. E. Bayne, A.M.E.I.C.

Visit of the General Secretary

A protracted but exceedingly interesting meeting was held on March 6th, at which members of the branch had the pleasure of meeting the general secretary, R. J. Durley, M.E.I.C., and of discussing with him various matters affecting The Institute, more particularly certain proposed amendments to the By-laws.

The general secretary made very flattering reference to the activity of the Moncton Branch, and commended the members on the interest shown in the welfare of The Institute.

In introducing the subject of the proposed amendment to Section 29 of the By-laws, an amendment sponsored by members of Moncton Branch, Mr. Durley agreed that the whole question of qualifications for the various grades of membership needed careful study. He felt that the requirements as outlined in the By-laws were neither clear nor satisfactory, and suggested that the present proposed amendment be withdrawn so that Council could give more time and consideration to the whole problem.

On the other hand, Moncton members pointed out that the present amendment has been before Council since February 1927,—considerably over a year,—and the feeling was expressed that if no constructive suggestions had been made in that time the better plan would be to try out the proposed amendment. If any defects developed in the working of the amendment, no serious harm could result. The amendment was at least superior to the present anomaly, and engineers were not the men who could not make a third attempt at improvement.

Further to the discussion of the amendment to Section 29, the suggestion was made that, in the case of a candidate making application for admission or transfer, all councillors should be furnished with the opinions of his sponsors. At present, this information is only available to councillors actually present at a meeting of Council. Those unable to attend have only the brief synopsis printed in the Journal to guide them in deciding on the qualifications of a candidate, and this, it was felt, was not enough to enable them to come to an intelligent decision.

The suggestion was also made that when action is taken by Council in connection with an application for admission or transfer, the branch concerned should be notified immediately. The executive committee of a branch has an important part to play in these matters, and it is only right that it should be advised as to the outcome of the cases in which the branch has an interest.

During the latter part of the discussions, light refreshments were served, after which the meeting adjourned.

Montreal Branch

C. K. McLeod, A.M.E.I.C., Secretary-Treasurer.
W. McG. Gardner, A.M.E.I.C., Branch News Editor.

The New By-Product Coke Plant of the Montreal Coke and Manufacturing Company

(Reported by W. McG. Gardner, A.M.E.I.C.)

On February 23rd, the branch was privileged to welcome a friendly discussion on a most timely subject when Mr. D. G. Munroe, managing director of the Montreal Coke and Manufacturing Company, gave an entertaining and instructive description of the new by-product coke plant now under construction by his company in the town of LaSalle.

In referring to the history of the development of the coke industry, the speaker maintained that even as the production of coke by the bee-hive oven had sprung from the soft coal regions of Pennsylvania, so to-day the Carnegie Steel Company still led the industry with a tremendous plant capable of coking over 30,000 tons of coal per day.

Despite the rapid expansion of the bee-hive coke industry, the growth of the by-product coking plants had been even more phenomenal. From their introduction only thirty-five years ago, they have progressed to equal in production the output of the former early in 1919. Even more striking are the figures for 1926, when of the 520 million tons of coal mined in America, more than 63 million tons were converted to coke by the by-product process, while only 11 millions were utilized in the bee-hive ovens. This marked development in favour of the by-product plant may be appreciated when it is realized that, besides conserving a vast quantity of coal, they provided the industry with by-products valued at some $66,000,000.

However, to derive a profitable advantage from the sale of these by-products, consisting mainly of gas, tar, ammonia and the benzols, it was essential to locate the coking industry adjacent to either a large centre of population or to a metallurgical industry where the products of the plant would be readily saleable.

Such an outlet was being sought in Montreal by the new by-product coking plant situated in the town of LaSalle. This plant, built to utilize 400,000 tons of coal a year, besides providing some 300,000 tons of coke, would produce 5 billion cubic feet of gas and

4 million gallons of tar and 9,600,000 pounds of ammonia sulphate annually.

Owing to the strong market already prevailing in this locality for anthracite coal, it was quite evident that not only must a substitute be eminently satisfactory, but it must also offer an attractive price inducement.

With this object in view, the new plant was designed to utilize carefully selected coals that would yield a coke dense enough to obviate frequent firings, tough enough to withstand rough handling and sized to suit any boiler. Besides these primary qualities, the coke produced must not only be low in ash content, but the ash that is present must be free of any tendency toward fusing at low temperatures.

The coal arriving at the new LaSalle plant, on being unloaded from the barges, is stored in a huge pile by two travelling bridges 300 feet wide. From the pile it is carried on belt conveyors to a hammer mill, where it is pulverized, sufficient pulverized fuel being stored in eight hours to serve the plant in a 24-hour run. The pulverized fuel is then delivered to the fifty-nine ovens through their manholes by a travelling larry.

The long, narrow ovens lined with silica blocks bound with steel are provided on the one side by a ram for pushing out the coke and on the other by a movable car to receive the finished product and carry it to the screens.

The gas, passing off to water-cooled condensers, where the tar is extracted, eventually flows through a lead lined sulphuric acid tank, where the ammonia is precipitated out as ammonia sulphate. Two 6-million cubic feet gas holders store the gas.

The very fine slides and moving picture films with which the speaker illustrated his paper were a feature of the meeting.

In the animated discussion which followed, it was explained that with care the silica linings would last fifteen to twenty years and that the coke weighing 30 pounds per cubic foot must be selected to suit the size of the furnace.

The speaker believed that in a short while coke was destined to be the common fuel.

E. J. Turley, A.M.E.I.C., presiding as the chairman, tendered the vote of thanks, ably moved by Dean H. M. MacKay, M.E.I.C., to the speaker.

Study of Transmission Line Power Arcs

(Reported by N. S. Walsh, A.M.E.I.C.)

A most enjoyable and well illustrated paper of high original merit and outstanding interest was presented to the branch on March 1st by P. Ackerman, A.M.E.I.C., on "A Study of Transmission Line Power Arcs."

The tests which formed the basis of the study were performed by the author at the La Gabelle power house of the Shawinigan Water and Power Company, where the most ingenious arrangements were utilized to control and record these ordinarily ungovernable phenomena.

The study was initiated with a view to determining the main characteristics of these power arcs and to establish a theory that would explain adequately their properties and behaviour.

The theory thereupon developed by the speaker was founded upon the general principle of a heat balance between the heat generated in the arc and that dissipated from its surface. Application of this theory to various combinations of current voltage, insulators and conductors permitted an estimate to be deduced in each case of the pressure and strength as well as of the dimensions of the arc which were then checked by actual observations obtained with oscillograph and kinetograph on artificially created arcs.

The simultaneous acquisition of oscillographic and moving picture records permitted the observations to be preserved, analyzed and studied at leisure.

From the data obtained, it was at this stage possible to reach the following conclusions:—

(a) The duration of the arc does more damage than the value of the current. If the arc is cleared within one-tenth of a second, complete immunity could be expected.

(b) With arcs between parallel conductors wind perpendicular to the lines is the most serious and damaging.

(c) Arcs over suspension insulators usually damage the end units. Arc horns and rings help to protect these units.

(d) Pin type insulators are more sensitive to arc damage than the suspension type because the hot gases are caught under the bottom petticoats and break them.

(e) The arc assumes very large dimensions within one-thousandth of a second.

(f) The pressure during the arc formation is very great.

(g) Arcs tend to spread upward due to a natural chimney effect and are very susceptible to air currents spreading in the direction of the prevailing wind.

(h) There is a fixed relationship between arc voltage, arc current and arc length.

The author emphasized the necessity of clearing a power arc quickly, and stated that the arc voltage is practically independent of the current magnitude, but is proportioned to the length of the arc.

One of the most interesting features of the evening was the slow motion picture demonstration whereby half-second, second and one and one-half second power arcs were lengthened to about five times their duration, rendering their form more easily discernible.

In the discussion which followed, Dr. R. A. Ross, M.E.I.C., and H. Milliken, A.M.E.I.C., drew some interesting comparisons, following which, on a motion of W. C. Adams, M.E.I.C., the chairman, A. B. Rogers, A.M.E.I.C., presented the thanks of the meeting.

Diesel Engines

(Reported by W. McG. Gardner, A.M.E.I.C.)

Following a lucid description of the construction and operation of the "Diesel Engine" before the branch on March 8th, Marc Boyer, S.E.I.C., revealed a wide field of adaptability of this engine as a prime mover to modern industry.

In entering upon his subject, the speaker pointed out that the main difference of the Diesel engine from all other engines employing liquid and gaseous fuels was its method of utilizing the fuel by internal combustion, in contrast with other oil and gas engines, which are, so far as fuel is concerned, strictly speaking, internal explosion engines.

In the Diesel cycle, air alone is compressed to upwards of 500 pounds per square inch and until it reaches a temperature approaching 1,000° Fahrenheit. On the conclusion of this stroke, but previous to the attainment of the dead centre, fuel is admitted gradually in a finely atomized condition during about one-tenth of the working stroke. This fuel is ignited by the prevailing high temperature of the compressed air. There then occurs a gradual burning of the charge which further heats and expands driving the piston outwards. This constant pressure cycle permits 35 per cent of the heating value of the fuel to be directly recuperated in brake horse power at the crankshaft.

With the high temperatures and pressures prevailing in the cylinders of this engine, the pistons, cylinders and cylinder covers are subjected to very high stresses requiring careful study from a metallurgical viewpoint, as well as from that respecting the actual design of these parts.

The importance of this fact in the success and failure of the Diesel engine has now been fully recognized by the metallurgist and the founder.

One of the outstanding features of the Diesel engine is the fuel valve. Of the two systems of fuel injection, known as the air-blast injection and the mechanical or solid injection, the latter has proven its superiority in simplified mechanism and higher efficiency. Unfortunately, it cannot yet be applied to the higher powered units, owing to a deficiency in the inlet velocity, necessary to thoroughly mix the fuel and compressed air. However, research is proceeding and there is reason to believe that this system will be extended, in the near future, to embrace more developments of economical operation.

In the wide field of application for which the Diesel motor is so eminently suited, it is owing to its economy of fuel space and attendance, its high efficiency, low cost of maintenance, absence of ashes, smoke and need for large funnels, reliability and cleanliness of operation, ease of manœuvre and its instantaneous availability becoming increasingly popular for marine propulsion, particularly for submarines.

For stationary installations, these advantages are equally apparent. Its cleanliness recommends it to the flour mill, its high efficiency at any load and overload suits it for application to the peak load problem, and, to the cement mill, its economy of operation has favored its adoption as a source of power for transportation units in both the automotive and the locomotive traction fields. These and other illustrations indicate its great flexibility of adoption to any possible industrial and commercial enterprise.

Following an interesting discussion, H. W. Swabey, M.E.I.C., moved the thanks of the meeting, which was presided over by T. J. Durley, S.E.I.C.

Ladies' Tea

The proposed new club composed of the wives of the Montreal members of The Engineering Institute of Canada held their first tea meeting in the Blue Room of the Windsor hotel on Friday afternoon, March 16th.

The seventy ladies present were received by a committee consisting of Mrs. Geo. R. MacLeod, Mrs. J. L. Busfield and Mrs. W.

C. Adams. The remaining member of the committee, Mrs. F. C. Laberge, was absent on account of illness in her family.

Mrs. MacLeod, who presided, described the aims and objects of the proposed club.

For the present, the activities will be purely social. The next meeting will be in April, and, following that, in October there will be a business and organizing meeting.

The tables were artistically decorated with spring flowers provided by branch members.

Niagara Peninsula Branch

Walter Jackson, M.E.I.C., Secretary-Treasurer.
C. G. Moon, A.M.E.I.C., Branch News Editor.

On February 24th, the Branch had a dinner meeting and evening business session at the Hotel Dexter in Welland city. The local Lions Club also happened to be meeting there at the same time and quite a few of the Lions remained to hear the addresses.

A "roar" was given for the engineers and one of our most prominent members participated. The exact ethics of an Engineering-Lion "roaring" for himself as an engineer is being hotly debated. The question being as to whether he should not also join in the applause for his roar.

After dinner a short business session was held and among other things the scrutineers announced that the recent amendments to the branch by-laws were adopted by a vote of 35 for and 3 against.

Congratulations were extended to A. J. Grant, M.E.I.C., upon his recent election to the vice-chairmanship of the Institute for Ontario and to M. B. Atkinson, M.E.I.C., as councillor representing the branch.

The branch recorded an approval of the action taken by the Toronto Branch in withdrawing from the vice-presidential contest this year with the expressed intention of assisting the membership in electing to this office a nominee from one of the numerically smaller branches.

Grand Falls, Hydro-Electric Development

Gordon Kribbs, M.E.I.C., of H. G. Acres and Company, was the intended speaker on the subject of Grand Falls development, but at the last minute he was unavoidably detained and his place was filled by Messrs. J. C. Krumm, H. E. Barnett, JR.E.I.C., A. W. McQueen, JR.E.I.C., and W. D. MacDonald, S.E.I.C., all of whom belong to the same organization,—filled most successfully, judging from the interest shown and the number of questions that were being asked.

Mr. Krumm began by giving a general description of the plant illustrated by a very fine set of lantern slides. The stream flow at Grand Falls, he said, is very fluctuating with a minimum flow of 800 c.f.s and maximum 133,000 c.f.s, thus requiring considerable storage capacity for the operation of the plant. Storage is now being developed for three units at 20,000 h.p. with two units installed, provision for two similar units in the future and a potential capacity of seven or eight units, when sufficient storage can be made available.

There is a head of 132 feet available at Grand Falls with a tunnel about 2,700 feet in length. The single tunnel already built is of horse-shoe shape with a nominal diameter of 24 feet 6 inches. It will serve the first four units.

The head works include a dam with nine Stoney sluice gates, each 23 feet high and 50 feet wide, as well as two gates 24 feet wide between concrete piers. The wide gates are controlled by a travelling hoist and the two smaller gates each by a stationary hoist, the intake is of the Johnson-Wahlman draught distributor type, consisting of two concrete tubes extending for a distance of 160 feet in opposite directions from the tunnel, carrying the water to the power house. The tubes are throughout their length provided with a slot for admission of water, the width of which gradually decreases from the end of the tube towards the tunnel entrance, thus providing equal draught throughout the length of the tube and also an even distribution through the rack.

At the lower end of the tunnel and immediately behind the power house stands the huge differential surge tank 73 feet in diameter and 37 feet high, with a capacity of approximately 1¼ million gallons. This tank is also one of the notable features of the plant. It is supported on a tower consisting of eighteen columns, 95 feet high, built of H-section, and provided with adjustable bracing to be finally tightened when the tank is filled to normal operating water level.

The external riser connecting the penstock with the bottom of the tank is 21 feet in diameter. Inside the tank and concentric with the external riser is an internal riser of 19 feet in diameter. This extends for a certain distance down into the external riser, leaving an annular opening, through which water can enter or leave the tank. This opening, or port, is so proportioned that under load changes an artificial—differential—head is created to accelerate or decelerate the flow of water in the tunnel within a predetermined limit of head variation.

Extreme precautions were taken to prevent any frost action both at the top of the tank and at the penstock junction. The sides, however, were left more or less unprotected, as experience has proved that a maximum of six inches of ice would form and this would not seriously interfere with the proper performance of the tank.

Mr. McQueen explained the details and operation of this surge tank and also the newest type of water seal, which was used in conjunction with the butterfly regulating valve at the power house.

The valve disc is set about 1/16 inch clear of the housing. In this is a recess which holds the rubber hose ring seal. The hose is prevented from collapsing by means of an internal spiral spring. When the valve is shut, water pressure is let into the hose, thus expanding it and closing the 1/16 inch opening. Tests have shown this type of seal to be highly successful.

Mr. Barnett dealt with both the political and economic phases of water power development in New Brunswick and questions as to the electrical equipment were answered by Mr. MacDonald.

E. C. Cameron, A.M.E.I.C., who was in the chair, thanked the speakers most cordially on behalf of the branch and took occasion to say that the scenery along the St. John valley was particularly fine and worthy of inspection if any member ever happened to be motoring through that part of Canada.

Ottawa Branch

F. C. C. Lynch, A.M.E.I.C., Secretary-Treasurer.

Ottawa Branch activities in the past month included three Thursday luncheons at the Chateau Laurier, at which the speakers were:—Wyatt Malcolm, of the Geological Survey, Department of Mines; Col. David Carnegie, C.B.E., F.R.S., and A. C. Fieldner, Member, American Chem. Soc., chief engineer of the Experiment Stations Division, United States Bureau of Mines.

On February 23rd, Mr. Malcolm, who is chief of the Division of Geological Information in the Geological Survey, described the trip which he made to Newfoundland with the Empire Mining and Metallurgical Congress last summer, and gave the members first-hand information on the mining resources of that country.

Mining Resources of Newfoundland

Newfoundland, Mr. Malcolm said, now has a population of about 263,000, and its largest city, St. John's, has 40,000 inhabitants. Touching on the geological history of the island, he described it as a peneplain with a structural trend to the northeast descending from an altitude of 2,000 feet at the west to 700 feet at the east, with a westerly coast line indented by deep fiords of picturesque beauty and an east coast of numerous peninsulas and long bays.

The Congress party crossed over from Sydney, Nova Scotia, to Port aux Basques and travelled across Newfoundland by railway. They were given excellent opportunities for studying the resources of the island, the extensive stands of timber, the pulp and paper industries at Corner Brook and Grand Falls, the water powers, etc.

The minerals of Newfoundland, Mr. Malcolm said, consist of iron, lead and zinc, copper, pyrites, limestone, gypsum and coal. At Buchan's mine there are extensive deposits of lead and zinc. The American Smelting and Refining Company had entered that field and is carrying on electrical prospecting. Development work to date has indicated 3,000,000 tons of ore, carrying 3 ounces of silver to the ton, 2 per cent copper, 7 per cent lead and 16 per cent zinc. A concentrator is being erected to handle 600 tons per day. Very wonderful developments in zinc, lead and copper might be expected, Mr. Malcolm thought, if an active campaign of prospecting was undertaken similar to that in Ontario and Quebec.

The greatest mineral wealth yet disclosed in Newfoundland was, however, the great Wabana or Bell island iron ore deposits, which had been worked for 30 years and there was still not the slightest indication of any exhaustion. There was no danger, the speaker said, of these deposits being exhausted in the present generation. Sea erosion had stripped all but a remnant of the red hematite iron ore from Bell island, but the strata dip under Conception bay and the iron is recovered in extensive submarine mining operations, which Mr. Malcolm described in considerable detail. The limit of recoverable ore will depend on the distance to which submarine mining can be carried, and the ore had been estimated at 3,500,000,000 tons to a distance of five miles. This year's programme calls for taking out 1,300,000 tons, 800,000 tons of which are for Germany, 400,000 to be shipped to Sydney, Nova Scotia, and 100,000 tons elsewhere. There are three ore beds, in thickness ranging from 5 to 8 feet, 7 to 10 feet and 13 to 24 feet. These beds are separated by sediments 58 feet and 240 feet in thickness. Submarine mining is carried on for 1 to 2½ miles under the sea.

Dr. Chas. Camsell, M.E.I.C., chairman of the Ottawa Branch, presided and extended the thanks of the members to Mr. Malcolm for an interesting and instructive address.

Armaments Problem

On March 1st, Col. David Carnegie was the guest of the Ottawa Branch, and delivered a forcible address on the "Armaments Problem from the National and International Viewpoint." Col. Carnegie is well-known to Ottawa members through his work during the war as technical adviser to the Canadian government in the manufacture of munitions. He was the Canadian member of the Temporary Mixed Commission for the Reduction of Armaments, 1921-24, and has recently been engaged in giving a series of addresses in England for the League of Nations Union.

Introduced by Dr. Chas. Camsell, in the chair, Col. Carnegie declared that there is a very serious danger of a repetition of 1914 unless armaments are reduced. During the war he had been engaged in munitions work, not for war, but to help to put out the conflagration in Europe, and he saw danger of another conflagration for which the faggots were being piled in international competition in armaments. "There is a limit," the speaker said, "beyond which armaments provoke war, and it was the function of the League of Nations to keep within that limit."

Col. Carnegie outlined the efforts of the League to establish a just basis for the reduction of war armaments. A certain amount of armament was necessary for protection of trade routes; the problem was to find an equitable limit for each nation and to get them to agree to it. As it is now, Nation A builds certain armament and Nation B, through fear, immediately embarks on a building programme, not of equal strength, but adding an increment claimed to be necessary for her own safety, and so the process goes on. Human nature, Col. Carnegie contended, had not changed a bit.

The failure of the League to establish a just basis for reduction of armaments was ascribed by the speaker to three underlying causes:—non-ratification of the Treaty of St. Germain; the subsidizing by governments of the public and private manufacture of poison gas, and the freedom of the seas. Referring to the latter, Col. Carnegie contended that Great Britain was no longer able to exercise what she considered her right to search and blockade, owing to the introduction of aerial warfare, and considered that the right of blockade should be relinquished to the League of Nations.

Col. Carnegie made a strong plea for the adoption by Great Britain and Canada of the optional clause, which recognizes the jurisdiction of the Permanent Court of International Justice in any classes of legal disputes, the interpretation of a treaty, any question of international law and the nature or extent of the reparation for the breach of an international obligation.

"The public mind in Great Britain," stated Col. Carnegie, "is not yet adjusted to the acceptance of a third party judgment." The speaker stressed the fact that Canada was devoid of entangling relations with neighbours, and without any armament along her frontier has for years settled all her disputes by arbitration. These were given as reasons why Canada should accept the optional clause. It had been accepted by twenty-eight nations, but there is not one state within the British Empire which has signed it. That is why a campaign is going on all over Britain "to shake from the minds of the people the stubborn idea that they are so superior to justice itself." The acceptance by Canada of the optional clause would, Col. Carnegie thought, have a far-reaching effect on Great Britain.

Experimental Stations, United States Bureau of Mines

On March 15th, A. C. Fieldner, chief engineer of the Experiment Stations Division of the United States Bureau of Mines, was the guest of the Ottawa Branch, and gave the members a comprehensive outline of the research work carried out under his supervision.

The speaker was introduced by Dr. Charles Camsell, M.E.I.C., in the chair, who feelingly alluded to the generous and prompt action of the Pittsburgh Experiment Station in forwarding by special train a car equipped for mine rescue work to Porcupine at the time of the disaster at the Hollinger mine.

Mr. Fieldner traced the history of the formation of the experiment stations, which now number eleven, the Pittsburgh station, the oldest and largest, owing its inception to a realization of the necessity of taking adequate steps to safeguard coal mines. At Pittsburgh, stated Mr. Fieldner, there is a staff of 250 research workers; at Bartlesville, Oklahoma, 60, and at the remaining nine stations an average of 6 each.

The Pittsburgh station is engaged primarily in research problems relating to coal and coke. The field of work covers mining and utilization, and includes safety and efficiency or the reduction of waste so as to conserve coal as a natural resource. The safety work of the experiment station is not entirely confined to mines, and, in fact, Mr. Fieldner said, was much in demand outside. A great many studies centered around carbon monoxide—the dangerous product of incomplete combustion. He said that through the work of the experiment station apparatus had been perfected which would determine the proportion of carbon monoxide in air to 1/1,000 of one per cent. The instruments had been installed in the new vehicular traffic tunnel under the Hudson river at New York, and gave the engineers absolute control of atmospheric conditions at all times. At times, when traffic is light, the volume of air supplied to the tunnel can be curtailed and again increased for rush hour traffic—this control being possible with safety due to the carbon monoxide indicators. The economies effected in power consumption, in the opinion of the engineers, would pay for the installation in the first year. Tetraethyl lead was investigated as to toxicity at the Pittsburgh station, this at the request of General Motors Corporation. Mr. Fieldner said that the station frequently carried out investigations for private interests at the expense of the applicant, but that such research work must be on broad problems of public interest and with the understanding that the researches will be published.

The station at Bartlesville, Oklahoma, in which 60 research workers are engaged, is for petroleum research. The other nine stations are what are termed "Foster Experiment Stations," Mr. Fieldner said, because they were provided for under the Foster Act. They are located in close proximity to the mining fields. They work in co-operation with the state, which supplies part of the appropriation, and they are usually located at the state university, but control rests with the federal Bureau of Mines.

Mr. Fieldner closed his talk with a sketch of the investigations at present being carried on at these Foster Experimental stations, and stated that a great deal of valuable assistance had been given to the mining industries through this decentralized system of handling research in stations close to the industry. The list of stations and their principal work was stated by Mr. Fieldner to be:—Minneapolis, Minn., iron ores, beneficiation, reduction of slag, blast furnace problems; Mosco, Idaho, concentration problems of Coeur d'Alene ores; Seattle, Wash., clays and non-metallic minerals, coal washing; Berkeley, California, physical constants, metal oxides and sulphides, metallurgical processes; Reno, Nevada, rare and uncommon minerals, research on gold, silver, platinum, etc.; Salt Lake, Utah, flotation problems of lead-silver, lead-zinc and copper ores; Tucson, Arizona, low-grade copper ores, leaching, reaction in converters; Rolla, Missouri, ore dressing problems, lead and zinc ores; Tuscaloosa, Alabama, beneficiation of low-grade bauxite, flotation of low-grade phosphate ores, coal washing.

Fuel Station to Operate in Ottawa

Dr. Camsell, in thanking the speaker for his interesting address, stated that the Dominion government had set aside $100,000 for the erection of an experimental fuel research station in Ottawa destined to be the most complete of its kind under one roof in North America. It would be in operation next fall, he said, and its erection had been made possible through the interest manifested by Hon. Chas. Stewart, Minister of Mines.

Peterborough Branch

W. E. Ross, A.M.E.I.C., Secretary.
B. Ottewell, A.M.E.I.C., Branch News Editor.

The usual fortnightly meeting of the branch was held on Thursday, February 23rd, the speaker being B. E. Norrish, M.E.I.C., managing director of the Associated Screen News, Limited, Montreal. His subject was "The New Era of the Motion Picture." This meeting was somewhat of a departure from the usual engineering subjects, but Mr. Norrish pointed out several instances where the motion picture camera could be utilized by engineers and others in developing particular lines of business.

The New Era of the Motion Picture

Mr. Norrish stated that we are entering a new era of the motion picture in which it is about to be discovered as a new tool of general utility. The time is near at hand when an understanding of the capacities of the camera and the projecting machine is likely to be as fundamentally important to the engineer and the industrialist as the table of logarithms or any of the common instruments of applied science. Fundamentally, the motion picture is but the most recently evolved of a long line of instruments of expression and record, running through history from the stylus, pen, brush and printing press to the evolution of the camera.

The speaker mentioned that until recently there was a continual striving towards more powerful light sources for the taking of motion pictures, but due to the development of illumination we now have all the light necessary for this purpose. Moreover, the film emulsions are now many times more sensitive than those in use years ago. Lenses have been developed to admit eight or more times as much light as formerly.

In the purely mechanical aspects of the camera and the cinema machinery we are already pretty close to perfection. The best of our cameras now work to precision limits well within one ten-thousandth of an inch. Something of their accuracy may be understood from the fact that a single negative can be put through a camera ten times for a series of multiple exposures and yet so perfectly register each of those exposures with reference to the others that the picture is steady within itself as though it had all been exposed at one passage through the mechanism. This accuracy is made necessary because of the tremendous magnifications to which the picture is subjected in screen projection. The tiniest error casts a vast shadow of itself on the screen.

At the close of the lecture, Mr. Norrish showed several short films illustrating very well the points he had brought out in his paper. An interesting discussion concluded the evening, and Mr. Norrish was accorded a hearty vote of thanks.

Presentations to Students

At the regular meeting of the Peterborough Branch held on Thursday, March 8th, 1928, several presentations were first of all made by the chairman, A. E. Caddy, M.E.I.C. Messrs. M. C. Lowe, S. J. Hayes and O. T. Foulkes, Student members of the branch, were presented with Institute badges for having prepared and delivered papers before the branch at a recent meeting. W. T. Fanjoy, S.E.I.C., was then presented with The Institute prize for his paper on "Controls of Common Types of A.C. Motors," which was given last year and entered for the Student prize competition. This presentation was made by B. L. Barns, M.E.I.C., past-chairman, who instituted the Student Section of the Peterborough Branch. Mr. Barns called attention to the honour reflected on Peterborough Branch through the winning of the prize by Mr. Fanjoy. The recipient, in reply, expressed the hope that the prize might come to Peterborough again in the future. He had derived real benefit from the work of preparing the prize-winning paper.

The Lengthening of Niagara Falls

The speaker of the evening was Mr. W. K. Bradbury, of the Public Relations Department of the Niagara Falls Power Company, his subject being "The Lengthening of Niagara Falls" and covering the proposed remedial works for the preservation of the natural beauty of the falls. The speaker used a large number of very fine lantern slides to illustrate his address. He commenced with the progress of the Niagara Falls Power Company from 1906 to the present time, pointing out the various additions to the power plant during that time. A detailed description of the most recent extension, including the three 70,000 h.p. waterwheel units, both during construction and on completion, was given. The illustrations of this plant during construction gave a good idea of the magnitude of the undertaking.

Pictures of other power plants, both on the Canadian and American sides, were in turn explained, and the speaker passed on to discuss the problem of preserving the natural beauty of the American and Canadian falls. By diagrams, pictures and finally by showing a model of the entire district, built to scale, Mr. Bradbury told of steps necessary and feasible whereby the constant wearing away of the Horseshoe falls might be checked, and concluded by answering a number of questions from his auditors, ranging from inquiries for technical details to his opinion of the Chicago water diversion.

A hearty vote of thanks was accorded the speaker at the close of the meeting.

St. Maurice Valley Branch

Romeo Morrissette, A.M.E.I.C., Secretary-Treasurer.

At a meeting of the St. Maurice Valley Branch held at Grand'-Mere on January 21st, 1928, an interesting address was given by Mr. J. S. Riddile.

The speaker dealt with various features of modern water power development and referred to the improvements in the design of hydraulic equipment; the greater control of the run-off of streams; and the proper design of plants to ensure the full use of the maximum power available as items which have greatly increased the efficiency of power developments and thus provided much greater returns to the operating companies. He also discussed briefly the excellent research work which is being carried on through experiments with modern equipment.

A Glimpse of Our Rivers Through the Eyes of the Law

On March 17th, Hector Cimon, A.M.E.I.C., engineer, Price Brothers and Company, Limited, Quebec, presented before the branch a very interesting paper entitled "A Glimpse of Our Rivers Through the Eyes of the Law." After briefly outlining the present stage of development of the water power resources, the speaker gave various extracts from the Statutes in order to explain the principles and laws which govern the administration of the rivers in the province of Quebec. He then explained the present practice of the government in granting power rights.

Sault Ste. Marie Branch

A. H. Russell, A.M.E.I.C., Secretary-Treasurer.

The regular monthly meeting was held on Friday, February 24th, in the Y.W.C.A. rooms.

W. S. Wilson, A.M.E.I.C., the chairman, called the meeting to order, and, the regular business being completed, he gave a brief account of his trip to Montreal when he attended the Annual General Meeting held in February, and while there he met several of our old members who are now in and around Montreal.

The Legal Aspect of a Contract from an Engineer's Standpoint

The speaker, Mr. H. S. Hamilton, of the firm of O'Flynn, Hamilton and Carmichael, solicitors, of this city, gave an address on "The Legal Aspect of a Contract from an Engineer's Standpoint." He used as a basis the "Laws of England" by the Earl of Halsbury and followed through a building contract in relation to the engineer and architect. After carefully explaining the preliminary work and specifications which lead up to the letting of a contract, he said that "A tender or bid is an offer from a contractor to owner, and once accepted it becomes a binding and legal contract and must be carried out by all parties concerned; also, that a contract in writing must be varied only by a written agreement by both parties and that municipal corporations are governed by statutory laws in regard to contracts."

A lengthy discussion followed and all the members and guests took an active part in it, many interesting local cases were aired and Mr. Hamilton was kept busy answering and explaining questions. Messrs. Seymour and Ross moved a hearty vote of thanks to Mr. Hamilton for his splendid address.

Toronto Branch

W. B. Dunbar, A.M.E.I.C., Secretary-Treasurer.
J. W. Falkner, A.M.E.I.C., Branch News Editor.

The Requirements for a Durable Concrete as Observed from Structures in Service

Owing to the Annual General and Professional Meeting held in Montreal from February 14th to 16th, 1928, the regular meeting of the Toronto Branch was postponed from Thursday, February 16th, to Thursday, February 23rd, when the chairman of the branch, R. B. Young, M.E.I.C., presented, before a good attendance of the branch, the same paper presented by him a week previously before the Annual Meeting at Montreal, the subject being "The Requirements for a Durable Concrete as Observed from Structures in Service."

The speaker dealt with his subject in a most interesting and useful manner, first reviewing our present knowledge regarding the action of the various natural destructive agencies on concrete as revealed by structures in service, and then pointing out the important part that porosity plays in each of these. The conclusion was reached that much of the lack of durability displayed by concrete structures is preventable by the exercise of ordinary care in the selection of the concrete materials, and by the use of right methods of protection. The paper was well illustrated with numerous slides showing structures in excellent condition after 25 to 60 years of service, and also by numerous slides showing different types of concrete deterioration, the reasons for which were explained in detail. No more than a summary of the paper will be here given, as the paper was printed in full in the March issue of the Journal.

The interest taken by the membership in the paper was exemplified by the live discussion and the numerous questions put to the speaker following his paper, after which Geo. A. McCarthy, M.E.I.C., moved a hearty vote of thanks to the chairman for his paper, mention being made that while Mr. Young had not this year given a chairman's address to open the season's work, he had now more than made up for the deficiency by the paper he had given. The motion was enthusiastically carried by the meeting, and at the unanimous request of the members was presented by the chairman, (in his capacity as chairman), to the speaker, (in his capacity as speaker).

Tendencies in Steel Building Design

(*Reported by G. A. Tobias,* A.M.E.I.C.)

The feature of the regular meeting on March 1st, 1928, was the presentation by D. C. Tennant, M.E.I.C., designing engineer of the

Dominion Bridge Company, Montreal, of a highly interesting paper dealing with "Tendencies in Steel Building Design," the meeting being preceded by a well-attended dinner at the Faculty Union, Hart House, to welcome the speaker. A large number of members were present, and L. W. Wynne-Roberts, A.M.E.I.C., was chairman of the meeting, owing to the unavoidable absence of R. B. Young, M.E.I.C.

Mr. Tennant first traced the development of steel as a building material, from the early days, when metal structures were composed almost exclusively of wrought iron, showing that gradually iron was displaced by carbon steel, until at the beginning of the twentieth century the use of iron for this purpose had been almost wholly discontinued. At the present time, alloy steels have made their appearance and have been incorporated to a small extent in structures.

Certain of the structural shapes evolved at the beginning have persisted to the present, whereas many others have become obsolete.

The steady increase in the design stress, as improvements took place in manufacturing and fabricating methods, was clearly shown by reference to various bridge and building specifications which made their appearance as the use of structural steel developed.

The speaker laid emphasis on the great divergence in the building code regulations prepared by various municipal and technical bodies, but while stressing the importance of uniformity, he pointed out the dangers of too much standardization.

Up to this point, Mr. Tennant's paper dealt with structures in general, but, to be more specific, he stated that he wished to confine his further remarks to high buildings in particular.

A comparison of the building codes of twelve large cities would show very little variation in the unit weights specified for dead loads; but a similar comparison, made on the basis of unit live loads, and permissible reductions therein, unit stresses for dead and live loads, wind loads, and allowable stresses for same, indicated a wide discrepancy.

The various points referred to were brought out clearly by slides thrown on the screen.

To illustrate some of the results brought about by applying different theories of wind stresses, Mr. Tennant quoted from the words of a chief engineer of a large fabricating concern, who points out "that, of four large buildings passing through our shops, in one case, where the wind bracing might be called reasonable and sufficient, the provisions for taking care of the wind stresses were about twelve per cent by weight of the connecting beams and girders, whereas in another building, designed for a similar purpose, these extra provisions for taking the wind stress were about five times those carrying the vertical load, and the total beam connections were nearly forty per cent of the weight of connecting beams and girders." A considerable difference, indeed !

Mr. Tennant then spoke of the general problem of ascertaining the amount of horizontal shear, both transversely and longitudinally, transmitted from floor to floor, and the part played by each unit of the structure in transmitting this shear.

The effect of the wall and partition resistance, their bond to the steel work, the assistance given the steel skeleton by the concrete, were matters of uncertainty, and, in the opinion of the speaker, called for further research work to establish the validity of the assumptions upon which our present analytical methods are based.

Each high building brought its own problems, due to different limiting conditions, and it was not to be expected that any one method of solution would find a universal application.

An illuminating example then followed of the wide difference in results to be expected from applying the regulations of three different building codes to the design of a given structure. A hypothetical twenty-one storey office building was chosen, of regular outline and uniform column centering in both directions. All assumptions were simplified in order to carry out the designs, three of which were made, one each in conformity with the codes of Winnipeg, Montreal and Toronto. The columns were designed to Bethlehem sections, and the beams to the new Carnegie sections. The Winnipeg code gave a structure showing the lowest unit weight, or 1.1 pounds per cubic foot. Montreal came next with 1.16 pounds, whereas Toronto code gave 1.38 pounds, or a variation between Toronto and Winnipeg of 25 per cent. These unit weights were comparative only, inasmuch as simply the steel skeleton proper had been considered, whereas the supplementary features of the building, such as stairs, cornices, pilasters, corbels, etc., would add considerably to the weight. These, however, would be common to each design and would not affect the relationship of the unit weights to any extent.

Mr. Tennant had suggested before commencing his paper that it might be better for discussion to take place during the reading of the paper, and in the discussion which ensued at this juncture, attention was drawn to the economic significance of these figures by J. M. Oxley, M.E.I.C. The rigid application of the provisions of a building code of an unduly conservative nature imposed a severe burden on the building industry. Capital seeking investment looks askance at high building costs. Manufacturers in weighing the advantages of this or that city considered the capital outlay required for building, and any city in which too severe regulations prevailed would find itself hampered in attracting new industries.

The speaker then mentioned alloy steels and pointed out the conditions under which their use could be made profitable.

The uses of welding in fabrication were next considered, and results were given of tests made at the Rensselaer Polytechnic Institute and also in the Dominion Bridge shops at Lachine. It was stated that research in welding has not yet progressed to a point where it is possible to safely establish working unit stresses for tension and transverse shear in welded joints, but that the future for this recent development in fabrication seemed very bright, and those engaged in research in this field were doing a work for which all engineers should feel thankful.

An interesting discussion ensued, but the speaker having arranged to catch the night train, it unfortunately became necessary to curtail the discussion, and the presentation of a vote of thanks to the speaker closed a most successful meeting.

Modern Building Regulations for Reinforced Concrete

(Meeting reported by F. N. D. Carmichael, A.M.E.I.C.)

The regular meeting of the Toronto Branch was held on Thursday, March 15th, in the Mining Building, University of Toronto.

Previous to the meeting a dinner was given at Hart House, where a number of members of the branch, as well as several guests from Brantford, Hamilton, St. Catharines, Niagara Falls, etc., and also representative architects, availed themselves of the opportunity to meet the speaker of the evening, F. R. McMillan, director of research, Portland Cement Association, Chicago.

At 8.15 the meeting was opened, with one hundred members present and R. B. Young, M.E.I.C., chairman of the branch, presiding, who introduced Mr. McMillan, and an intensely interesting paper followed, the subject being "Modern Building Regulations for Reinforced Concrete."

Mr. McMillan summarized the steps, covering a number of years and embracing a vast amount of research work, which resulted in previous standard codes and finally in the proposed Standard Building Code for Reinforced Concrete, which was presented in February of 1928 at the Convention of the American Concrete Institute, Philadelphia. This code was prepared jointly by the American Concrete Institute and the Concrete Reinforcing Steel Institute.

The problem of a standard code is extremely complex, more so than for the older forms of construction, due to (1) the comparative newness of this form of construction, (2) the various ways or systems of construction, (3) the rapidly accumulating test data relating to reinforced concrete.

The value of such a code is readily seen, as at present practically every city works on different regulations and a standard code would serve as a basis for the different cities to revise their regulations in keeping with the times, tending to bring more consistency of design in the various parts of the country.

Some outstanding variations from the Joint Committee and other reports were dealt with very capably by Mr. McMillan.

The new regulation for load tests calls for less live and dead load, but requires more rigid attention to the duration of the test, the amount of permanent distortion and the percentage of recovery after the removal of the test load.

The importance of competent inspection by the owner, which would be certified for the benefit of the local building department, is very apparent, as it is impossible for the various building departments to superintend everything.

In respect to the quality of concrete, full recognition is given to the definite dependence of the concrete strength on the water-cement ratio, and with this ratio fixed the proportions of aggregates are fixed by the requirements of consistency and placing.

Unit stresses in concrete are in accord with the Joint Committee, with the exception of a higher shearing stress under certain conditions, the requirements being certified inspection as to placing of reinforcing by the designing engineer.

The unit tensile stress in reinforcement has been raised to 20,000 pounds per square inch for intermediate grade of billet steel and rail steel reinforcing bars.

The design assumptions vary from present methods in regard to the value of "n" and for negative moment in end spans slightly restrained.

Changes have been made in the method of computing the safe load on steel columns encased in concrete, and also in that of spiral columns, where the requirement is that the spiral reinforcement shall always be 25 per cent of the longitudinal to insure an increasing amount of lateral reinforcement with increasing loads and unit stresses.

At the conclusion of the paper the meeting was thrown open to general discussion and some very appropriate points were raised which Mr. McMillan answered to the satisfaction of the large and interested audience. After a hearty vote of thanks to the speaker, the meeting was adjourned.

Vancouver Branch

F. P. V. Cowley, A.M.E.I.C., Secretary-Treasurer.

A regular meeting of the branch was held at the University Club on February 15th, at which W. L. Ketchen, M.E.I.C., gave a most interesting paper on "The Manufacture of Bleached Sulphite Pulp on the Pacific Coast of British Columbia."

The Manufacture of Bleached Sulphite Pulp on the Pacific Coast of British Columbia

Mr. Ketchen described briefly the preliminary information necessary before a site for a mill can be decided upon, and then went into the different features entering into the choice of equipment and the marketing of the product. He dealt at some length with the pulp wood resources of the province of British Columbia, and explained briefly the process of manufacturing bleached sulphite pulp, describing in turn various types of equipment used in such a mill.

In closing, he emphasized the importance of the research work which is being carried on in order to find new and profitable uses of the by-products and cellulose.

Executive Committee Meeting

During the period from February 8th to March 14th, one meeting of the executive committee of the branch and five regular meetings of the Student Section of the branch were held, the latter being reported elsewhere.

At the executive committee meeting which was held on February 17th, the subject uppermost in the minds of the members was the forthcoming Western Professional Meeting to be held June 7th to 9th, 1928. Great interest is being taken in the meeting, and preliminary organization work is being undertaken.

Student Section of the Vancouver Branch

The Student Section of the Vancouver Branch has held a number of interesting meetings since its formation, some of which were reported in the last issue of the Journal. The officers of this section are:—E. Bebb, president, J. H. Legg, S.E.I.C., vice-president, and A. Peebles, S.E.I.C., secretary-treasurer.

The Major Street Plan for Greater Vancouver

At the Students' Section meeting, held on Wednesday, February 8th, at the University of British Columbia, the speaker was A. E. Foreman, M.E.I.C., chairman of the Major Streets Committee of the Vancouver Town Planning Commission. His subject was "The Major Street Plan for Greater Vancouver." Mr. Foreman gave the audience a clear insight into the future of Vancouver from a population and traffic standpoint and of the future conditions of traffic density in this city. He showed the necessity of meeting these conditions in the present by means of a liberal street development. The cost of such development, while appearing considerable just now, would be negligible compared with the future cost after the streets have been built up. This was illustrated by examples from large cities which are now experiencing this problem. Mr. Foreman illustrated the street planning in Vancouver on the screen.

About 60 students and members of the faculty were present.

Rail and Water Transportation Facilities of Vancouver

At the meeting held on Wednesday, February 15th, at the university, the speaker was H. L. Seymour, M.E.I.C., who gave the scheduled lecture on "Rail and Water Transportation Facilities of Vancouver." This address was to have been delivered by Major W. G. Swan, M.E.I.C., who was unable to be present. The president read a letter from Major Swan expressing regret at his absence and promising to address the club in the near future.

Mr. Seymour undertook to give the address on very short notice, but he gave a clear view of the harbour possibilities of Vancouver, and also of the plans of the Town Planning Commission to regulate this development. The lecture was illustrated by a number of lantern slides.

About 70 students and members of the faculty were present.

Address on Forestry

At the meeting held on Monday, February 21st, at the university, the speaker, Dr. C. A. Schenck, was introduced by Prof. H. R. Christie. Dr. Schenck is a well-known German forestry expert who is at present making a tour of North America. He gave a very interesting address, partly informative, partly philosophical, showing how he combined philosophy with study and teaching. His remarks on forestry were general and designed to reveal it in the light in which it should be regarded. In closing, he warned the people of British Columbia to protect their forests or they will be left with barren wastes, which is all that remains of some of the mediæval European forests.

About 120 students and members of the faculty were present.

Bridges, Ancient and Modern

At the meeting held on Wednesday, February 29th, at the university, the speaker was Mr. Robert Bayliss, civil engineering graduate of the University of British Columbia, who gave a lecture on "Bridges, Ancient and Modern." By means of lantern slides, Mr. Bayliss showed the developments in bridge building from ancient times down to the present. He illustrated the various types of bridges and showed also some of the famous bridges of the world.

About 50 students and members of the faculty were present.

Enlarging the Capacity of City Streets

At the meeting held on Thursday, March 8th, at the university, the speaker, J. C. Oliver, S.E.I.C., civil engineering graduate of the University of British Columbia, gave a very interesting address on "Enlarging the Capacity of City Streets." Mr. Oliver treated this problem from the standpoint of ways and means of relieving existing traffic congestion. He indicated the various methods adopted under various circumstances to meet this situation, and showed cases where such methods are being carried out. The speaker presented some real information, which will be valuable to all those fortunate enough to be present.

The lecture was illustrated by excellent lantern slides. About 75 students, members of the faculty and visitors were present. The chairman announced a trip of inspection for those interested to the Harbour Board grain elevator and Ballantyne pier.

Examination of High-speed Rotor Forgings

Most of the defects and irregularities of forgings are found, in an accentuated degree, in larger forgings, and consequently, attention is directed first to the very large forgings such as are required for the field rotors of turbo-alternators. The quality of a forging is determined very much at its birth, i.e., at the ingot, and in order to appreciate the purpose of some of the tests made at a later stage, it is desirable to notice some of the more common birth-marks. The problem of the heterogeneity of steel ingots is now being investigated by a sub-committee of the Iron and Steel Institute, with the co-operation of the leading steel manufacturers of this country, and a valuable report has already been issued.

Defects most likely to arise are due to segregation cavities and slag inclusions, and methods of test must be employed which will ascertain the degree to which these are present.

No steel-maker can guarantee the axial soundness of a large ingot, and therefore all high-speed rotors should be bored and the bore closely inspected for defects. The usual inspection is made by means of a periscope, of which various forms are available.

This visual inspection, where necessary, is supplemented by sulphur printing, and magnetic testing may, in special cases, be applied with advantage. Further, in all important cases, a core is trepanned from the rotor in the boring process. This core is carefully inspected visually, microscopically and by means of physical tests. Periscopic examination reveals cavities, slag inclusions and other discontinuities in the metal, and sulphur printing shows whether what may appear to be small isolated cavities or irregularities are parts of a large cavity which has been closed up by forging. This examination and the tests upon the core, taken in conjunction, enable the axial soundness of a rotor forging to be judged. The other tests found soundness are made at the outside and ends of the forging, and, apart from physical tests, consist in visual inspection and sulphur printing.—*Engineering.*

Britain and Canadian Commerce

The activity in Canada is astonishing. This autumn she has harvested a wheat crop which, if not a record, is said to have been better than that of any previous year but one. Her output of electrical power is increasing by giant strides. The year 1926 showed an increase in total business of 14.5 per cent over that of 1925, the United States showing only one-third of this rate, though, of course, on a larger total. Sales of stocks and shares in Canada in 1926 increased no less than 56.5 per cent, and of bonds no less than 14 per cent, while in the United States in the same period the former increased by only 4 per cent and the latter actually decreased by 13 per cent. Building contracts showed a growth of 25 per cent, and the production of coal a like increase. How important in the world this scion of our house is becoming is seldom realized. Canada, in the matter of imports, stood seventh among the world's nations in 1926, surpassed only by the United Kingdom, Germany, the United States, France, Japan and Italy. In exports, from tenth on the list in 1913, Canada has moved up to fifth, in total trade occupying the same position, being surpassed only by the United States, the United Kingdom, Germany and France. In total trade per capita the country shows up still better, being second in the world; while to-day with her population of less than ten millions, her exports exceed those of the United States when that country had a population of 75 millions.

At the present time, of the outside capital invested in Canada, some three thousand million dollars represent United States property. Against this, British investments are only responsible for a value about two-thirds of that amount. Moreover, the former figure is advancing very rapidly, while the latter shows almost complete stagnation. The country is full of branch works of United States firms, necessarily carrying with them close touch and constant dealings with the parent bodies across the border. Is it surprising that Canada complains of our lack of interest in the opportunities she has to offer, and of our unwillingness to embark on new ventures, leaving the risks to be gladly taken by the United States, and, of course, by the Canadians themselves, staking their all on their country's future ?

As in capital, so in our trade, our record is an extremely unsatisfactory one. Forty years ago no less than 41 per cent of Canada's import trade was derived from this country, while 47 per cent of her exports were destined to these islands. While the latter have dropped to 36 per cent, the former figure has steadily shrunk till it is now reduced to 16 per cent. In the same period her imports from the United States have increased from 44.6 per cent to 67 per cent. Thus, we have lost a great deal of ground, though the position in 1927 shows some little improvement on that for 1922. Totals, of course, have grown, and the percentages are figured on very much larger amounts, but the position is anything but satisfactory, in spite of a preferential tariff in our favour. That this has had some effect is clear from the fact that from 1886 to 1896 our imports to Canada fell off to the extent of 16 per cent, while after the establishment of the preferential tariff the tide turned, and to 1927 has shown an increase of 400 per cent; but we cannot close our eyes to the fact that in this same period the United States imports have increased, not by 400 per cent, but by 1,200 per cent.—*Engineering.*

A British Locomotive in the U.S.A.

Considerable interest has been aroused, both in this country and in the United States, by the presence at the centenary celebrations of the Baltimore and Ohio Railroad, held at Baltimore from September 24 to October 8 last, of the Great Western Railway locomotives North Star and King George V, the former having been built in 1837, and the latter, of course, being the first of a new class recently designed by C. B. Collett, C.B.E., and built at the Swindon Works.

After the conclusion of the centenary celebrations, the King George V was employed on a run in passenger service on the Baltimore and Ohio Railway, from Baltimore to Washington, thence to Philadelphia and back to Baltimore, the total distance covered in the three sections being 271.8 miles. The report on this run of the Baltimore and Ohio Test Bureau is reprinted in the current issue of the *Great Western Railway Magazine,* from which we gather that the performance of the engine was regarded as particularly creditable by the officials present. The train consisted of three passenger coaches, two Pullman sleepers, an official car and a dynamometer car, the total weight hauled being 543.6 tons, and records were taken of drawbar pull, speed, boiler pressure, throttle opening and reversing-level position throughout the whole of the run; no record of coal or water consumption was kept. The first section, of about 39 miles, from Baltimore to Washington, was completed in 58 minues 45 seconds, actual time in motion, the maximum speed attained being 74 m.p.h. From Washington to Philadelphia, some 135 miles, the running time was 2 hours 56 minutes, and the maximum speed 73 m.p.h., while for the third section, of about 96 miles, from Philadelphia to Baltimore, the time in motion was 2 hours 14 minutes 50 seconds, and the maximum speed 69.3 m.p.h. Throughout the trip, no difficulty was experienced in starting or in hauling the load, although the fuel used, a hard gas coal for which the form of grate was not well suited, gave some trouble from clinkering . When it is remembered that Driver W. Young and Fireman G. Pearce, both of the Great Western Railway, were unfamiliar with the road and with the class of fuel used, it will be evident that some, at least, of the credit for the satisfactory performance of the engine is due to these two men,—a fact which was fully acknowledged by the American officials. The latter commented particularly on the smooth-running qualities of the engine, as well as on its performance, workmanship and appearance. The engine has thus worthily upheld the high traditions of British locomotive engineering, and the reception accorded it by American engineers must be gratifying to the directors of the Great Western Railway Company, as it is also to British engineers in general.—*Engineering.*

Light and Heat in Medicine and Hygiene

An international conference on light and heat in medicine, surgery and hygiene, combined with an exhibition, was opened in the Central Hall, Westminster, on Tuesday afternoon, December 13. The conference will conclude its afternoon and evening sessions to-day. Dr. R. King Brown, chairman of the Committee of Hygiene and editor of the *British Journal of Actinotherapy,* which has organized the exhibition, presided at the inaugural meeting, and Lieut.-Col. F. Fremantle, M.B., M.P., chairman of the Medical Committee of the House of Commons, delivered the opening address in place of Sir Alfred Mond, who was unable to attend. Like Dr. K. Brown, who mentioned that he had introduced sunlight treatment into Bermondsey, Colonel Fremantle dwelt upon the great benefits that light, natural or artificial, could confer upon healthy and enfeebled or diseased organisms, while warning also against the home-use, especially of strong light, without due medical advice. The conference, he said, was the first of its kind, and papers on actinotherapy and on vision would be presented by the leaders of British science in this field, as well as by Drs. Nagelschmidt and Huidschinsky, of Berlin, and Dufestel and Saïdman, of Paris. Light treatment, long since appreciated by botanists, had recently found also industrial application; for instance, in the leather industry. So many of the exhibits, which are arranged in sixty stands, are of cognate nature that we hesitate to mention names of the firms, most of which show appliances due to several experts. We may mention the vita and other glasses which allow part of the ultra-violet rays to pass, shown as windows and roof glazings, the rest-light lamps which absorb the excess of orange red in the spectrum, and the sunlight lamps, much used in the textile industry, to imitate the colour of sunlight. The medical profession makes use of ordinary light, and particularly also of ultra-violet and infra-red radiations. The lamps used are ordinary arcs with electrodes of carbon, of tungsten and of tungsten-cored carbons and further quartz-mercury lamps. In one type of tungsten lamp the tungsten rod is replaced by two tungsten discs, which are fixed to copper rods flanged with large copper radiators. In the vilite lamp two Jablochkoff candles for ultra-violet radiations are combined, (in parallel), with a spiral resistance for infra-red radiations, each of the sources of light having its own movable parabolic mirror; the candle electrodes are said to be made of carbon, tungsten and rare earths. A new pantaphos lamp which eliminates shadows in its strong beam by the aid of parabolic and cylindrical mirrors was also demonstrated.—*Engineering.*

De Laval Steam Turbine Company has just issued a leaflet describing the pumps installed at the new water filtration plant at Wenatchee, Wash., copies of which may be obtained from the Trenton, N.J., office.

The Northern Electric Company, Limited, 121 Shearer Street, Montreal, has published a new bulletin, No. 100-C, on Sangamo meters, which brings all the printed information on the S-2 Sangamo meter up to date and gives a full description of this meter in its various applications, together with useful shipping data, etc.

The Gypsum Industries, 844 Rush Street, Chicago, Ill., has issued a twenty-three page booklet entitled "Gypsum Partition Tile," which is made up of three parts as follows: Part I, Fire Tests; Part II, Specifications for the Erection of Gypsum; Part III, American Society for Testing Materials Standard Specifications for Gypsum Partition Tile or Block.

Preliminary Notice

of Applications for Admission and for Transfer

March 14th, 1928.

The By-laws now 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 election 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 1928.

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 or 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.

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.

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

ABBEY—CHARLES GARFIELD, of Montreal, Born at London, Eng., Dec. 14th, 1891; Educ., Brighton Tech. College, 1907-10; apprentice, Lancs. Dynamo & Motor Co., Ltd., Manchester, Eng., 1910-13; 1913-16, asst. & outside engr. to Messrs. Kelsall & Parsons, Glasgow, agents in Scotland for L.D. & M. Co.; 1916-18, plant engr. in charge of outside work for L.D. & M. Co., Manchester; 1918-26, return to Kelsall & Parsons, Glasgow, and later made partner with company as Kelsall, Parsons & Co.; 1926 to date, president, Lancs. Dynamo & Motor Co. of Canada, Ltd.

References: F. Newell, W. G. H. Cam, F. C. Peacock, G. E. Booker, A. H. Pattenden, J. G. Lennox, P. T. Davies.

BOURASSA—L. WILFRED, of La Tuque, Que, Born at St. Johns, Que., Apl. 9th, 1887; Educ., B.A.Sc., C.E., Ecole Polytechnique, Montreal, 1911; 1914, Q.L.S.; 1911-16, specializing in municipal work with Ouimet & Lesage, consulting engrs.; 1916-18, private practice; 1918-26, city engr., St. Johns, Que.; 1926-28, town manager, La Tuque, Que.

References: O. O. Lefebvre, T. J. Lafreniere, A. Bernier, R. Morrissette, N. J. A. Vermette.

COOK—ARNOLD BLAIR, of Taber, Alta., Born at Smithville, Ont., Apl. 18th, 1884; Educ., 2 yrs. Sci., Univ. of Toronto, preliminary D.L.S. examination, certified Alta. Mine Surveyor; 1905, topographer, Dom. irrig. surveys in Alta.; 1906, Dom. hydrometric surveys in Alta.; 1907-12, Dom. land survey work; 1913-14 (winter), asst. on Alta. base line survey; 1915, on Dom. irrig. surveys; 1916, preliminary location, Dom. irrig. surveys, level and transitman; 1915-16 (winter), in Dom. Hydrometric office, Calgary; 1916-18, office engr. in Dom. Hydrometric office, Calgary; 1918-20, ranching; 1920, i/c 27-man plane table party and irrig. design with Dom. Irrig. Branch, Calgary; 1921, i/c reconnaissance party for Dom. Irrig. Branch; 1922-27, coal mine surveys under Alta. mine certificate, i/c highway constrn., etc.

References: J. S. Tempest, B. Russell, J. B. deHart, N. H. Bradley, C. L. Dodge.

FRY—ALBERT EDWARD, of Montreal, Born at Cornwall, Ont., Dec. 27th, 1885; Educ., public school, 1892-98, machine shop practice and mech'l engrg. courses with I.C.S.; 1902-06, machinist apptce. with J. Smart Mfg. Co., Brockville, Ont., and Miller's Machine Shop and Foundry, Cornwall, Ont.; 1906-09, machinist with Toronto Paper Mills at Cornwall, Ont., and C.P.R. Angus Shops, Montreal; 1909-12, master mechanic, Merchants' Branch, Dom. Textile Co., Montreal; 1912-15, installation of machinery and equipment and then taking mech'l charge of Dom. Mahogany Veneer Co., Montreal West; Mch. to Dec. 1915, designed and built pan conveyors and biscuit icing trolley, Mooney Biscuit Co., Montreal; 1915-18, designed major proportion of tooling for Steel Co. of Canada's 9.2 shell shop, supt. when it went into operation, also worked on design of a central steam power plant; 1918-19, with Dougall Varnish Co., Montreal; 1919-20, with Steel Co. of Canada; 1920 to date, general mechanical engrg. work with Dom. Glass Co., Montreal.

References: H. M. Jaquays, E. C. Kirkpatrick, G. P. Cole, H. W. Racey, F. Peden.

GEAR—SYDNEY STUART, of Buffalo, N.Y., Born at Fort Erie, Ont., Jan. 19th, 1884; Educ., grad., Univ. of Toronto, 1908; 1909-16, instructor in electrical engrg. courses, Buffalo High School; 1914-15-16, dftsman, Dominion Steel Co. of Buffalo; 1921 to date, contracting engr., Horton Steel Works, Ltd., Bridgeburg, Ont.

References: C. H. Scheman, W. R. Manock, C. S. Boyd, E. M. Proctor, W. N. Redfern, E. S. Turner.

HAYES—ROLAND EARLE, of Ottawa, Ont., Born at Ottawa, May 21st, 1900; Educ., B.Sc., McGill Univ., 1924; 1919-20, engrg. staff, Brit. Am. Nickel Co.; 1922, engrg. staff, Hollinger Gold Mines; 1923, on geological surveys; 1925 to date, with General Supply Co. of Canada as sales engr. filtration and water works equipment and mgr. water works dept.

References: J. P. McRae, J. B. McRae, J. H. McLaren, J. McNiven, C. M. McKergow, J. B. Porter, G. E. Booker.

JACKSON—WILLIAM, of Edmonton, Alta, Born at Manchester, Eng., Oct. 16th, 1883; Educ., Allen Glen High School, Glasgow, Glasgow Tech. College; 1900-04, articled to Kyle, Dennison and Laing, Glasgow, general office work, dfting, surveying, constrn. of macadam roads and whin sett streets with concrete base, sewers and sewage disposal plants, etc.; 1904-05, employed by father, A. Jackson, as foreman on constrn. of sewers, macadam roads, etc.; 1905-06, with father, engr. i/c of same class of work as above and experience in preparing tenders; 1907-09, dftsman on preliminary and location with C.P.R., took topography, ran transit and level and projected when required; 1909, C.N.R. Winnipeg office, dfting, checking location plans and profiles, making approval plans, etc.; 1910-11, A. & G.W.R., Edmonton, ch. dftsman, G.T.P.R., Edmonton, dftsman, same experience as with Can. Northern Ry.; 1911-17, E.D. and B.C.R., i/c location, constrn. and mtce., supervised preparation of all standard plans and specifications, prepared general design for steel bridges, checked steel work and prepared substructure plans, etc.; 1917-28, Dept. of Rlys. and Canals at Edmonton, worked on lifting and relaying of 200 miles steel on Can. Northern and G.T.P. Rly. west of Edmonton, on Can. Northern Ry. investigation, investigated dispute between G.T.P. and C.N.R., etc.; 1920-28, inspecting engr., highways branch, Dept. of Rlys. and Canals, for three prairie provinces.

References: T. Turnbull, A. Ferguson, G. Grant, R. W. Jones, L. C. Charlesworth, A. T. Kerr, J. W. Porter, J. A. Heaman, R. J. Gibb, W. T. Moodie.

JONES—ROBERT BOLTON, of Montreal, Que., Born at Glasgow, Scotland, Mch. 21st, 1885; Educ., Queen's Park School, 1891-1900; apptceship with North British Rly. Co., 1900-06; 1906-10, asst. engr. with Wm. Beardmore Co., Ltd., constrn. & mtce. naval constrn. works at Dalmuir, Scotland; 1910-12, dftsman, transitman, res. engr., G.T.P. Rly. Co., on constrn. Fort William terminals, Regina engine terminal, etc.; 1913-15, dftsman, transitman, C.P.R., track revision surveys, lake Superior div., yard & terminal design, Montreal; 1915-19, gunner, sergeant, lieut., C.F.A., Canada, England & France; 1919 to present date, asst. engr., C.P.R., terminal and yard design, valuations rail, etc.

References: J. E. Armstrong, J. M. R. Fairbairn, D. Hillman, A. R. Ketterson, A. C. Mackenzie, J. W. Orrock.

MACLEAN—CHARLES SALMON, of Saint John, N.B., Born at Chipman, N.B., May 16th, 1891; Educ., B.A., 1911, B.Sc., 1913, Univ. of N.B.; 1913-14, apptce., test. dept., C.G.E. Co., Ltd., Peterborough, Ont.; 1916-17, sawmill design and operation, Can. Forestry Corps, C.E.F.; 1917-19, instructor in technical subjects, N.S. Tech. College, Halifax; 1919-20, electrical machine design, Canadian Westinghouse Co., Hamilton; 1921, sales dept., same company, Hamilton and Winnipeg; 1922-23, electrical machine design, C.G.E. Co., Peterborough; 1924-25, design, erection, operation of sawmill apparatus and auxiliaries, Stetson, Cutler & Co., Shives Athol, N.B.; 1926-27, design of machinery and misc. apparatus, Can. Crocker Wheeler Co., St. Catharines, Ont.; Aug. 1927 to date, gen. mech'l engrg. in connection with design and mfr. of valves and specialties, and sulphite pulp mill apparatus, T. McAvity & Sons, Ltd., Saint John.

References: W. F. McLaren, P. Manning, W. J. Johnston, W. R. Weston, J. Stephens, N. D. Wilson.

MELLOR—ARTHUR LEES, of Montreal, Born at Stalybridge, Eng., Oct. 24th, 1877; Educ., Rossall School, Fleetwood, Lancs; 1899-1901, pupil at the office of Messrs. G. H. Hill & Sons, Manchester, Eng.; 1901-14, with same company as assistant res. engr. on the Chew reservoir for Ashton-under-Lyne, Stalybridge & Dukefield (district) joint water board, 1907-14; 1915-19, war service; 1920-26, asst. on the staff of Messrs. G. H. Hill & Sons; drawings for laying of trunk mains and two reinforced concrete reservoirs, and asst. engr. on execution; 1926-27, senior inspector on Montreal South Shore bridge, Messrs. Milton Hersey Co., Ltd.

References: F. B. Brown, S. Howard, C. N. Monsarrat, P. L. Pratley, J. W. Roland, R. A. Ross.

MITCHELL—AUBREY COLELEUGH, of Toronto, Ont., Born at Point Edward, Ont., Sept. 18th, 1886; Educ., gen. public school, 2 yrs. high school, I.C.S. course; 1903-04, with G.T.R. gen. freight office, gen. supt. office and bldg. and bridge dept. as time and stores keeper, clerk of works, erection of freight sheds and constrn. of cribwork bulkhead, etc.; 1904-05, asst. clerk of works, middle div. bridge and bldg. dept., G.T.R., London, Ont.; 1905-09, Central Vermont Rly., St. Albans, Vt., bridge and bldg. dept., supt. i/c grade separation, concrete plant, pile driving equipment, steel and wooden bridge erection, during 1909 asst. general supt. (system); 1909-10, supt. of constrn. with F. H. McGuigan Constrn. Co., Toronto; 1910-12, supt. of constrn., engrs. dept., corp. of city of Toronto, i/c bridges and docks, constrn., mtce. and repairs of bridges, docks, wharves, etc.; 1912-26, with Toronto Hbr. Comm., 1912-19, supt. of constrn., i/c all constrn. embodied in the Commissioners' development, design and constrn. of steel and wooden barges, tugs, land and floating derricks, dredges, piledrivers, etc., constrn. of hbr. retaining walls, bulkheads, wharves, piers, quays, concrete and macadam roads, etc.; 1919-23, asst. general manager, and, 1923 to 1926, general manager.

References: F. A. Gaby, J. M. R. Fairbairn, G. G. Powell, H. G. Acres, E. L. Cousins.

SMALL—HERBERT W., Jr., of Arvida, Que., Born at Concord, N.H., Apl. 7th, 1892; Educ., civil engrg. at Penn. State College and Chicago Tech. College; 1911-13, res. engr., design and dfting in industrial plants, hydraulic structures, etc., with Walter McCulloh, consulting engr.; 1913-14, design and supervision of extensions and design and installation of plant equipment, Electro-Chemical Plants, Niagara Falls, N.Y.; 1914-15, res. engr. and design and investigations industrial bldgs., etc., W. McCulloh; 1915-16, supervision of design, estimates, specifications, etc., industrial developments, Austin Co., Plula, Pa.; 1916-17, supervision of design and investigations steam and hydro-electric power plants with J. J. White Engrg. Corp., N.Y.C.; 1917-18, with U.S. Engrs. on design of Fort Saulesbury and coast defence investigations, and plant and mtce. engr. at explosive plants; 1918-19, hydro-electric investigations and design with L. E. Myers Co., Chicago; 1919-22, supervision of design, investigations, etc., with Stone & Webster, Inc.; 1922-27, principal asst. and charge of designs on power plants, investigations, etc., with Fargo Engrg. Co., Jackson, Mich.; 1927 to date, ch. engr., Alcoa Power Co., Arvida, Que.

References: J. W. Rickey, F. H. Cothran, T. H. Hogg, F. P. Shearwood, F. Newell.

SMITH—EVELYN GORDON, of Fort Qu'Appelle, Sask., Born at Edgar, Ont.; Educ., Toronto Tech. School, 1904, I.C.S. diploma, electrical engrg., 1926, Diesel engines, 1927; 1918-22 foreman, repair shop handling only storage batteries and ignition work; 1923-25, supt. with Arcola Light & Power Co.; 1925-26, master mechanic, Central Manitoba Mines; 1926-27, engr. for electric generating station, Fort Qu'Appelle, Sask.; in June 1927 operations were taken over by Fort Qu'Appelle Electric Light Co.; at present, supt. for Fort Qu'Appelle Electric Light Co.

References: R. N. Blackburn, H. J. DeSavigny.

WOOLLATT—DAVID HERBERT, of Walkerville, Ont., Born at Walkerville, Ont., May 18th, 1892; Educ., B.Sc., McGill Univ., 1916; 1923 to date, vice-president, Ryan Construction Co., Ltd.

References: A. J. M. Bowman, H. Thorne, J. C. Keith.

WRIGHT—NOEL MITHSDALE, of Champaign, Ill., Born at Ripley, Eng., Dec. 23rd, 1904; Educ., B.Sc., Univ. of Illinois, 1928; 1 yr. Arts at Univ. of B.C., 1923-24; 1920-22, garage mechanic; 1924 (3 mos.), rodman, B.C. Electric Ry. Co.; 1927, asst. ch. electrician for Big Lake Oil Co., electrification of an oil field, i/c all motor depts. and installation; at present, business mgr., Univ. of Ill. 1928 electrical show.

References: I. M. Marshall, I. D. Mylrea, R. W. Brock, W. R. Bonnycastle, W. G. Swan.

FOR TRANSFER FROM ASSOCIATE MEMBER TO A HIGHER GRADE

BEGG—JAMES McGEE, of Vancouver, B.C., Born at Cumnock, Scotland, Feb. 13th, 1882; Educ., B.Sc., Glasgow Univ., 1905; 1903-07, apptce., Warren & Stuart, Glasgow, water and sewerage schemes; 1907-08, res. engr. i/c constrn. water and sewerage systems, Summerside, P.E.I.; 1908-12, design and constrn. under V. H. Dupont of various water, sewerage and paving schemes in suburbs of Montreal; 1912-14, engr. i/c sewers, Edmonton, Alta.; 1914-19, served with Royal Engineers overseas; 1920, asst. engr., city of Montreal; 1920-22, city engr., Brandon, Man.; 1923, tech. work for Can. Brit. Corp., London; 1924, asst. engr., Point Grey, B.C.; 1924 to date, ch. engr., Vancouver & Dists. Joint Sewerage & Drainage Board.

References: R. S. Lea, E. A. Cleveland, C. Brakenridge, R. J. Gibb, W. M. Scott.

CARSWELL—JOHN BALLANTYNE, of Toronto, Ont., Born at Paisley, Scotland, Apl. 9th, 1888; Educ., B.Sc., Glasgow Univ., 1911; 1903-09, apptce. with J. B. Brodie, M.I.C.E., Glasgow, one year as asst. engr. on hbr. and dock work in Scotland; 19 0, asst. to res. engr., G.T.R. eastern div.; 1911, asst. supt. with General Contractors, Montreal, on reinforced concrete work; 1911-12, engr. to Ross & Macdonald, architects, Montreal; 1913-15, Ontario representative, Ross & Macdonald, i/c constrn. Union Station, Royal Bank building and Central Tech. School; 1916-18, ch. engr., aviation dept., Imperial Munitions Board, built and maintained all flying camps, barracks and other properties throughout Canada for R.A.F.; 1919 to present date, president, Carswell Constrn. Co., Ltd.; 1920, retained as consulting engr. to Toronto Transportation Comm. during period of rehabilitation work; at present, consulting engr. to Burlington Steel Co., Ltd., Toronto Gen. Hospital Board, Canada Steamship Lines, Rail Steel Products Assn., U.S.A., Playfair interests in Montreal, Toronto and elsewhere; retained for consulting services by National Trust Co., city of Toronto, C.N.R., etc.

References: C. R. Young, W. Gore, H. E. T. Haultain, W. A. Bucke, E. G. M. Cape, A. D. Swan, J. L. Busfield.

MILNE—ARTHUR H, of Montreal, Born at Montreal, July 19th, 1890; Educ., B.Sc., McGill Univ., 1917; 1911-12-13-14-15-16 (summers), inspector on municipal work for town of Montreal West and city of Westmount; Oct. 1911 to Mar. 1912, instrumentman for Amburson Hydraulic Const. Co. at Donnacona, Que.; 1917-18, dftsman, Dom. Bridge Co., Ltd.; 1918-19, lieut., Can. Engrs., overseas; 1919-21, structural designing engr., T. Pringle & Son, Ltd.; 1921-26, constrn. engr. and sec.-treas., J. MacGregor, Ltd.; Apl. 1926 to date, mgr. of mtce. for the Protestant Board of School Commissioners, i/c all heating, repairs and new bldgs.

References: J. S. Costigan, W. M. Wynn, D. C. Tennant, F. B. Brown, D. Bremner, A. F. Byers.

PATTENDEN—ALBERT HENRY, of Montreal, Que., Born at London, Eng., Dec. 23rd, 1889; Educ., Borough Polytechnique, 2 yrs.; 1903-07, apptce., Everett Edgecombe Elec. & Mech. Engrs., London, Eng.; 1907-10, M.L.H. & P. Co., Montreal; 1910-12, Monarch Electric Co., Montreal; 1912-16, i/c electric car dept., Angus Shops, C.P.R.; 1916-18, i/c elect'l and mech'l development work, W. J. O'Leery & Co., Montreal; 1918-22, Can. Cons. Rubber Co., elect'l engr. of eastern plants; 1922 to date, elect'l engr., eastern and western plants, same company.

References: J. A. Shaw, J. M. Robertson, J. D. Alder, A. H. Ross, A. R. Sprenger, H. P. Raynsford, H. W. B. Swabey.

FOR TRANSFER FROM JUNIOR TO A HIGHER GRADE

BROSSEAU—JOSEPH CHARLES, of Verdun, Que., Born at Montreal, Dec. 17th, 1896; Educ., graduate from Mtl. Tech. School, 1919; 1914-16, rodman, transitman and dftsman, J. P. B. Casgrain; 1917-18, summer survey work with Malcolm D. Barclay, chainman, rodman and instrumentman; 1919, engrg. dept., Mtl. Tramways Co., transitman; 1920, Wayagamack Pulp & Paper Co., mechanical dftsman; 1921 to date, on constrn. and mtce. of streets and roads, general dfting, designing and constructing sewerage system, designing and installation of centrifugal pumps, sidewalks constrn., etc.; at present, asst. to city engr., Verdun, Que.

References: F. C. Laberge, W. M. Gardner, J. A. Lalonde, M. D. Barclay, P. Baily, A. Chartier, H. Hadley.

BUNTING—WILLIAM RUSSELL, of Montreal, Que., Born at St. Catharines, Ont., Dec. 14th, 1897; Educ., B.A.Sc., Univ. of Toronto, 1923; 1920-21 and 22 (summers), with H.E.P.C. of Ont. as jr. elect'l operator, receiving clerk and checker of shipments of elect'l apparatus, inspection and testing of switchboards, cables and accessory equipment; 1923-24, with Gen. Electric Co., Schenectady and Pittsfield, test floor—testing of motors, generators, circuit breakers, control apparatus, transformers, illumination; 1924 to present time, with Northern Electric Co., Ltd., as power apparatus specialist.

References: A. H. Pattendon, K. O. Whyte, W. C. Adams, R. C. Smith, A. D. Ross.

McKAY—HUGH ALEXANDER, of London, Ont., Born at Seaforth, Ont., Aug. 23rd, 1896; Educ., B.A.Sc., Univ. of Toronto, 1923; dftsman and engr., Disher Steel Constrn. Co., Ltd., Toronto; engr., Sutcliffe & Co., New Liskeard; sales engrg., London Bridge Works and Sarnia Bridge Co., Ltd.; 1927 to date, manager, London Structural Steel Co., Ltd., i/c design, sales, production and erection work, London.

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References: I. E. Vallee, O. Desjardins, D. C. Tennant, F. T. Cole, C. C. Lessard, J. G. O'Donnel.

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References: A. W. Connor, F. W. Thorold, R. C. Muir, H. Thorne, J. C. Keith.

FOR TRANSFER FROM STUDENT TO A HIGHER GRADE

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A Study of Transmission Line Power-Arcs

A Study of Transmission Line Power-Arcs, the Practical Results of a Series of Power-Arc Tests carried out by the Shawinigan Water and Power Company, with the Theoretical Analysis of the Power-Arc

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Paper read before the Montreal Branch of The Engineering Institute of Canada, March 1st, 1928 and to be presented for discussion at the Western General Professional Meeting in Vancouver, B.C., June 7th to 9th, 1928

In connection with relay protective work, it is essential that the properties and behaviour of the power arc be known.

In order to acquire this knowledge, the Shawinigan Water and Power Company has carried out a series of power arc tests with simultaneous oscillographic and moving picture records. This permitted the synchronizing of electrical and physical conditions of the arc.

This paper is to present the practical results of these tests, along with a theoretical analysis of the power arc. The tests were to supply the knowledge regarding the following points:—

(1) Arc voltage in relation to arc current to determine the sensitiveness of directional relays required.

(2) Power arc damage in relation to current and time, to establish the importance of quick clearance of arcs so as to avoid permanent damage.

(3) Spreading of the arc in relation to time, to show the importance of quick clearance of arcs to avoid spreading of the arc into other phases or adjacent circuits.

In order to cover as much as possible the whole range of practical conditions, it was decided to extend the tests over a current range of approximately 100 to 10,000 amperes and to include arcs over pin insulators of representative voltages from 2,200 to 60,000 volts, suspension insulators for 110 k.v. and arcs across line conductors. It is natural that actual conditions out on the transmission line are so largely different that it is impossible to cover all conditions. It is felt, however, that the series of tests made are giving sufficient data to learn about the main characteristics of the power arc.

The first chapter deals with the general characteristics of the power-arc and the second chapter with the practical conclusions deducted from the power-arc tests. In Appendix I the test arrangement is discussed. Appendix II develops a theory for the power-arc based on the theory of heat balance between ohmic heat generated in the arc and heat radiated from the surface of the arc. Appendix III treats theoretically the condition of the unstable arc under which condition self-extinction of the arc will occur.

Definition and General Characteristics of a Power-Arc

Lightning flashing over an insulator causes a fine filament of air to heat up to arc temperature. The resistance in this air path is thus lowered and thus offers a ready path to the power current of the system itself.

The heat produced in the narrow air or puncture path is enormous, and as a result thereof the hot air will explode to a larger diameter and thus form the large arc known as power-arc.

The same condition will be created where wires are getting within striking distance of one another, the voltage thus puncturing the air and thus creating the low resistance path for the power current.

The power-arc, when expanding, will lower the ohmic resistance of the arc, and in consequence the ohmic heat generated within will drop. On the other hand, the heat radiation from the arc surface will increase because of the increasing arc surface. The arc will therefore expand to such dimensions until the dropping ohmic heat generated in the arc will strike a balance with the increasing heat radiated from the arc surface.

The theory of the power-arc is developed in detail in Appendix II. It is seen from this appendix that the physical dimensions and the voltage of the arc are in direct dependence of the arc current.

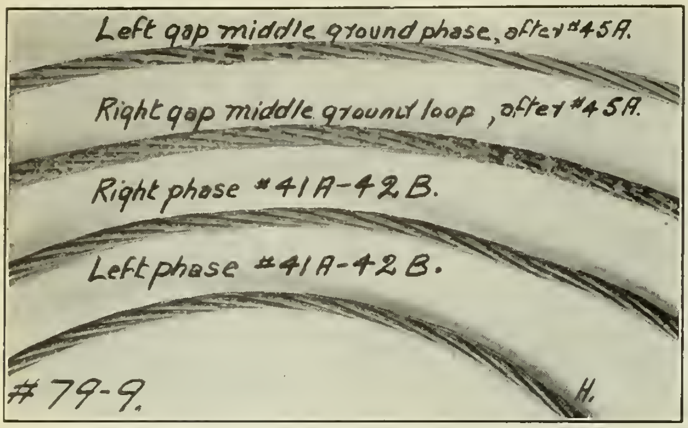


Figure No. 1.—Arc Damage on Conductors.
600-ampere and 1200-ampere arcs of 0.5 second.

The tests have brought out the following chief features of the power-arc:—

(1) *The initial explosive expansion* of the puncture path to the final dimensions of the power-arc takes place within approximately 1/1,000 of a second, (see oscilligram, figure No. 12*a*).

In our tests the puncture path was represented by a No. 34 copper wire which has a diameter of 0.006 inches. The arc diameter was in most cases between 2 and 3 feet. In other words, the arc exploded within 1/1,000 second to a diameter about 5,000 times its original size.

(2) *The specific resistance* of the arc vapour is approximately 14 ohms per cubic inch, compared with 7 x 10^{-7} ohms per cubic inch for copper. This means that the specific resistance of the arc vapour is approximately 20,000,000 times greater than the specific resistance of copper.

(3) *The energy in the power-arc* in its initial stage is ranging anywhere from 50 to 3,600 k.w. for 600- to 1,200-ampere arcs and 3,000 to 15,000 k.w. for 10,000-ampere arcs.

(4) *The radiating constant,* that is, the power radiated from the arc surface, seems to vary largely in different tests. Table No. 2, column 9, shows the results obtained for the various tests. It will be noticed that most of the values for k_1 are ranging from 150 to 350 watts per square inch arc surface for currents below 1,500 amperes, whereas for 10,000-ampere arcs it varies between 2,000 and 4,300 watts per square inch. It is suspected that the large variation for k_1 is largely apparent only, due to the possible unavoidable error in judging and calculating the arc surface because of the inability to judge the depth of the arc. The increased value for k_1 for large currents cannot be fully explained. Partly, it may be due to a change in the heat radiating facility, these tests having been made under different conditions and with certain air currents present. Partly, it may be only apparent because of the inaccuracy and natural error in the arc measurements.

It appears reasonable to consider $k_1 = 300$ watts per square inch as an average value for all practical short circuit currents up to several thousand amperes. How far this value may be increased by prevailing winds is uncertain.

(5) *The arc diameter* of the initial arc increases only slightly with the current.

For the long stretched arc, the relation of arc diameter and arc current is found as, (see formula 5, appendix II),

$$D = m_D \sqrt[3]{I^2}$$

where $m_D = .24$

The results of the actual tests for the long stretched arc, (see table No. 1), are somewhat irregular. This, however, is to be expected because of the possible error in determining the arc dimensions. No formula has been worked out for the diameter of arcs over insulators, as the problem becomes too complex. It is to be expected, however, that the arc diameter would increase in a slower proportion than is expressed in the above formula for the long stretched arc because of the arc forming a hollow conductor with the insulator obstructing the passage of the current within. This seems to check with the results as per table No. 2 for the various items of insulator flashovers.

It is important to note that the power-arcs for 600 to 1,200 amperes are always about 2 to 3 feet in diameter, irrespective of the size or type of insulator. Arcs for 10,000 amperes increase the diameter to 4 to 5 feet.

(a) 600 amperes, 1.5 second. (b) 1200 amperes, 0.5 second.

Top or Ground Units

Figure No. 2.—Ground and Line Units

(6) *The arc voltage* for long stretched arcs is given in appendix II, formula 6.

$$V = m_v \frac{L}{\sqrt[3]{I}}$$

where $m_v = 250$

This formula indicates that the voltage changes very little with a change in current, its tendency being downwards with increasing current. The arc voltage, however, is directly proportional to the arc length, which indicates that the voltage will increase with the spreading of the arc.

No attempt has been made to develop a formula for the flashover voltage for insulators, as this problem becomes too complex. Test results, (see table No. 2), indicate the interesting fact that for a range of current from 70 to 10,000 amperes the voltage for the initial arc is about the same for the same type of insulator or the same length of arc. The average values for the various types of insulators and conductor spacings was found to be approximately the following:—

7 disc suspension insulator	1200 volts
60 kv. pin insulator	900 "
27 kv. " "	500 "
2 2 kv. " "	250 "
Conductors:	
18-inch spacing	600 "
60- " "	1900 "
96- " "	2800 "

The arc voltage is thus chiefly dependent on the arc length. The voltage will therefore change in the course of the development of the arc along the following lines:—

(a) If the power-arc breaks up the insulator, then the arc voltage may drop slightly.

(b) If the arc on an insulator bulges out due to heavy wind, the arc voltage may increase. Such increase will, however, never be very large because of the tendency of the arc vapours to rise and short-circuit the loop, thus not allowing a long stretched arc to form. This is borne out by the tests, where in no case the arc voltage at the end of a one and one-half second arc was more than four to six times its original value.

(c) An arc between widely-spaced conductors may, under certain conditions, develop a very long stretched arc with the result of the arc voltage increasing proportionally. This is chiefly borne out by some of the tests, where, by its natural chimney effect, the arc rose in about three-quarters of a second to a height of 30 feet or more, corresponding to an approximate arc length of 60 feet, the voltage in this case exceeding 20,000 volts.

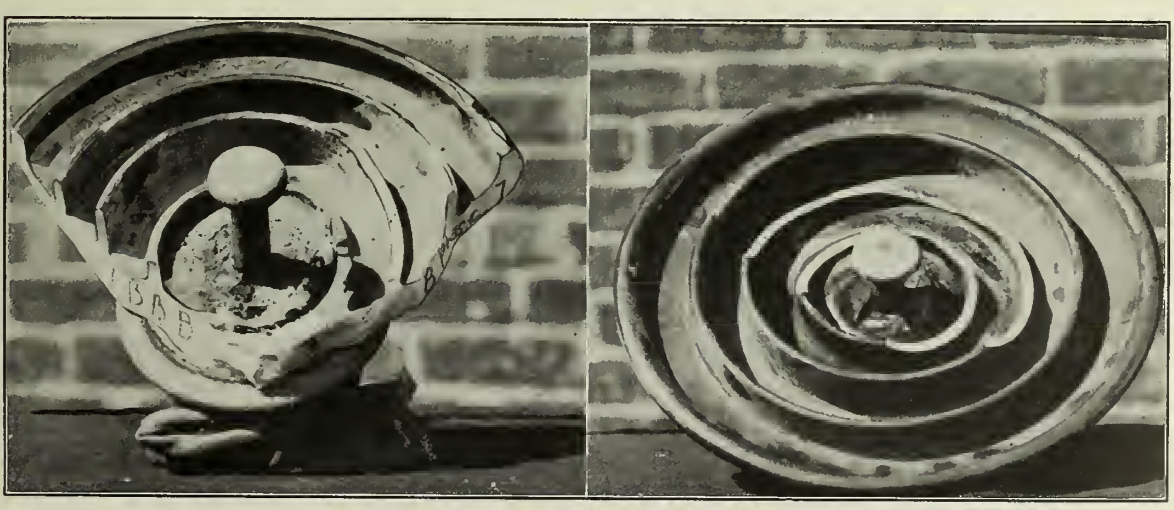
For practical purposes, it may be assumed that the arc voltage will be approximately 400 volts per foot length of arc, irrespective of the short-circuit current.

Practical Conclusions Regarding Tests

Power-Arc Damage

The tests show clearly that the duration of the arc is more serious and more damaging than the current magnitude. The arc has an excessively high temperature, likely in excess of 3,000°C. As a result, wherever the arc clings to the insulating material or the conductor, damage must result if this condition prevails for any length of time, irrespective of the current magnitude. If the arc, on the other hand, is cleared instantaneously, then only the very surface of the insulating material or the conductor is touched and therefore no damage will result if the arc is quenched before the heat had time to penetrate. Complete immunity to damage from power-arc could be expected if the arc was cleared within one-tenth to two-tenths of a second. Under this condition, full control of the situation would be obtained. With present-type oil breakers, such quick clearance cannot be obtained. The quickest arc clearance to be expected with so-called instantaneous protection is approximately one-half second or slightly less. Even with this time delay, the damage is usually found to be comparatively small. With power-arcs in excess of one-half second duration the extent of damage is entirely dependent on circumstances.

In case of arcs between conductors, wind at right angle to the transmission line will be most serious and may result in burning-off of the conductors or seriously damaging same. With the wind in the direction of the line or under a small angle to the line, the arc will travel along the conductors and thus avoid serious damage at any one point, causing simply a pitting of the surface of the conductor. Figure No. 1 indicates how variable the damage may be,



(c) 1200 amperes, 0.5 second. (d) 1200 amperes, 0.5 second.

Bottom or Line Units

of 7-Disc Suspension Insulators.

depending on how stationary the arc is. The damage in test 45*A* is very pronounced. All these tests involved 600- to 1,200-ampere arcs of one-half second duration.

In case of suspension insulators, the power-arc damage is usually confined to the top and bottom units. The discs in between are shielded until the end units are broken up. This takes a fraction of a second. Wind in the direction of the transmission line also tends to immediately carry the arc away from the insulator along the conductor and up into the supporting structure, thus completely protecting the insulator. Wind at right angle to the transmission line may affect the bottom skirts, whereas the top unit again is likely protected by the arc passing off into the structure. Arc horns and arc rings help to deflect the arc, and thus tend to protect the end units.

With quick clearance of arcs, the suspension insulator is quite safe from serious power-arc damage, even without protecting arc horns or rings. This is borne out by practical experience, which indicates that with instantaneous line protection there are hardly ever any insulators found damaged from lightning flashovers, or if such damage occurs it is confined to a slight chipping of the bottom unit without affecting the insulation of the line. In figure No. 2 are shown damages to top and bottom units, tests 1*B*, 1*BB* and 1*BBB* being 1,200-ampere arcs of one-half second and 1*D* a 600-ampere arc of one and one-half second, unit No. 1 being top unit and unit No. 7 the bottom unit.

Pin type insulators are more sensitive to power-arc damage because of the hot gases being caught underneath the bottom skirt, breaking them even with arcs cleared within one-half second. Power-arc damage in case of pin type insulators is particularly serious because of the smaller safety factor existing on the pin type insulator by nature of its construction, consisting as a rule of only two to three skirts. Thus, with two of these skirts broken up, the flashover value of the insulator may be greatly reduced. With pin type insulators, there exists also a great danger of burning off the tie wires, thus leaving a mechanical weakness which may later on result in the cable falling off the insulator. The tests, however, indicate that with instantaneous clearance there is a fair chance also on pin type insulators to get away without permanent damage under most conditions. This is verified by actual experience on transmission lines, where lightning flashovers hardly ever cause a permanently disabled line. Figures Nos. 3, 4 and 5 show the effects of power-arcs of different magnitude on different type insulators. The damaging effects are very irregular, depending chiefly on the speed with which the arc is deflected.

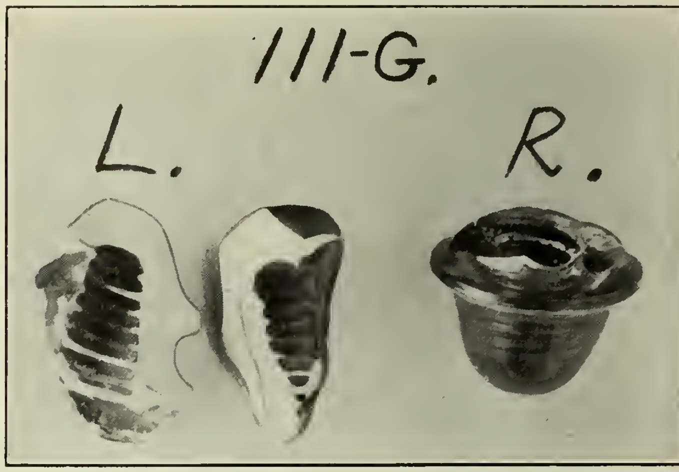
The tests clearly indicate that it cannot be sufficiently emphasized how everything possible is to be done to reduce the duration of a power-arc if full control over power-arc damage is to be obtained. It is not sufficient to provide instantaneous relays, but it is necessary also that the switch manufacturer does everything possible to speed up the total opening time of the oil circuit-breakers.

Spreading of Arc

There are different conditions which may cause the spreading of an arc into adjacent phases or circuits.

Initial Explosive Expansion of the Arc

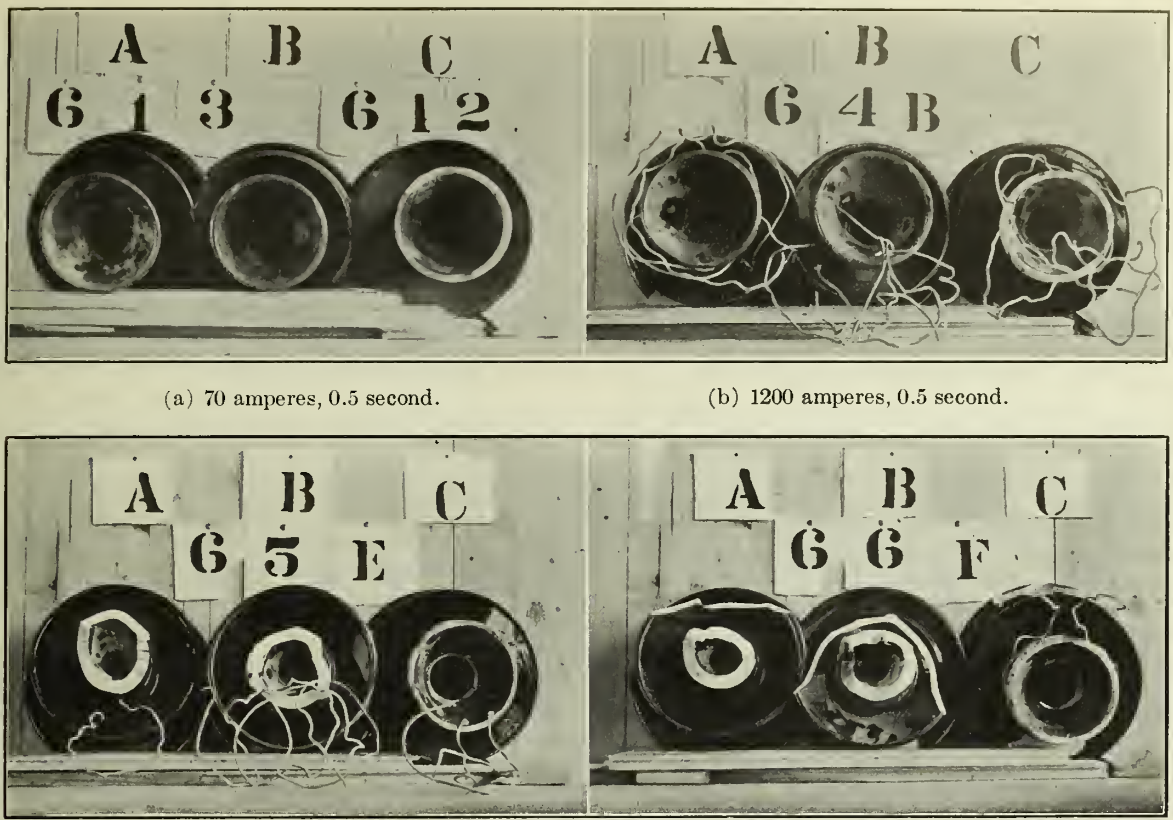
The tests indicate that the initial explosive expansion of the arc after the air has been punctured assumes within 1/1,000 of a second or less a very large diameter of several feet. This diameter will be 2 to 3 feet for currents of a magnitude of 600 to 1,200 amperes, whereas with 10,000 amperes the diameter may extend to 4 to 5 feet. The com-



(a) 10,000 amperes, 0.5 second.

Figure No. 3.—Arc Damage on 2200-volt Pin Insulators.

(b) 600 amperes, 0.5 second. (c) 600 amperes, 1.5 second.



(a) 70 amperes, 0.5 second. (b) 1200 amperes, 0.5 second.

(c) 1200 amperes, 0.5 second. (d) 1200 amperes, 1.5 second.

Figure No. 4.—Arc Damage on 60-kv. Pin Insulators.

parative size of arcs of various current magnitude can be seen in figure No. 6, showing the initial arc formation on 110 k.v. suspension insulators for different currents. Each picture shows the first three exposures of the moving picture film.

It is evident that with a small separation of conductors between phases or circuits, such as is customary on low voltage lines, the arc will have spread into adjacent phases or lines almost instantaneously. Nothing can be done to prevent this, except isolated phase construction, as far as station work is concerned. On transmission lines, separation of phases, to avoid such spreading of the arc into adjacent phases, would have to be made far too great to warrant it for economic reasons. With quick clearance of the arc, no harm, however, should be experienced from such arcs.

In case of higher voltage systems, the currents are usually less than 4,000 amperes, so that the initial arc should not exceed 3 to 4 feet diameter, whereas the separation of phases is usually larger. With quick clearance, there should be no danger, therefore, in this case, of the first initial arc reaching into other phases.

Arcs, discharged in a wooden box, indicate the high pressure forming in the arc before the arc is completely exploded. Figure No. 7 shows the wreckage of two 4-foot long boxes of 9 by 9 inches and 12 by 12 inches cross-section, through which 10,000-ampere arcs were discharged. The boxes exploded completely, blowing the sides as far as 10 to 20 feet away. If it is assumed that the law of gas compression applies to the arc vapours, then the arc pressure within the 9- by 9-inch box before its explosion would have been about twenty-eight times greater than atmospheric pressure, its diameter being only 1/5.2 of the stable arc of 4 feet. This result explains readily the reason of switch cell doors or loose-phase partitions being found blown off after local short-circuits.

Figure No. 7 indicates a blackening of the inside walls of the wooden boxes. This blackening is only on the surface of the wood, there having been no tendency of ignition whatsoever. This indicates how even inflammable material is immune to ignition from power-arcs if the arc is extinguished instantly. This observation is verified by the practical experience of switch bushings, with a compound surface, flashing over and being cleared instantly. The only harm to such bushings was a very slight surface charing which could be easily scraped off.

Chimney Effect of Arc

Hot air has the tendency to rise, so that the arcs will tend to spread upwards. The tests were conducted on windstill days, so that, whatever spreading of the arc has been observed, such spreading was chiefly due to the natural chimney effect of the arc.

Figures Nos. 8, 9 and 10 show the development and spreading of arcs across 110-k.v. suspension, 60-k.v. pin and 2,200-volt pin insulators respectively. The three pictures of each figure represent a series of three successive exposures cut out of the moving picture film at different stages of the arc. The pictures show plainly how the expansion and the spreading of the arc, in case of insulator flashovers, is rather limited and how the arc retains a compact form. The decided reduction in the size of the arc noticed in figure No. 10*c* is caused by the breaking of the insulator.

Figure No. 12*a* represents the oscillogram of a 600-ampere arc over a 110-k.v. suspension insulator. The fluctuation noticed in the arc voltage is to be attributed to a corresponding fluctuation in the length of the arc. Arcs between conductors have a tendency to rise to considerable heights, as can be seen from figure No. 11, showing the development and spreading of an arc between conductors 60 inches apart. The first picture series shows the initial development of the arc, which gives a shape similar to the arc over insulators. The second picture series shows how, after three-quarters of a second, the arc gradually bulges out upwards due to the chimney effect of the arc, rising from then on very rapidly. This rapid rise is seen from the last picture series, showing exposures of the moving picture film after one and one-half seconds.

The tests clearly indicate that only quick acting protection will be able to save spreading of power-arcs into other phases or other wires located above.

It is often customary to string low voltage circuits on the same pole line located above each other. The tests indicate how in such cases it is not impossible for the arc to rise into the upper circuits, with the result that different circuits will be involved simultaneously.

In case of high tension lines, it is very essential that ground faults are cleared as such without developing into phase short-circuits to keep down the disturbing effect on the whole system. It will be essential, therefore, that the arc of lower phases is cleared quickly if it is to be avoided that the arc will rise into upper phases.

In order to avoid arcs blowing into other circuits, the layout of switching stations should be such that the least number of crossings of apparatus leads are provided, and that in those cases where such crossings are unavoidable effective separation is provided, irrespective of the operating voltage, unless instantaneous zone protection is provided. This point should be particularly observed in all those cases where multi-phase short-circuits are disastrous to the synchronous stability of the system.

Wind Effect on the Arc

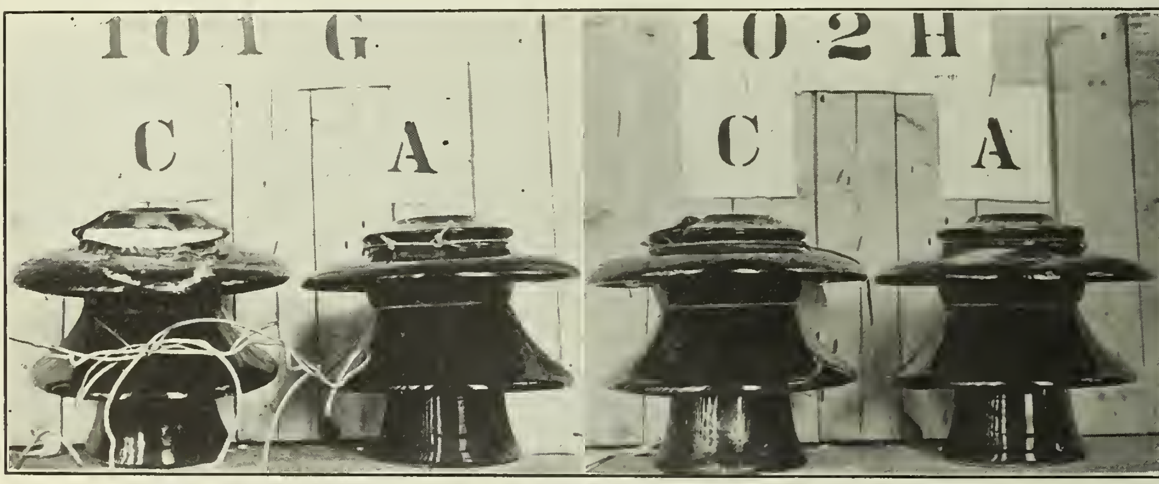
The arc is very susceptible to air currents. The arc will always spread very readily in the direction of the wind. All tests have been made during comparatively wind-still days, but they all indicate the effect from only very slight wind currents of driving the arc in its direction.

If we consider that a wind at 60 miles an hour corresponds to approximately 100 feet per second, it will be realized that it is comparatively easy for a power-arc to be blown into an adjacent line 20 feet away with a heavy gale blowing at right angle to the line. This indicates that if full control of this condition is to be obtained it will be necessary to extinguish the arc within a small fraction of a second.

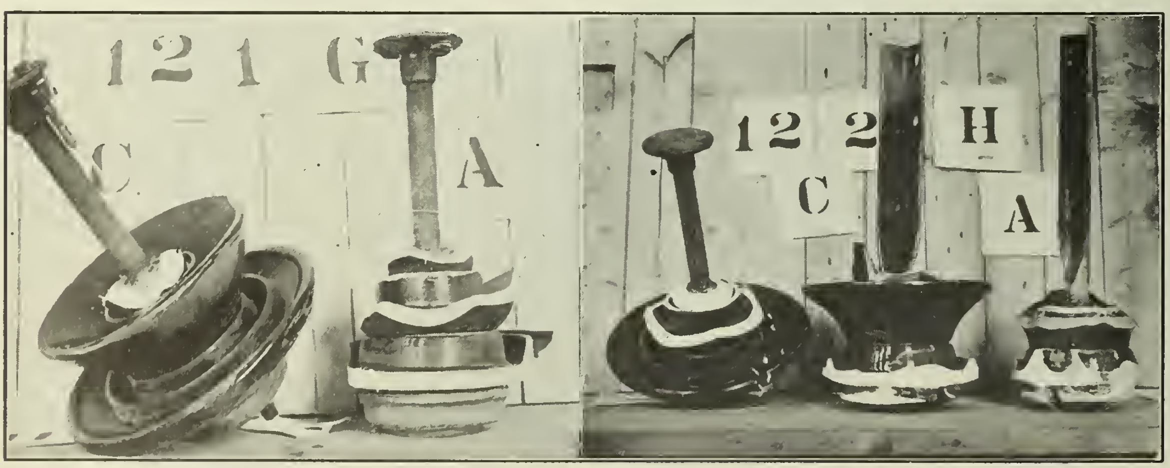
It may be stated, therefore, that even with the quickest clearance of arcs it will not be possible to fully prevent arcs from spreading into other phases or other lines, but it will be possible at least to reduce such hazard to an absolute minimum.

Persistency of Power-Arcs

In appendix III, the theory has been developed for the possible self-extinction of power-arcs. From this appendix, it will be noticed that there is a certain fixed inter-relation between arc voltage, arc current and arc length, which, if disturbed, will result in the extinction of the arc. It was further found that for currents between 100 and 10,000 amperes the critical relation of volts and arc length is practically the same. Tests indicate that this critical relation is approximately 400 volts per foot of arc length. In other words, if the voltage is less than 400 volts per one foot of arc length, then an unstable condition is created which will result in the complete extinction of the arc.

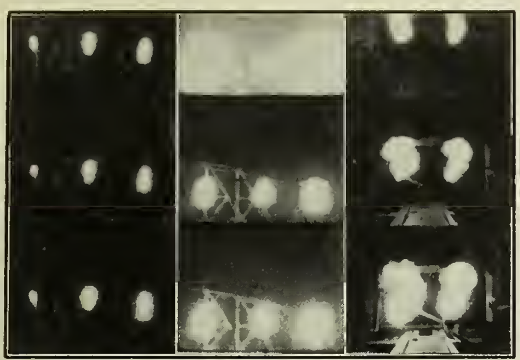


(a) 10,000 amperes, 0.5 second. (b) 10,000 amperes, 1.0 second.



(c) 10,000 amperes, 0.5 second. (d) 10,000 amperes, 1.0 second.

Figure No. 5.—Arc Damage on 60-kv. Pin Insulators.



(a) 70 amperes. (b) 200 amperes. (c) 10,000 amperes.
Figure No. 6.—Initial Arcs over 110-kv. Suspension Insulators.

This comparatively low voltage required to maintain an arc explains the persistency of a power-arc. It means, for example, that with 60,000 volts across an arc the arc is able to expand to 150 feet without danger of rupture, provided the system is able to supply the current without pulling down the voltage. Table No. 4 of appendix III shows how great the critical arc length may be for different operating voltages and currents. The values in the table may not be exact, but they should show at least the trend.

It will be clearly seen from the table that arcs, even of moderate amperage, are readily able to reach into adjacent circuits on the same tower line or even adjacent tower lines of the same right-of-way, if the arc hangs on long enough to permit such long arc to develop.

The table further indicates and explains the reason why a power-arc is so persistent. There is little prospect of a power-arc being extinguished except under most favourable conditions of very strong wind and ideal condition of a long loop being possible without vapours short-circuiting out the loop. This condition, favourable to arc extinction, seems to be only possible in case of power-arcs between conductors. It appears next to impossible in case of insulator flashovers.

It is interesting to consider a few practical conditions usually handled by air-break switches in the light of the foregoing.

Cutting Out Line Sections Under Voltage

In this case, the capacity current is to be interrupted. At higher voltages and longer sections, this current may readily amount to a few amperes.

With good air-break switches, this method of disconnecting a line section may be satisfactory under good weather conditions where the arc can rise vertically and finally exceed the critical arc length. With wind, such arc may, however, be blown into adjacent phases, developing into grounds or short-circuits. This is liable to happen, even with comparatively great spacing, if the wind is very strong and is blowing directly across the phases. Under all circumstances will the arc take in excess of one second until it has developed to its critical length, where snapping-off occurs.

Rupturing of the Magnetizing Current of a Transformer Bank

On smaller transformer banks and high voltages, this current may readily be less than one ampere, so that the critical arc length may be within the possible scope of an air-break switch. It will be appreciated, however, that as soon as the bank capacity gets larger, with correspondingly higher magnetizing current, such an arc will be more persistent, and, depending on the wind, there will be a limit reached in the safe handling and rupturing of such magnetizing current.

To Break a Parallel with Disconnecting Switches

On longer transmission lines, trouble is often experienced in transferring customers between transmission lines at the instant of separating the two circuits with disconnecting switches or air-break switches. Depending on the operating condition, it is possible sometimes to have to break a considerable load current when separating the two lines with a possible difference of several thousand volts across the arc.

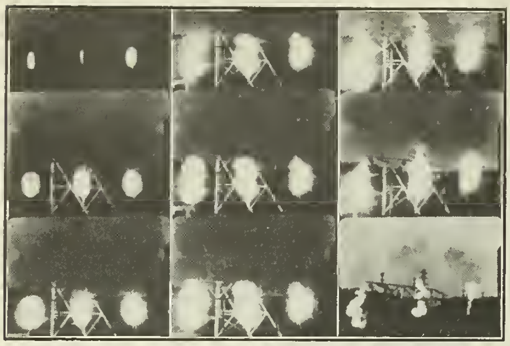
It will be noticed from table No. 4 that, based on the assumption that the table can be considered correct, even with 2,200 volts across the switch and with 100 amperes in the arc the critical arc length would be almost 4 feet before the arc would have a chance to rupture. With special air-break switches of liberal dimensions and favourable weather conditions, no trouble may result. If this break, however, is made with ordinary disconnecting switches a ground or short-circuit may be developed if conditions are unfavourable. It will be well to analyze the possible condition of current and voltage in any such case to fully appreciate how far such operating method is to be permitted.

Under very exceptional conditions, it is also possible sometimes to have an arc cleared on a transmission line by self-extinction after the short-circuit hung on for a few seconds. The writer feels that this condition can only arise in case of an arc existing between or having been blown up into the wires. The condition must be such that either by the natural chimney effect of the arc or by the prevailing wind, an unlimited loop length can be created until the arc reaches the critical length and snaps off. In this connection, it is considered further essential that the generator feeding into the short-circuit has been completely demagnetized by the short-circuit current, thus reducing the voltage across the arc so that a comparatively small critical arc length will cause the snapping off.

The very same condition had been observed in a series of tests with only approximately 6,000 volts across the air gap. In all these cases, it was found that after approximately three-tenths of a second the arc snapped off on its own account, with the current rapidly diminishing within a few cycles to zero. It is contended that in these cases the short-circuit current demagnetized the field of the generator, thus bringing gradually the voltage across the arc down below the critical arc voltage of the corresponding arc distance. Figure No. 12*b* shows the oscillogram for such a test. The gradual dying out of the current can be noticed distinctly.

There is another type of self-extinguishing arc observed on transmission systems. With a short-circuit of a multi-line system occurring close to a power house, it is often observed that the respective line switch at the power house end only opens, causing apparently the power-

(a) Box 12 x 12 x 48 inches. (b) Box 9 x 9 x 48 inches.
Figure No. 7.—Wreckage of Wooden Boxes after Discharging 10,000 amperes through same.



(a) Initial. (b) After 0.5 sec. (c) After 1.5 sec.
Figure No. 8.—Development of 600-ampere Arc over 110-kv. Suspension Insulators.

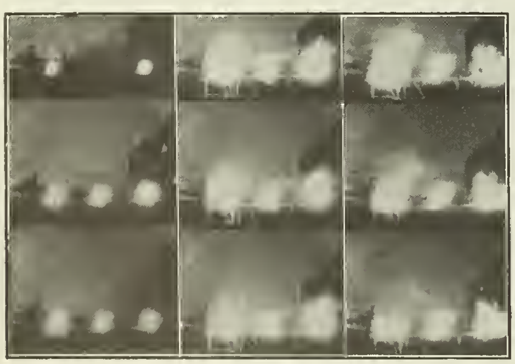
arc to extinguish before the other end of the transmission line has opened. In this case, the extinction of the arc is to be explained by the fact that the current will be largely changed in magnitude at the instant of the power house oil-switch opening up. It has been found from investigating actual cases of transmission line troubles that self-extinction does only take place if the short-circuit current changes considerably in magnitude after the oil-switch has opened up. The reason of such arc extinction under this condition is apparently due to the fact that the arc volume at the instant of the current change has still the dimensions corresponding to the original arc. For instance, with the current reduced to one-fifth of its original magnitude, the ohmic heat produced in the arc would be reduced to $I^2R = 1/25$. At that instant, however, the radiating surface would be still the same as at the time of the large current, thus the radiating ability of the arc would be twenty-five times greater than the heat produced. This doubtlessly results in a rapid cooling, with consequential snapping off of the arc.

Conclusion

The tests fully confirm the necessity of quick clearance of power-arcs, if arc damage and spreading into other phases or lines is to be avoided.

The tests bring out the interesting fact that the arc voltage is practically independent of the current magnitude. It is proportional, however, to the arc length, that is, approximately 400 volts per foot arc length, which explains the persistency of arcs on high voltage systems.

In closing, appreciation is to be expressed to the operating staff of the Shawinigan Water and Power Company for the efficient and punctual way of carrying out the large number of short-circuits without a single mishap to equipment. Acknowledgment is also made to E. W. Knapp, Jr.E.I.C., for his assistance in collecting and analyzing the various test data.



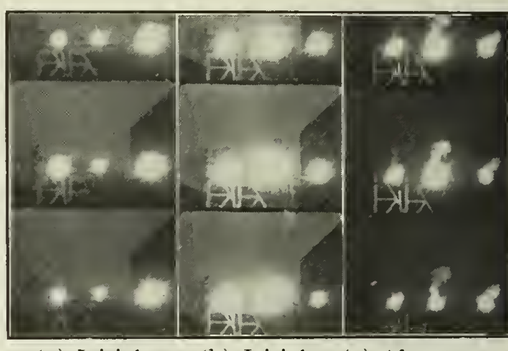
(a) Initial. (b) After 0.5 sec. (c) After 1.0 sec.
Figure No. 9.—Development of 1200-ampere Arc over 60-kv. Pin Insulators.

Appendix I.

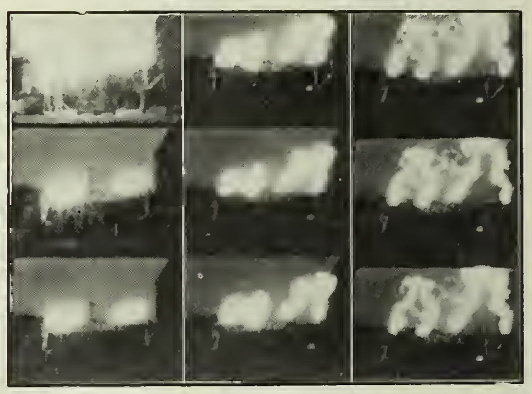
Test Arrangement

It was aimed to cover as much as possible the full range of short-circuit currents to be expected on various transmission systems.

The tests cover a range of 70 to 10,000 amperes. The chief concern, when arranging for the tests, was to arrange for a test which would avoid as much as possible stressing or endangering any equipment. In line with this, it was decided to have all tests carried out as 3-phase short-circuits so as to keep down the magnetic stresses on the generators. This was carried out, even in those cases where only two arcs could be arranged, by having the middle phase directly grounded. A power house was chosen with generators of high reactance so as to limit the short-circuit stresses on the generators.



(a) Initial. (b) Initial. (c) After 1.5 sec.
Figure No. 10.—Development of 600-ampere Arc over 2200-volt Pin Insulators.
(a) Arc started with fuse wire.
(b and c) Arc started without fuse wire.



(a) Initial. (b) After 0.75 sec. (c) After 1.5 sec.
Figure No. 11.—Development and Spreading of 600-ampere Arc between Conductors of 60-inch Spacing.

The arrangement for the tests is shown in the various diagrams in figure No. 13. The arrangement as per figure No. 13*a* was used for the currents of 70 to 1,200 amperes. A 60-k.v. transmission line was tapped outside the power house and connected to a special structure with three insulators with grounded pins. The necessary number of 30,000-k.v.a., 6,600-volt generators, and the corresponding 60-k.v. step-up banks were connected in normal fashion through the bus to the respective line. The short-circuit current magnitude was obtained as follows:—

For 600 amperes short-circuit current, one 30,000-k.v.a. unit built up to normal 60 k.v., high-tension, no-load voltage.

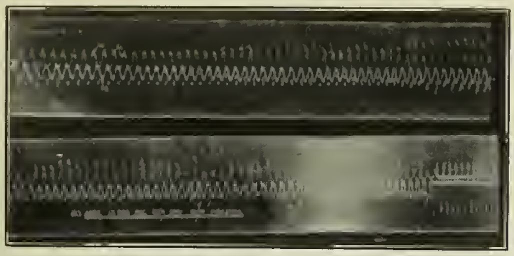


Figure No 12a.—Oscillographic Record of 600 amperes, 1.5 second, Arc over a 110-kv. Suspension Insulator.

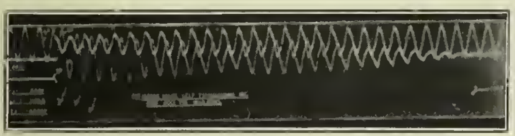


Figure No. 12b.—Oscillographic Record of 10,000 amperes, self-extinguishing Arc over a 60-kv. Pin Insulator.

For 1,200 amperes short-circuit current, two units built up to normal 60 k.v., high-tension voltage.

For 70 to 300 amperes, one generator with the field reduced to give the desired short-circuit current value.

The voltage on the generators was adjusted to the desired point with the line switch open. The three insulators were by-passed with a fine copper wire to start the short-circuit. The 3-phase short-circuit was then established by closing the disconnecting switch, (1) with oil-switch, (2) already being in closed position. Oil-switch (2) then cleared by its normal line protection, the time of clearing being adjusted to suit the specific condition.

For the 10,000-ampere test, it was necessary to resort to 6,600 volts, as it was not possible to obtain as large a current in any other way.

In this case, the whole 120,000-k.v.a. power house was made use of by providing an arrangement as shown in figure No. 13*b;* three generators were stepped-up to the 60-k.v. bus and the transformer of the fourth unit was used to step-down to this point; the corresponding generator was disconnected during this test. The 6,600-volt leads were then connected to a similar structure as used in the previous tests, except that in all these cases only two arcs were established because of lack of space. In this latter case, the short-circuit was closed in by means of the disconnecting switch, (1) of the respective unit with the oil-switch of the bank already in closed position. Switch (2) was then tripped with current protection of the desired time lag.

The various records were obtained by the following means:—

Arc Potential

A 6,600/110-volt potential transformer was located across the respective insulator or air gap. In order to avoid too high voltage and possible breakdown of the potential transformer to the secondary, a safety gap of one-half inch was installed across the potential transformer.

Arc Current

This current was obtained from a special bushing type current transformer placed on the specific phase on the oil-switch. Potential and amperes were recorded on the oscillograph. Generator voltage was also recorded on the oscillograph.

Motion picture and oscillographic records were made for all tests. In order to synchronize the starting of the oscillograph and the motion picture, an arrangement was made whereby with a knife switch the electric controlled disconnecting switch was energized to close, starting at the same time an alarm signal for the camera man, and also a definite time relay which in turn started the motor of the oscillograph just an instant before the disconnecting switch closed and started the arc.

Figure No. 13*c* shows the arrangement for short-circuits between conductors. Semi-circular loops of 150,000 cm. aluminium were provided opposite each other with a certain separation ranging from 18 to 96 inches. All these tests were carried out with two arcs only because of lack of space for the three arcs.

The semi-circular loop was chosen to try to obtain the worst case of arcing across conductors at right angle to the line. It was hoped that whichever way the arc would be blown by the air current, it would instantly assume a position as indicated in sketch by the dotted lines *a, b* or *c*, thus still representing the arc across the conductor.

The arc was started in all cases with No. 34 copper wire for all tests above 600 amperes and No. 42 copper wire for the tests at 300 amperes or less, the copper wire being connected across the insulator or the air gap respectively.

In order to cover approximately the conditions of all commercial voltages, the tests were carried out for the following conditions:—

Current range	70 to 12,000 amperes
Insulators	2.2 kv. pin
	27 kv. pin
	60 kv. pin
	110 kv. suspension (7 discs)
Conductor spacings	18 inches
(150,000 cm. Al.)	30 "
	60 "
	96 "
Arc time	0.5 second
	1.0 "
	1.5 "

Figure No. 14 shows the structure for the insulators. Figure No. 15 shows the structure for the conductor loops. Figure No. 16 shows the picture of the various insulators with approximate over-all dimensions of the insulators and initial arc dimensions. The approximate arc voltage is also recorded for each insulator.

In addition to these arc tests on the insulators and conductors, a few tests were made to study the explosive effect of the arc when enclosed in a wooden box of various cross-sections. In this case, wooden boxes of dif-

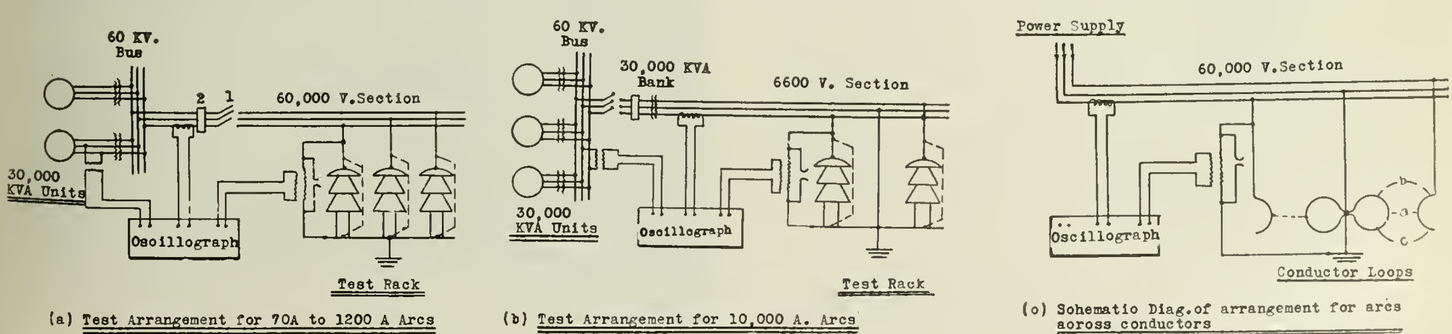


Figure No. 13.—Schematic Diagram of Test Arrangements.

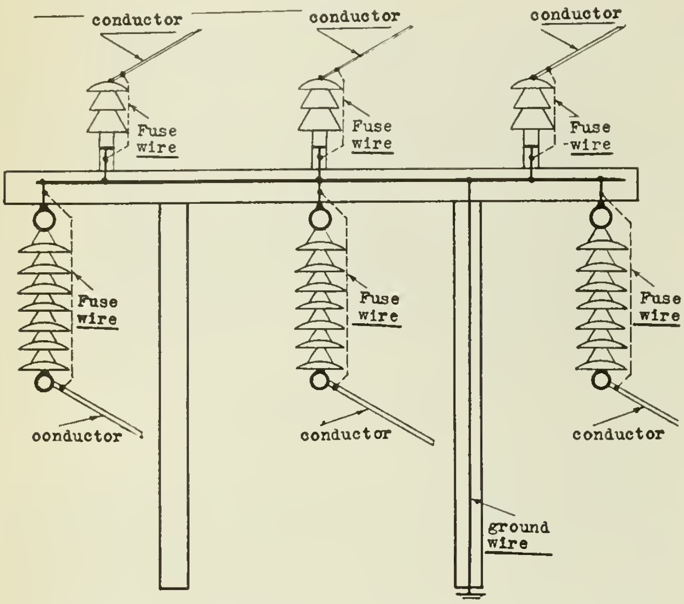


Figure No. 14.—Schematic Sketch of Structure used for Arc Tests of Pin and Suspension Insulators.

ferent sizes were made up to take the place of the insulator. Terminals were provided in top and bottom of the box, with a small fuse wire being placed between the terminals. A first series of tests was made with 4 and 6 feet cubical boxes and thereafter with 9- by 9-inch and 12- by 12-inch cross-section, 48-inch long boxes. The same records and general arrangement was used as in the other tests.

Appendix II.

Theory of the Power-Arc

It is shown hereafter that the inter-relation between arc current, arc dimensions and arc voltage, can be established by applying to the power-arc the same basic law of heat balance as is applied to conductors. In other words, it will be shown that a power-arc assumes such dimensions that the heat generated in the arc will be balanced with the heat radiated from the arc's surface.

Theory of Heat Balance Applied to Air Viewed as a Conductor

A resistance wire, upon application of voltage across its terminals, will heat up due to the ohmic heat generated in the wire from the current passing through same. The temperature of the wire will rise until the temperature drop to the surrounding air has risen sufficiently to increase the heat radiating power of the surface to establish an equilibrium between heat generated in the wire and the heat radiated from the surface of the wire. If the voltage is raised sufficiently, the wire may be heated to the fusion point. On the other hand, if the voltage is kept low, the temperature of the wire may be only slightly above normal. Because of the positive temperature coefficient of the resistance of metallic conductors, such heat balance can be effected at almost any temperature of the wire between normal and melting temperature, depending on the voltage applied. The following general formula controls this problem. The heat generated in the wire may be expressed by,—

$$H_G = I^2R = \frac{V^2}{R}$$

The heat radiated from the surface of the wire may be expressed as,—

$$H_R = k\,(T_1 - T)\,S$$

wherein

H_G = generated heat.
H_R = radiated heat.
V = voltage across the wire.
I = amperage in the wire.
R = resistance of the wire.
k = specific heat radiating power per unit surface and per degree temperature difference.
T_1 = temperature of the wire.
T = temperature of the surrounding wire.
S = surface of the wire.

The equilibrium or heat balance is established with,—

$$H_G = H_R$$

$$\text{or } \frac{V^2}{R} = k\,(T_1 - T)\,S \qquad (1)$$

$$\text{or } I^2R = k\,(T_1 - T)\,S$$

The behaviour of air, whether in its cold state as an insulator or in its hot state in the power-arc, may be looked upon as being governed at all times by the same general laws of heat balance.

Air Used as an Insulator

Cold air looked upon as an insulator may more properly be termed a very bad conductor. In other words, it is assumed that the voltage applied across a given air space will always create a certain current to flow in the air path. Only the current is so small that it is not measurable. The heat generated in the air path under this condition is so small that it is carried off at practically no temperature rise in the air path.

Referring to formula (1). Every voltage within permissible limits of electric stresses creates a new equilibrium by increasing the temperature T_1 accordingly until the heat generated becomes equal to the heat radiated.

This represents the balanced condition of cold air used as so-called insulator within the permissible voltage stresses.

Air Vapour in the Power-Arc

Air, in contrast to metallic conductors, has a negative temperature coefficient of resistance.

If the voltage, therefore, is raised to a point where the temperature of the air is increased so much that the resistance is dropping rapidly, then the current and accordingly the wattage in the air path is more rapidly increased, thus creating an unstable condition. This leads rapidly to the so-called puncture, that is, the heating up of the air path to arc temperature. This in turn causes a violent expansion of the air path, thus leading to the formation of the so-called power-arc. The dimensions of the power-arc are so large that the resistance of the path becomes small, allowing unlimited current to flow, thus creating what is termed a short-circuit. The power-arc, in its final dimensions, may be looked upon as the new state of equilibrium governed again by the same general law of heat balance.

In this case, however, the governing factor of the balance is no more the voltage across the arc, such as was the

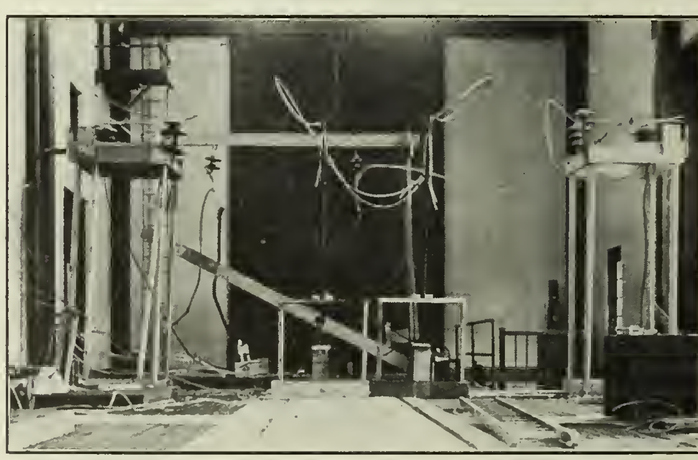


Figure No. 15.—View showing Structure and Loops over which Arcs were Formed.

case with the cold air acting as insulation, but instead it is the short-circuit current which the system is able to discharge through the power-arc.

In this paper, only this last condition, that is, the heat balance of the power-arc, is to be discussed, with the aim of trying to establish the relation of arc amperage, arc voltage and arc dimensions based on the theory of heat balance.

General Formula for Power-Arc

Assume the power-arc to be the stable condition of the heat balance between heat generated in the arc and heat radiated from the arc surface, then,—

$$H_G = I^2R$$
$$H_R = kS\,(T_1 - T)$$

If we assume that the arc temperature is always the same, then we may write,—

$$k_1 = k\,(T_1 - T)$$

In this case, therefore,—

$$H_R = k_1 S$$

wherein

- H_G = heat generated in arc (watts).
- H_R = heat radiated from the arc surface (watts).
- I = current in arc (amperes).
- R = resistance of arc (ohms).
- k = specific heat radiating power per unit arc surface per degree temperature difference (w/sq. ins./1°).
- k_1 = specific heat radiating power per unit arc surface (w/sq. in.). (average value 300 w/sq. in. arc surface.)
- S = arc surface (sq. ins.).

For the heat balance it is found, therefore,—

$$H_G = H_R$$
$$I^2R = k_1 S$$
$$\text{or } \frac{S}{R} = \frac{I^2}{k_1} \qquad (2)$$

Both values S and R are dependent on the physical dimensions of the arc. With increasing dimensions of the arc, S will increase, whereas the resistance R will decrease. This peculiarity permits the ratio S to R to adjust itself to any requirement determined by the ratio I^2/k_1.

Formula for Long Stretched Arcs

In this case the arc may be looked upon as being a circular conductor, see figure No. 17a. Then,—

$$R = r_s \frac{L}{A} = \frac{4\,r_s}{\pi}\frac{L}{D^2}$$
$$S = D\pi L$$

Entered in formula for heat balance,—

$$\frac{S}{R} = \frac{\pi^2 D^3}{4\,r_s} = \frac{I^2}{k_1}$$

From this the diameter of the arc is found as,—

$$D = m_D \sqrt[3]{I^2} \qquad (3)$$

$$\text{where } m_D = \sqrt[3]{\frac{4}{\pi^2}\,\frac{r_s}{k_1}}$$

The voltage across the arc is found from,—

$$V = \frac{k_1 S}{I} = \sqrt[3]{k_1{}^2\,\pi\,4\,r_s}\;\frac{L}{\sqrt[3]{I}} = m_v \frac{L}{\sqrt[3]{I}} \qquad (4)$$

$$\text{where } m_v = \sqrt[3]{k_1{}^2\,\pi\,4 r_s}$$

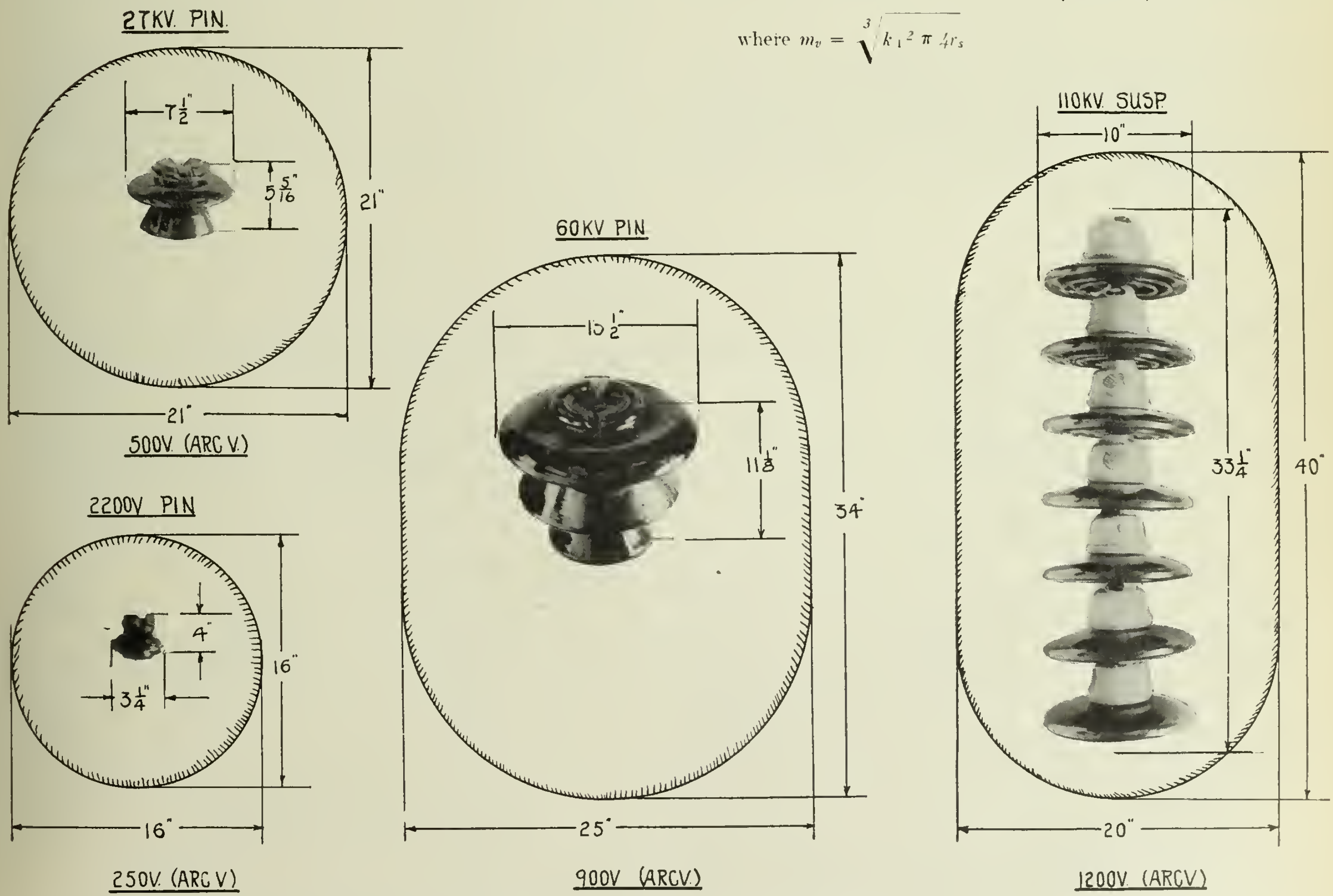


Figure No. 16.—Condensed Summary Results

Showing

Pictures and dimensions of insulators used during tests.
Approximate size and shape of initial arc at 600 amperes before it becomes distorted.
Approximate initial arc volts for currents between 70 and 10,000 amperes.

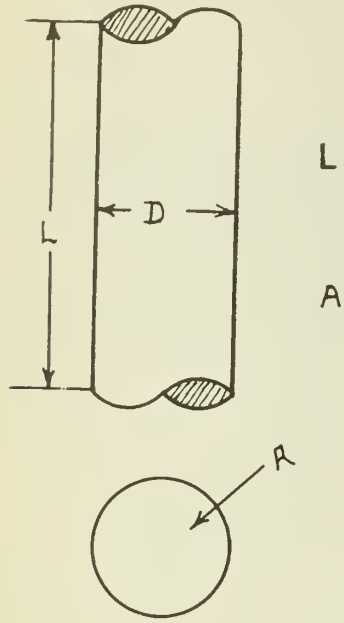


Figure No. 17a.—Assumed Shape of Long Stretched Arc.

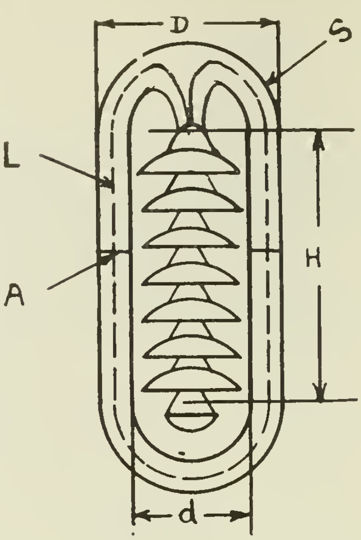


Figure No. 17b.—Shape of Arc Path on Suspension Insulator.

From the tests it is known that the specific resistance (r_s) of the arc vapour is approximately,—

$$r_s = 14 \text{ ohms/cu. inch}$$

and the specific heat radiating constant of the arc surface k_1 = approximately 300 watts per square inch.

Thus, the two practical formulæ for diameter and voltage in relation to the current for the long stretched arc are found as,—

$$D = m_D \sqrt[3]{I^2} \qquad (5)$$

$$V = m_v \frac{L}{\sqrt[3]{I}} \qquad (6)$$

where m_D = 0.26 (based on k_1 = 300 w./sq. inch and r_s = 14 ohms/cu. inch).
m_v = 250.
D = diameter of arc (inches).
L = length of arc (inches).
V = arc voltage (volts).
I = arc current (amperes).
r_s = specific resistance of arc vapour (ohms/cu. inch).

Formula for the Long Suspension Insulator

In this case, the determination of the formula is principally complicated because of the irregularity of the resistance path at the electrode ends which makes it difficult to express the resistance R in a simple formula.

It is beyond the scope of this paper to establish the correct formula for this condition, but it is interesting to bring out this case as an example of a more complex physical shape so as to illustrate the difficulties to obtain a correct formula of the interdependence of diameter, current and voltage of the arc.

In this case, the surface of the arc may be considered as consisting of a cylindrical portion of a height corresponding to the insulator height and two semi-sphere surfaces at the two ends of a diameter corresponding to the arc diameter.

Based on this assumption, the arc surface could be expressed as,—

$$S = D^2 \pi + D \pi H \qquad (7)$$

The resistance of the arc in this case is expressed by,—

$$R = r_s \Sigma \frac{(L)}{A} \qquad (8)$$

From figure No. 17*b*, it can be seen that it is rather difficult to develop the correct formula for the resistance because of the greatly irregular shape of the arc path at the terminal ends. No attempt has been made, for this reason, to solve the mathematical formula for this condition.

Practical Values for the Constants as Deducted from the Various Tests

Specific Resistance of the Arc Vapour

The long stretched arc, as obtained in several of the tests, was considered the ideal test to determine the specific resistance of the arc vapour. In this case of the long stretched arc, the arc shape approaches the simple form of the cylindrical conductor.

No attempt has been made to determine the true wattage in the arc. The oscillographs indicate that there seems to be no shifting between the current and voltage wave, so that it was assumed that the product of volts and amps. would correspond to the true wattage. Also, no attempt was made to determine the true effective voltage from the distorted voltage wave of the arc voltage, but instead the calibration is based on the peak voltage of the distorted wave to correspond to an equivalent sine wave.

All these factors introduce, naturally, a certain error which, from a physicist's viewpoint, would not be acceptable. From a practical viewpoint, however, these assumptions may be considered acceptable, in view of other natural errors of possibly far greater proportions in the determination of the arc dimensions, because of one view of the arc being available, whereas the depth of the arc being not definitely known.

Table No. 1 shows the values obtained from an analysis of the long stretched arc for different stages of the developing arc.

It will be noticed that the results are fairly close, and that, as a result thereof, the specific resistance of the arc vapour may be taken as approximately 14 ohms per cubic inch.

Compared with copper, which is 7 x 10^{-7} ohms per cubic inch, the resistance of the arc vapour is about 20,000,000 times greater than the specific resistance of copper.

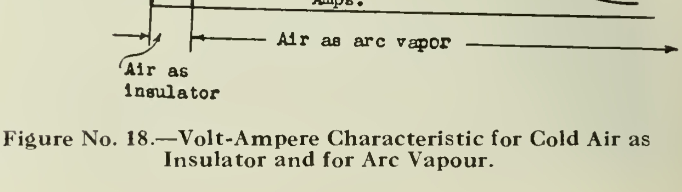
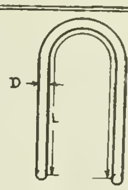


Figure No. 18.—Volt-Ampere Characteristic for Cold Air as Insulator and for Arc Vapour.

Table No. 1.—Test Results on Long Stretched Arc, giving also Calculated Values for r_s and k_1 (from Test 43d).

Ref.#	1	2	3	4	5	6	7	8	9	10	11	12	13
Ref.#	Pict. No.	Time Sec.	Cycles	Va Volts	I Amps.	V_aI_a Watts	L Inch	D Inch	S Sq.in.	k_1 Watts Sq.in.	V. ft.	rs ohms. cu.in.	Shape of arc at various stages.
1	1	0.014	0.86	1750	660	1150x10	60	34	6400	180	350		
2	5	0.069	4.25	2040	638	1300x	60	25	4710	277	407		
3	10	0.138	8.50	2040	605	1240x	63	24	4750	262	390		
4	15	0.207	12.8	2040	595	1210x	65	23	4650	260	375		
5	20	0.275	17.0	2330	585	1370x	70	22	4850	285	400		
6	25	0.345	21.8	2620	565	1480x	80	21	5280	281	395		
7	30	0.413	25.6	2920	540	1570	90	20	5660	277	390		
8	35	0.482	29.8	3000	530	1590	100	19	5980	265	360		
9	40	0.550	34.0	4080	520	2130	125	18	7070	300	390	15.0	
10	45	0.620	38.5	4950	497	2460	150	17	8005	306	385	15.1	
11	50	0.691	43.0	6700	486	3250	195	16	9700	335	410	14.1	
12	55	0.756	46.9	7300	466	3400	215	15.5	10455	321	410	13.6	
13	60	0.825	51.0	8180	444	3620	250	15.0	10705	310	390	13.0	
14	65	0.895	55.0	9900	423	4200	285	14.5	12960	325	415	13.5	
15	70	0.965	60.0	10800	410	4420	320	14.0	14015	314	405	12.6	
16	75	1.030	64.0	11700	390	4550	356	14.0	15615	290	402	12.9	
17	80	1.110	69.0	13100	380	4970	380	13.5	16078	308	415	13.1	
Average	–	–	–	–	–	–	–	–	–	288	395	13.7	

Note: Average values for rs computed from 0.55 sec. to 1.1 sec. (inclusive)

It is felt that the specific resistance of the arc vapour should change very little. In other words, it should be a constant value under practically all atmospheric conditions.

Radiating Constant k_1

From the moving pictures, it is possible to determine the approximate arc surface for the various arcs. If we further accept that the wattage of the arc is represented by the product of volts and amperes, it is possible to determine the watts per square inch surface of radiating power of the arc. The long stretched arc used for determining the specific resistance of the arc vapour is found to be satisfactory also for the determination of this constant, giving comparatively close values, as indicated in table No. 1.

In a similar way, as above, (k_1) has been determined for other tests with other shapes of arcs. It is found, however, that these values, in some extreme cases, are rather largely different. This large variation may partly be due to the crude method and uncertainty of measurement of the arc dimensions because of not knowing the actual depth of the arc. Partly, the difference in values may be due to different radiating conditions either influenced by the shape of the arc or by the air conditions. Table No. 2 shows the values obtained for the various tests.

The average value may be taken as $k_1 = 300$ watts per square inch for arcs below 1,500 amperes. Some of the values have been, however, as low as 60 watts and a few values as high as 600 watts per square inch. For 10,000-ampere arcs (k_1) has been found to vary between 2,000 and 4,000 watts per square inch. It is not quite clear whether these high values are to be attributed to the higher

Table No. 2.—Test Results on Arcs.

	1st cycle of fully developed arc									6th cycle (0.1 sec.)							
Ref.No.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
	Ref. No.	Test Series	Va Volts	I_a Amps.	V_aI_a Watts	L Inch	D Inch	S Sq.In.	K_1 W.sq.in.	Time Sec.	Va Volts	I_a Amps.	VaIa Watts	L Inch	D Inch	S Sq.In.	W.sq. in.
110 K.V. 7 Disc Suspension	1	72A	1260	120	151x10	37"	19"	2210	68.5	1	940	120	113x10	50"	16.5"	2590	44
	2	73A	1260	210	265	40"	24"	3000	88.5	"	1260	210	250	53"	23"	3830	65
	3	1D	1100	675	740	36"	13"	1470	500	"	1330	630	840	40"	18"	2270	370
	4	1C	1100	725	795	42"	21"	2780	292	"	1550	630	975	50"	21"	3300	296
	5	92H	1080	12000	13000	57"	45"	6482	2000	"	2250	10600	23800	84"	60"	15820	1500
60 K.V. pin	6	61AA	760	60	46	16.5"	3.3"	171	270	"	960	52	50	20"	2.5"	157	320
	7	61A	925	67	62	16.5"	3.3"	171	362	"	820	60	49	20"	6.6"	413	119
	8	62A	437	120	52	20"	2.5"	156	345	"	875	120	125	20"	5.75"	361	347
	9	63A	770	250	192	20"	16"	1022	190	"	875	245	215	20"	13"	815	265
	10	2C	1000	680	680	36"	28"	3190	216	"	1330	630	840	46"	28"	1830	460
	11	2D	665	725	482	33"	31"	3250	148	"	1100	675	742	45"	40"	5630	132
	12	2BB	885	1400	1240	42"	36"	4720	264	"	1100	1260	1380	50"	36"	5580	248
	13	65E	1030	1620	1670	30"	30"	2830	590	"	2150	1620	3480	43"	36"	5790	600
	14	64B	925	1730	1600	36"	33"	3676	437	"	1030	1680	1730	20"	32"	2460	675
	15	101G	810	12000	9700	33"	37"	5980	2450	"	1080	10600	11400	57"	57"	10200	1120
	16	102H	720	12000	8600	36"	30"	3355	2550	"	1800	9900	17800	69"	45"	9850	1710
27 K.V. pin	17	3A	4403	725	322	25"	25"	2000	160	"	550	650	357	26"	26"	2120	169
	18	3D	460	725	333	24"	24"	1810	175	"	650	650	422	33"	33"	3420	123
	19	3B	620	1260	780	50"	36"	5700	137	"	1310	1210	1580	36"	27"	3055	515
22 K.V. pin	20	51A	256	810	207	19"	19"	1130	183	"	256	810	2070	33"	33"	3420	61
	21	52D	225	865	195	15"	13"	612	320	"	225	865	194	14.6"	14.6"	665	292
	22	111G	810	12000	9700	35"	35"	3850	2500	"	225	11400	2570	39"	33"	4044	635
	23	112H	248	11400	2830	18"	18"	1000	2900	"	247	11400	2800	33"	63"	6540	430
Conductor Spacing 60"	24	43D	1900	650	1240	74"	40"	9250	133	"	2350	595	1400	79"	30"	7420	188
96"	25	45A	2500	700	1750	104"	27"	8900	197	"	3140	595	1870	104"	20"	6560	285
96"	26	46B	2820	1300	3670	104"	44"	14400	255	"	3140	1140	3580	104"	42"	13650	245
18"	27	121G	540	11400	6150	24"	21"	1550	4000	"	540	11400	6150	51"	24"	3880	1580
30"	28	122H	1280	12000	15400	24"	48"	3580	4300	"	1280	11400	14600	45"	45"	6350	2300

Table No. 3.—Critical Arc Voltages.

Critical arc voltage for different arc currents for an arc of 1 ft. in length calculated from $V_c = M_v \times \frac{L}{\sqrt[3]{I}}$

based on assumed values (k_1 - 300 w./sq. in. (r_s - 14 ohms./cu.in. (m_v - 250

I	V_c	V_c expressed in % of the breakdown voltage of the equivalent air gap
10,000A	139V.	0.116%
1,000	300	0.25
100	645	0.54
10	1390	1.16
1	3000	2.50
0.001	30,000	25.0
0.000016	120,000	100% (Breakdown voltage of (1 ft. air gap

current values combined with the larger wattage creating a greater steering motion in the arc or whether they are due to the greater depth of the arc because of the larger explosive effect of this type of arc along the electrode. Another factor responsible for the higher values may be the altered test condition with somewhat greater air currents prevailing. Beyond doubt, it has to be assumed that this factor (k_1) is not a constant value and is probably largely dependent on wind and the shape of the arc changing the radiating condition.

Appendix III.

Theory of Self-Extinction of a Power-Arc

In appendix II, discussing the theory of the power-arc, it is shown that a power-arc assumes such dimensions until the generated heat within the arc and the radiated heat from the arc surface are striking a balance for a given amperage. The physical dimensions of the arc are therefore entirely controlled by the current in the arc.

For any such given condition, the voltage across the arc will be a certain definite value. Suppose, now, that the system is unable to maintain the voltage across the arc which is required for the respective set of conditions, that is, for the given amperes and the given length of the arc, then an unstable condition would be created which will tend to extinguish the arc rapidly. This can be appreciated from the following:—

Assume that the voltage across the arc is lowered below the critical arc voltage, then with certain given arc dimensions the current will be lowered. This causes the arc diameter to shrink, which in turn increases the resistance of the arc. This in turn again causes a further lowering of the current, which further accentuates the shrinking of the arc, etc. This will continue until the arc is completely ruptured.

The criterion for the critical voltage which is just able to maintain an arc can be deducted from the heat balance theory of the arc.

From the heat theory, it is known that the arc assumes physical proportions until the balance is established between generated heat and radiated heat.

The moment where the generated heat is smaller than the radiated heat, then a rapid cooling of the arc must result.

The generated heat may be expressed as,—

$$H_G = \frac{V^2}{R}$$

and the radiated heat,—

$$H_R = k_1 S$$

A cooling of the arc and consequential self-extinction is to take place, therefore, if,—

$$H_G < H_R$$

$$\frac{V^2}{R} < k_1 S$$

$$V < \sqrt{k_1 S R} \qquad (9)$$

The above is the general formula for the voltage of any kind of an arc.

Self-extinction can be expected only with a long stretched arc, the critical arc length depending on the available voltage. It is possible, therefore, to determine S and R for this particular shape of an arc assuming the shape of the arc path to be cylindrical.

The surface is then expressed by,—

$$S = D \pi L$$

and the resistance of the arc,—

$$R = r_s \frac{L}{\frac{D^2 \pi}{4}}$$

With the above values entered in the general formula, it is found that for self-extinction the voltage must fulfil the following condition,—

$$V < \sqrt[3]{k_1^2 \, r_s \, 4 \, \pi} \; \frac{L}{\sqrt[3]{I}} \qquad (10)$$

From the tests, values have been determined for k_1 and r_s and it is found, therefore, by inserting these values

Table No. 4.—Critical Arc Lengths.

Critical arc length for different operating voltages and arc currents, calculated from $L_c = \frac{V}{M_v} \times \sqrt[3]{I}$

based on assumed values (k_1 - 300 w./sq. in. (r_s - 14 ohms./cu.in. (m_v - 250

Operating voltage	Arc Amp.	Critical Arc length in feet
2200 V.	1A	0.73 ft.
	100	3.42
	1000	7.30
6600 V.	1	2.2
	100	10.2
	1000	22.0
13000 V.	1	4.4
	100	20.2
	1000	44.0
60000 V.	1	20.2
	100	93.0
	1000	194
110000 V.	1	37
	100	171
	1000	370
220000 V.	1	73
	100	342
	1000	730

that for the long stretched arc the critical voltage can be found as being,—

$$V_c < m_v \frac{L}{\sqrt[3]{I}} \qquad (11)$$

where

$m_v = 250$ (*based on $k_1 = 300$ w/sq. inch and $r_s = 14$ ohms/cu. inch*).

The above indicates that for any given amperes and arc length, there is a certain critical voltage necessary to maintain an arc, or that for any given amperes and voltage across an arc, there exists a certain critical arc length which, if extended further, will cause a snapping off of the arc.

A theoretical study of the inter-relation of the three values of voltage, current and arc length will give a clearer conception of certain facts known by experience.

Assume $m_v = 250$, this being the average found from the tests of the long stretched arc, and assume that the factor is unchanged for the most extreme conditions, then it is possible to work up a table showing the inter-relation of critical voltage, arc current and arc length.

Table No. 3 illustrates, for an arc of one-foot length, how the critical arc voltage changes with the current. For any given current, the arc would snap off, if the voltage across the arc would drop, for any reason, below the corresponding critical voltage.

The table indicates clearly how little voltage is required to maintain a power-arc after it has been established. This explains the reason for the tenacity and persistency of a power-arc. Even arcs on isolated neutral systems of only a few amperes capacity current will readily persist, as according to the table a one-ampere arc will only require 2,600 volts across the arc.

It is interesting to note that cold air used as insulating medium and subjected to any voltage below its breakdown voltage, that is, less than 120,000 volts for one-foot gap, must have a leakage current of less than 0.000016 amperes. Otherwise, no stable condition could exist. As soon as the air is subjected to breakdown voltage, then the leakage current increases rapidly and an unstable condition is created which ultimately ends with the formation of the complete power-arc which finds its new state of stability only after the arc has developed to the dimensions corresponding to the short-circuit current, which the power system is capable of discharging through the arc. With 1,000 amperes passing through the arc, the arc voltage, according to the table, would only be 260 volts; that is, only 0.2 per cent of the breakdown voltage of cold air.

The apparent relation of volts and amperes for cold air as insulator and for arc vapour is illustrated arbitrarily by the curve shown in figure No. 18.

Table No. 4 indicates how far an arc would have to be lengthened out for different operating voltages and currents before the arc would tend to snap off.

This table shows further the reasons of the tenacity of the arc hanging on and also how easily it is possible for the arc to reach out into adjacent phases or circuits.

The table shows clearly how little prospect there exists of self-extinction of a power-arc except under most favourable conditions of very strong wind and ideal condition of a long loop being able to form without arc vapours short-circuiting out the loop.

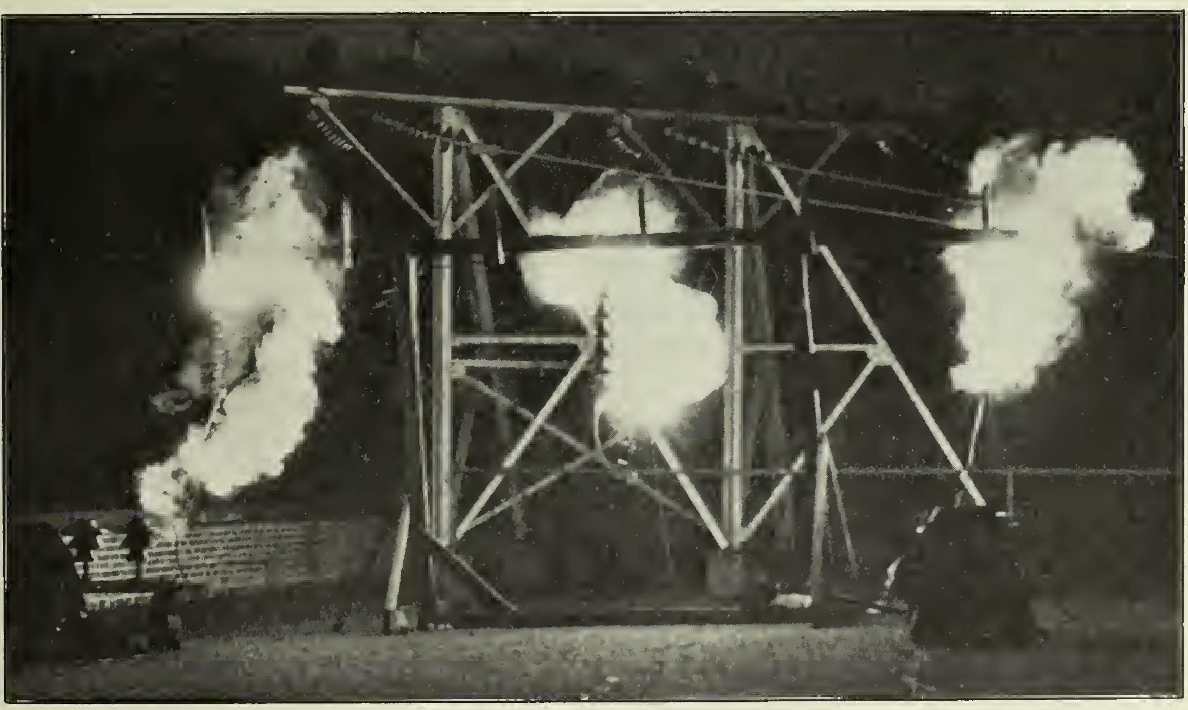


Figure No. 19.—1200-ampere, 0.5 second, Arc across Suspension Insulators at the Instant of Rupture.

Tendencies in Steel Building Design

A Review of the Development in the use of Structural Steel in Building Construction

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Structural Engineer, Dominion Bridge Company, Limited, Montreal.

Paper read before the Toronto Branch of The Engineering Institute of Canada, March 1st, 1928

The development of the use of structural steel in building construction is interesting. In the year 1881 there was published a " Pocket Companion of Useful Information and Tables Appertaining to the Use of Wrought Iron as Manufactured by Carnegie Brothers and Company, Limited, Proprietors, Union Iron Mills, Pittsburgh, Pa." This book was one of the earliest pioneers in the industry and may be considered as a classic. However, it does not make any mention of steel, but deals entirely with wrought iron. It shows beams and channels up to 15 inches deep only, and angles as large as 6 by 4 inches and 6 by 6 inches. It includes also tees and some now obsolete shapes such as half tees, star irons, corrugated columns, octagon columns and patent rivetless columns. The allowable unit stresses used for wrought iron are,—shear, 9,000 pounds; fibre stress in bending either tension or compression, 12,000 pounds per square inch, which is decreased to 10,000 pounds on the gross area of built-up girders in order to compensate for the loss in section due to rivet holes.

In 1887, the Pottsville Iron and Steel Company published a handbook illustrating much the same shapes as those in the 1881 edition of the Carnegie Pocket Companion, but showing strengths for both iron and steel, the allowable unit stresses on extreme fibres in bending being respectively 12,000 and 15,600 pounds per square inch.

In the early eighties, fabricating companies began to assume some importance in Canada, the first being the Toronto Bridge Company, which afterwards became the Dominion Bridge Company, with branches in several cities. The Hamilton Bridge Company came into existence shortly after this. In those days, production was on a very small scale and the fabricating companies, as their names would indicate, were concerned chiefly with bridges. Many of the bridges first built are still doing good service, carrying much greater loads than the designers intended. In fact, bridge work constituted at least seventy-five per cent of the tonnage of the day.

Iron was in general use for all purposes and was only gradually displaced by steel, iron rivets being in use until well on in the nineties. The feeling was that steel might not be thoroughly reliable, and some engineers insisted on built-up members being annealed after fabrication was complete. Sometimes the members emerged from this process badly twisted and sometimes not. By the end of the nineteenth century, steel had entirely replaced iron except for very special purposes, its quality was assured, essentials of good practice in design, fabrication and erection became recognized and bridge specifications were written.

Development of Specifications

Two specifications might be mentioned as helping to crystallize these essentials for bridges, namely, the 1905 Specification of the Department of Railways and Canals in Canada and the 1910 Specification of the American Railway Engineering Association. These required for mild steel an ultimate breaking stress in tension of 55,000 to 65,000 pounds per square inch and an elastic limit of one-half the ultimate strength. The allowable working stress in tension was given as 16,000 pounds per square inch. Due largely to the work of the American Society for Testing Materials, the steel now obtained from the American and Canadian mills is of uniformly high quality, the elastic limit ranging generally from 35,000 to 38,000 pounds per square inch and always rather more than one-half the ultimate strength.

In 1922, the Canadian Engineering Standards Association published two steel specifications, one on railway bridges and one on highway bridges. These have been for some time closely adhered to by all Canadian railroads and by most provincial highway departments. These two Canadian Engineering Standards Association's specifications call for a unit stress in tension of 16,000 pounds per square inch.

It was not until 1924 that the Canadian Engineering Standards Association's specification for Steel Building Construction was issued, being the first effort to standardize throughout Canada rules applicable to structural steel in buildings. The effort was timely. Previously, such regulations had been made in the larger cities by means of building codes, in other cases by the architect or engineer of the structure and sometimes by the steel contractor. Great variety resulted. Importance attaches to the situation owing to the fact that in the past thirty years the amount of building steel fabricated has increased from less than twenty-five to more than seventy-five per cent of the total, and the columns, girders and trusses of some of the larger buildings are among the heaviest and most complex members that occur in steel structures anywhere.

Of course, there is a danger of too much standardization. Some engineers hold that the first clause in all specifications should read, " This specification is not to be followed if good reason can be shown to the contrary." Others go further and remark that "Any organization that gets out a set of standards is bound for the grave." Undoubtedly, the best results are obtained only when those responsible for interpreting a specification have also written it or are capable of doing so.

Comparison of Building Code Requirements in Six Cities

It may be instructive to compare the present requirements regarding structural steel in the building codes of the six largest cities in Canada with those of six cities in the northerly portion of the United States. The six Canadian cities are Ottawa, Hamilton, Vancouver, Winnipeg, Toronto and Montreal. The others are Rochester, Buffalo, Cleveland, Detroit, Chicago and New York. Comparisons can be made regarding assumed live loads, allowable reduction of live loads, allowable unit stresses, specified wind loads and allowable stresses in connection with wind. The American Institute of Steel Construction has succeeded to some extent in standardizing steel requirements in building codes.

Of the cities considered, the Specification of the American Institute of Steel Construction has been adopted in whole or in part by Hamilton, Winnipeg, Montreal, Rochester, Buffalo and Detroit. As regards live loads, good work has been done by the United States Department of Commerce Building Code Committee, which issued in 1925 a

Table No. 1.—Assumed Weights of Various Building Materials.

	Per Cu. Foot
Brick, common	120 lbs.
Cement finish	144 "
Concrete, stone or gravel	150 "
Cork fill	12 "
Insulex	24 "
Interlocking tile	60 "
Marble	175 "
Steel	490 "
Stone, limestone	170 "
Terra cotta	50 "
Terrazzo floor	144 "

	Per Sq. Foot
Asphalt mastic flooring, 1½" thick	18 lbs.
Cement finish, 1" thick	12 "
Concrete slab, 5" thick	62½ "
Concrete joist construction 6"+ 2"	43 "
" " " 8"+ 2"	50 "
" " " 10"+ 2"	56 "
" " " 12"+ 2"	62 "
Gypsum partition, 3" thick, not plastered	11 "
" " 4" " " "	14 "
" " 5" " " "	17 "
" " 6" " " "	20 "
Marble, 1" thick, surface of walls	15 "
Plaster, on flat ordinary ceilings	8 "
" on walls, each surface	5 "
" ceiling on large public rooms, such as dining rooms, ball rooms and lobby, including steel furring	15 "
Roofing, based on 5-ply felt and tar and gravel	8 "

book, "Minimum Live Loads Allowable for Use in Design of Buildings," and it is well to compare live loads as listed in this book with those required by the various cities.

From a structural steel standpoint, the larger buildings, such as churches, schools, hospitals, hotels, office buildings, public buildings, and particularly those over ten storeys high, are of most interest, and high buildings will therefore be the ones specially dealt with here. The dead load is almost always described as including walls, partitions, framing, floors, roofs and all permanent construction. Only a few of the codes actually list the unit weights to be assumed for various building materials. There are a few unimportant discrepancies in these weights as given by different cities. Table No. 1 shows assumed unit weights acceptable to both Toronto and Montreal and probably to most other cities. This table of unit weights was actually used in the design of the steelwork for the Canadian Pacific Railway Royal York hotel, Toronto, on which the erection of steelwork is progressing.

A comparison of the live loads to be provided for in the various cities is shown in table No. 2, and there are also indicated the live loads called for by the Building Code Committee of the Department of Commerce at Washington. The dates shown for the various codes are those on which the latest revisions were made. Cases occur in the codes where more than one interpretation might be made of the live load requirements for a particular room, but it is believed that the table gives a fair comparison.

In the allowable reduction of live loads the codes show quite a variation, and table No. 3 illustrates this. Concentrated loads such as safes, vaults, ovens, pipe organs, elevators, elevator machinery and tanks should be specially provided for.

Again, in specifying unit stresses the different cities are at variance, as shown in table No. 4. It is notable that exactly one-half of the codes considered adopt the increased unit stresses allowed by the American Institute of Steel Construction, and this in spite of the fact that the Institute's specification is only five years old. The increasing use of these higher unit stresses is no doubt due to the feeling that constantly growing knowledge and care in the manufacture of the steel itself and improvements in accurate methods of fabrication and erection justify the change. In fact, a majority in the American Society of Civil Engineers actually favoured an allowable stress in tension of 20,000 instead of 18,000 pounds per square inch. The latter stress was adopted in order to obtain unanimity. Needless to say, however, it would be a mistake in any city to decide on allowable unit stresses without taking into account the likelihood of the assumptions regarding live load, special load or wind being fully realized.

Table No. 2—Live Loads.

City	Date of Latest Revision	Rotunda	Corridors	Dance Halls	Assembly Halls Fixed Seats	Dining Room	Sidewalks	Dwellings	Bedrooms	Offices	Class room	Roof
New York	1925	100	100	100	100	100	300	40	40	60	75	40
Chicago	1928	100	100	100	100	100	...	40	50	50	75	25
Detroit	1927	80	80	125	80	80	250	50	50	75	75	40
Cleveland	1927	70	70	125	80	125	200	60	70	70	70	35
Buffalo	1926	100	80	100	80	100	300	40	50	50	80	30
Rochester	1926	100	100	100	50	100	...	40	40	50	50	30
Montreal	1926	100	75	100	90	100	300	40	40	60	50	40
Toronto	1927	85	85	100	85	100	.	50	50	75	60	40
Winnipeg	1927	100	100	100	50	100	...	40	40	50	50	30
Vancouver	1927	100	100	125	75	100	...	40	50	50	75	40
Hamilton	1927	75	75	100	100	100	...	50	50	75	75	40
Ottawa	1925	80	80	120	80	80	200	30	40	40	40	40
Washington Committee	1925	100	100	100	50	100	...	40	40	50	50	30

Table No. 3—Allowable Reduction of Live Loads.

City	Columns				Floor Beams			
	Top Floor	2nd Floor Down	Succeeding Floors	Ultimately Reduced to	Beams		Girders	
	per cent	per cent	per cent	per cent	sq. ft.	per cent	sq. ft.	per cent
New York	100	95	5 on each floor	50	..	..	..	..
Chicago	85	80	5 on all floors	50	..	..	..	..
Detroit	100	60	60 on all floors except top	60	..	..	..	..
Cleveland	75	70	5 to 3 on each floor	20 at 15th Floor down	..	..	..	..
Buffalo	85	80	5 on each floor	50	300	85	300	85
Rochester	100	95	5 on each floor	50	..	..	..	..
Montreal	90	85	5 on each floor	50	150	90	150	90
Toronto	85	85	5 on all floors	50	200	85	200	85
Winnipeg	85	80	5 on all floors	50	..	..	..	..
Vancouver	95	90	5 on each floor	50	150	90	150	90
Hamilton	100	90	10 on each floor	50	..	..	..	..
Ottawa	90	90	5 on all floors	50	150	90	150	90
Washington Committee	100	95	5 on each floor	50	..	..	..	..

Wind Loads and Allowable Stresses

The cities do not agree any better about wind loads and allowable stresses therefrom than they do about other clauses. This is apparent from table No. 5. Canada is as free from earthquakes and hurricanes as any country in the world, and it would therefore seem reasonable that wind loads should be assumed somewhat less than would be desirable for Florida, San Francisco or Japan. Observations over many years of wind velocities at the top of Mount Royal show a maximum of 72 miles per hour, which occurred during a hurricane. This would correspond to a wind pressure of about 17 pounds per square foot. It will be seen from table No. 5 that most cities call for wind loads in excess of this 17 pounds. It seems unlikely, therefore, that the wind loads specified will ever occur. Moreover, once the building is complete the walls will surely relieve the steel of much of the wind stress.

Prior to the building of the walls there is likely to be very little exposed surface to obstruct the wind. At the same time, it is absolutely necessary, even in calm weather, to provide some considerable stiffness for general stability, especially during the erection of the steelwork, and ordinarily some adequate provision for wind will obviate the possibility of the steelwork shaking and getting out of plumb under the action of the erection derricks before any walls are built. The codes do not direct how the wind pressure is to be carried to the foundations, but it is often assumed to be resisted entirely by the steel, and engineering journals at present are replete with theories on the subject.

The engineer of a prominent fabricating company says:—"There has been so much written about this subject of late that it seems that our structural engineers are wandering far afield trying to follow some of the theories expressed by wind enthusiasts. We have recently gone over the details of four buildings going through one of our shops, where one might expect that the provision for taking care of wind stresses would be somewhat similar, that is, what would be safe for one building should be sufficient for all. In one case, where the wind bracing might be called reasonable, and for all practicable purposes sufficient, the beam and girder connections were about twelve per cent of weight of the beams, while in another the extra provisions made for taking the wind force were about four to five times those for carrying the vertical load, and the total beam connections were between thirty-five and forty per cent of the connecting beams or girders. The amount of wind bracing for the other two buildings was between these two extremes. Theorists start out with the wrong assumptions as to loading, without giving sufficient consideration to the construction of each individual unit, and then making use of one of the numerous methods of computing stresses they try to develop connections that will take care of the lateral forces they have discovered." The general problem resolves itself into finding, from the areas exposed to wind, the horizontal shear to be transmitted from each floor to the floor directly below it and making sure that the walls, partitions, vertical sway bracing and the stiffness of the steel frame exclusive of sway bracing, will give together a resistance sufficient to transmit this shear satisfactorily. This resistance should be considered both transversely and longitudinally. Opinions regarding wind loads differ, as has already been noted. Then the effectiveness of the resistance offered by walls and partitions, and their bond to the steelwork, and the reinforcing supplied to the steels beams and columns by the concrete floor slab, haunch or encasement, are matters of considerable conjecture. So that until our assumed wind loads and resistances are more fully known, it is not only foolish but impossible to expect accurate diagnoses of the results. There seems to be here a field for research.

It is not to be expected that one method of solution for the wind problem will apply to all high buildings. This one, owing to the great area of its base may not need any X bracing or knee braces, while that one, with perhaps lighter live and dead loads and narrower base, will demand it. Among recent buildings by the Dominion Bridge Company may be mentioned the Canadian Pacific Railway hotel at Banff, Alta., with a tower of sixteen storeys and specially strong wind connections on the tower portion only and for just about half the height; the Royal Bank building, Montreal, twenty-three storeys, with wind connections from beams to columns for practically the whole height, also X bracing and portal bracing wherever possible on the long storey height at the main floor level to accommodate the large banking room; the Canadian National Railways extension to Chateau Laurier in Ottawa, a ten-storey building with no special connections for wind and connecting to a portion already built; the Sun Life Assurance building, Montreal, where the new extension is eight storeys above the sidewalk, with provision for ultimately about twenty-four storeys and with no special provision for wind until the fifth floor, where heavy flange connections are used on the beams; the Canadian Pacific Railway Royal York hotel, Toronto, a twenty-six storey building with special wind connections almost to the top but with no X bracing at all; and the Bell Telephone building, Montreal, a twenty-one storey building with provision for wind resistance similar to that in the Royal Bank building.

Figure No. 1 shows a rather peculiar-looking building, the steelwork being designed with no provision for doors or elevators and assuming a uniform load per square foot of floor for partitions. In fact, it is a hypothetical office building with all assumptions simplified to facilitate the steel design. In height, number of floors, spacing of columns, area of base, cubical contents and exposed wind surface, this hypothetical building is about the same as the new Bell Telephone building in Montreal.

Three trial designs have been made, one to conform to the code of each of the three largest cities in Canada,—Winnipeg, Toronto and Montreal. The beams have been designed, as far as possible, to the new Carnegie beam section and the columns to the Bethlehem section, using special Bethlehem 14-inch, 149-pound H's where cover plates are necessary. Heavy slabs are used in all cases at the column footings, assuming an allowable soil pressure of

Table No. 4—Unit Stresses.

City	Steel					Reinforced Concrete	
	Tension	Compression	Bending	Rivet Shear	Rivet Tension	Conc. Compression	Steel Rein. Rods
New York	16,000	$16{,}000-70\frac{l}{r}$	16,000	12,000 S. 8,000 F.	....	650	16,000 to 20,000
Chicago	16,000	$16{,}000-70\frac{l}{r}$	16 000	12 000 S. 10,000 F.	......	$\frac{1}{5}$ ultimate strength	....
Detroit	18,000	$\frac{18{,}000}{1+\frac{L^2}{18{,}000\,r^2}}$	18,000	13,500 S. 10,000 F.	......	650	16,000 to 20,000
Cleveland	16,000	Special	16,000	10,000 S. 10,000 F.	......	750	16,000 to 22,500
Buffalo	18,000	$\frac{18{,}000}{1+\frac{L^2}{18{,}000\,r^2}}$	18,000	13,500 S. 10,000 F.	......	750	16,000 to 18,000
Rochester	18,000	$\frac{18{,}000}{1+\frac{L^2}{18{,}000\,r^2}}$	18,000	......	......	....	....
Montreal	18,000	$\frac{18{,}000}{1+\frac{L^2}{18{,}000\,r^2}}$	18,000	13,500 S. 10,000 F.	......	....	....
Toronto	16,000 18,000 in Conc.	$16{,}000-70\frac{l}{r}$	16,000	12,000 S. 10,000 F.	7,000 S. 6,000 F.	650	16,000 to 18,000
Winnipeg	18,000	$\frac{18{,}000}{1+\frac{L^2}{18{,}000\,r^2}}$	18,000	13,500 S. 10,000 F.	10,000	650	16,000 to 18,000
Vancouver	16,000	$16{,}000-70\frac{l}{r}$ $18{,}000-70\frac{l}{r}$ (in Conc.)	16,000	12,000 S. 10,000 F.	......	750	16,000
Hamilton	18,000	$\frac{18{,}000}{1+\frac{L^2}{18{,}000\,r^2}}$	18,000	......	......	....	....
Ottawa	16,000	$14{,}000-\frac{1}{3}\left(\frac{l}{r}\right)^2$	16,000	12,000 S. 10,000 F.	10,000	....	....

S=Shop. F=Field.

Table No. 5—Wind Loads and Allowable Increase in Stress.

City	Wind Load	Increased Str. Wind only	Increased Str. Wind in Comb.
	pounds per sq. foot	per cent	per cent
New York	30 pds.	..	50
Chicago	20 pds.	..	..
Detroit	15 pds.	33⅓	33⅓
Cleveland	20 pds.	..	25
Buffalo	15 pds.	33⅓	33⅓
Rochester	15 pds.	33⅓	33⅓
Montreal	30 pds.	25	50
Toronto	30 pds.	50	25
Winnipeg	{10 pds. below 40 ft.} {20 pds. above 40 ft.}	33⅓	33⅓
Vancouver	Wind not mentioned.		
Hamilton	30 pds.	33⅓	33⅓
Ottawa	30 pds.	..	25

50,000 pounds per square foot. Actually, it is not supposed that any real building of this size and shape would be built with so little total steel as these designs show, because special cornices, corbels, pilasters, offsets and skews would undoubtedly be introduced for appearance sake, to say nothing of necessary doors, windows, elevators, stairs and other irregularities which would all tend to increase the steel.

The diagram shows the differences in design data and in weight of steel per cubic foot of building. It will be noted that the Winnipeg code results in lighter steelwork than either of the other two. Incidentally, taken as a whole, it is the most recently written of the three, and thus naturally takes the fullest advantage of the trend towards a slight reduction in assumed live loads and a slight increase in allowable unit stresses. It is fair, also, to mention that had the steel beams been designed to standard sections, instead of special shapes, the differences would have partially disappeared, because it so happened that in a large number of them the variation in codes was not sufficient to justify the use of a different standard beam. A careful perusal of the Winnipeg code is well worth while. One is impressed with what it contains and how it is arranged.

To have a good garden, it is most desirable to have good garden tools and to keep them in shape, but a wise gardener with poor tools will often produce better results than a more ignorant one with the best equipment. The application of our building codes is much more important than the codes themselves, the smaller towns and villages near any large city are prone to make use of that city's building code, even when they are not fully conversant with the reasons underlying the code, and for that reason it may be well that the code be conservative. But in these large cities themselves there is always a very efficient architectural and engineering staff engaged by the city to interpret its rules, and such engineers look on the code not as a fetter but as a basis for the exercise of their sound judgment. At least, that is the case in the city of Toronto, and, so far as the writer's experience goes, it is also true of other large cities.

There is no sign that the end of improvements and economies in steel design for buildings is yet in sight. In 1924, under the guidance of Professor P. Gillespie, M.E.I.C., of the University of Toronto, Professor H. M. Mackay, M.E.I.C., of McGill University, and Professor C. C. Leluau, M.E.I.C., of the University of Montreal, tests were conducted on the strength of steel beams embedded in concrete slabs, and a set of tables was published as a result of these tests showing formulæ and increased carrying capacities for beams of various sizes with different concrete slabs. For some reason or other, engineers in general have been cautious in using these tables, even where they might do so without infringing on any regulation. It is not known that anyone seriously doubts the results of the tests, and it would be interesting to hear of any experimental data that would conflict with these results.

Use of Special or Alloy Steels

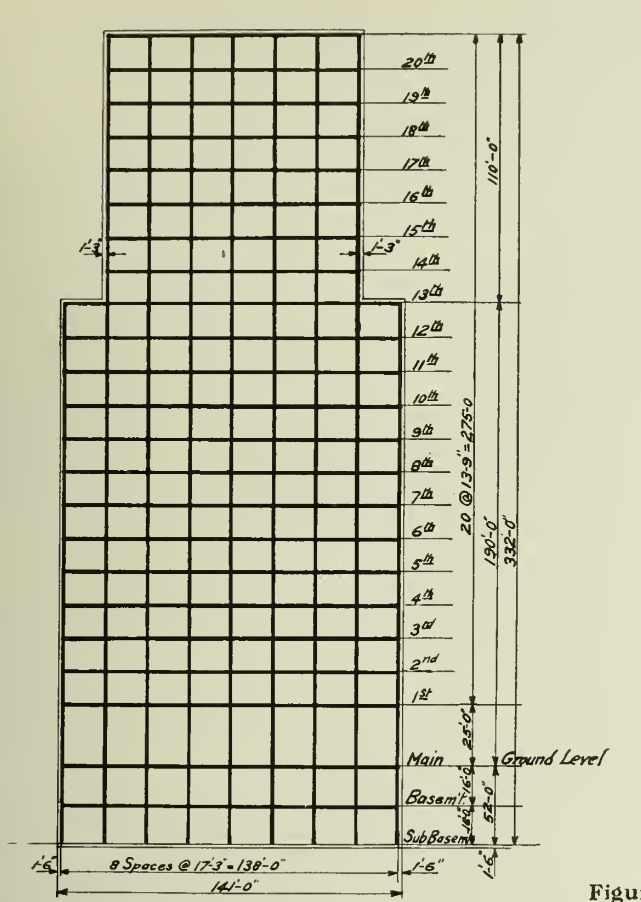
From time to time suggestions are heard that on the larger loft building columns, and even on other buildings, economic use might be made of special or alloy steels where higher unit stresses might be allowed. Special high carbon steel and silicon steel may be considered and table No. 6 shows some instances where such steels have been used in actual structures,—not all of them buildings.

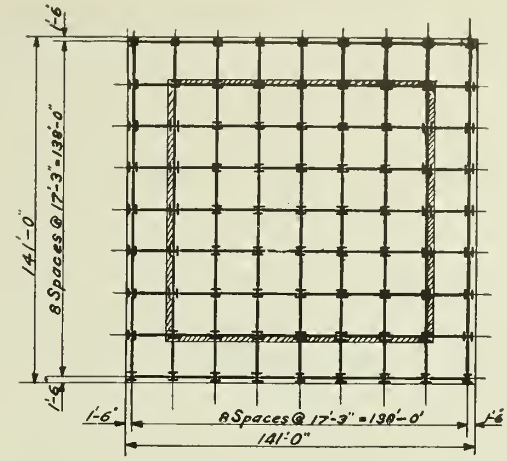
An interesting example not shown in table No. 6 may be noted. The specifications of the Canadian National Railways in the past have provided for an elastic limit of 27,500 pounds per square inch, with a minimum ultimate tensile strength of 55,000 pounds per square inch. In connection with the Point St. Charles shops now being built, the Canadian National Railways specifications provide for a minimum elastic limit of 35,000 pounds per square inch and a minimum ultimate tensile strength of 60,000 pounds per square inch. With this quality of steel, a design stress of 22,000 pounds per square inch was used. Silicon steel has, to the writer's knowledge, been used for only two important building structures on this continent, and these were by the American Bridge Company. In a power house for the Philadelphia Electric Company, silicon steel was used throughout in the design. This was modified somewhat in order to meet mill conditions by substituting carbon steel for shapes that were little used or that were not rolled at the same mills as the rest of the material. Thus, the rolling of the silicon steel was confined to one mill.

The other use of silicon steel was in the Cleveland terminal work, where, to some advantage, it was substituted for carbon steel in the heaviest columns and some of the large supporting girders. Experience seems to show

Table No. 6—Special Steels and Allowable Unit Stress.

Structure	Steel	Unit Stress pounds per sq. inch
Bear Mountain Bridge	Silicon Special	27,000
Philadelphia-Camden Bridge	Silicon A.S.T.M.	{24,000 in Towers 32,000 in Stiff Tr.
Sydney Harbour Bridge	Carbon Special	24,000
Montreal-South Shore Bridge	Silicon A.S.T.M.	23,500
Detroit-Windsor Bridge	Silicon A.S.T.M.	{24,000 in Towers 32,000 in Stiff. Tr.
Philadelphia Power House	Silicon A.S.T.M.	24,000
Cleveland Terminals	Silicon A.S.T.M.	24,000





	Winnipeg	Montreal	Toronto
Dead and Live Loads...	See Tables	Nos. 1, 2 and 3	
Unit Stresses	See Table	No. 4	
Wind Load and Stresses..	See Table	No. 5	
Total Weight.	5,993,000	6,327,000	7,507,000
Weight per Cubic Ft . .	1.1 lbs.	1.16 lbs.	1.38 lbs.

Figure No. 1.

that it is not worth while to attempt the use of silicon steel throughout a structure. It pays only when the tonnage produced by the mill on one order makes it worth while preparing ingots for rolling and where the use of this material in extremely heavy members makes a saving sufficient to warrant its use.

Nickel steel has not been used in buildings to any extent. With gradual increase in the size of building columns, owing to increasing number of storeys, there may emerge more pronounced advantages from the use of special steels.

Welding Structural Steel

Another important development in structural steel for both bridges and buildings is the use of acetylene and electric welding, especially the latter. Many structural concerns are using electric welding to some extent, both in their shop and erection work. With increased skill and knowledge, due to experience, the results are surprisingly reliable. Two of the most spectacular examples of welding in structural steelwork are a complete five-storey building for the Westinghouse Electric and Manufacturing Company at Sharon, Pa., by the American Bridge Company, and a complete one-storey building two acres in extent for the Westinghouse High-Voltage Insulator Company at Derry, Pa., by the Jones and Laughlin Steel Corporation.

As a result of welding developments, there is a demand for reasonable unit stresses usable by designers. A fillet weld may be stressed and fail in three ways,—longitudinal shear, transverse shear or tension. In structural steel work, welds can be and usually are designed for their value in longitudinal shear. Moreover, Mr. Andrew Vogel, of the General Electric Company, has just recently reported on a series of ninety-six tests performed by the Rensselaer Polytechnic Institute showing ultimate strengths in longitudinal shear. He suggests working strengths per lineal inch of 2,600 pounds per ¼-inch weld, 2,900 pounds for 5/16-inch weld and 3,200 pounds for ⅜-inch weld.

Electric welds are considerably affected by the quality of the welding wire used, also by the accessibility of the joint to be welded. Ideal conditions would be with the joint horizontal or on a slight incline and with the weld to be deposited from above; good results can also be obtained on vertical seams; but if horizontal or inclined seams have to be welded with the weld applied from below, it is difficult, if not impossible, to obtain the best results.

Experimental data are not yet sufficient to establish economical working stresses for tension and transverse shear in electric welds. It is hoped that these may come soon, and research along these lines is progressing. Meanwhile, structural welders may look to the future with hope and confidence. The advantages of welding are simplicity of equipment, rigidity of connections, saving in main material and details, watertightness, quietness of the operation. Its disadvantages are possible inexperience or inefficiency of the operator, introduction of heat stresses with crystallization. The research workers in the welding field deserve the thanks of all engineers.

Discussion of Paper on the Electric Heating of Rack Bars in Hydro-Electric Plants by C. R. Reid.[1]

Mr. C. R. Reid.[2]

Mr. Reid, in presenting the paper, desired to bring out a few points which he had omitted.

The possibility of contending with ice troubles by heating rack bars electrically had no doubt occurred to a great many operating engineers. Since preparing this paper he had learned that John Murphy, M.E.I.C., of the Department of Railways and Canals at Ottawa, had read a paper on the subject before the Canadian Electrical Association in 1907, had done some experimental work and had taken out patents which had since expired.

The installation at Shawinigan Falls had given satisfactory results, and the author believed that the features of its design and structural details would be of interest to the members of The Institute.

The cost of insulating the rack bars was approximately $10.00 per kilowatt of input. If racks were insulated when first built the additional cost for insulation should not exceed one-half of the above amount. The leakage current was calculated to be 1.6 per cent, this being based on the experimental determination of the resistance to ground on the racks in one bay. On this basis, a higher voltage might be used without leakage becoming excessive. He might also say that the leakage which passed through the water was not considered to be of any special value; it merely heated the water in general, while the important feature in this method of dealing with the ice was the heating of the rack bar, keeping it a fraction of a degree above the freezing point, so that the ice would not stick to it, and the frazil ice, as it came down, instead of adhering to the rack bar, would slip through.

He would not recommend using a higher voltage than 220, on account of the danger of breaking down the insulation, and more particularly on account of the danger to the employees who might be working on the racks. In this connection, he would point out that while it is possible to rake the racks while the power is on, it is the practice to shut off the power while raking. The circuits throughout the rack were so arranged that an ice rake could bridge over a portion of the circuit, creating a shunt through which the current would flow. Thus, putting a rake down and bridging across from one branch of the circuit to the next might cause rather severe sparking in the water and a slight amount of pitting or burning on the rack. Due to self-induction, the current tended to be crowded into the outer bars of a parallel group.

The ideal arrangement in this respect called for not more than two bars in a parallel. However, with the four-bar parallel used at Shawinigan Falls the distribution of current in the bars was uniform enough for all practical purposes, and, of course, the more bars in parallel the lower would be the cost of insulation. The power factor on a circuit made up of rack bars was quite low, and for this reason it had been found advantageous to use electrical energy of the lowest frequency available. In the case described, 30-cycle current was available and was chosen because it was the most convenient and also because it would give a slightly better power factor.

Mr. J. S. Riddile.[3]

Mr. Riddile believed that engineers and operating companies would welcome this concise and explicit description of a successful installation of electrical rack heating to prevent frazil troubles in power station operation.

He wished to mention another form of specific constant which would be found useful in first approximation to requirements for electrical heating of racks for a given unit or plant and which is mentioned in the literature of the subject. The power required for heating had a fairly definite relation to the rate of water flow through the racks. By computation from some of the author's constants, it appeared that this power is equivalent to that rate of flow taken at about three feet head. In the author's installation, this would amount to about two per cent of the unit rating.

The constant expressed in terms of head made it simple to rough out the heating requirements for any plant, the power equivalent to about 3 to 6 feet head being a good first guess.

In considering the possibilities for ice hazard, due attention should be given to all of the generally accepted conditions conducive to the formation of frazil. Briefly, these conditions consisted of:—

1. High wind or other source of turbulence;
2. Sudden substantial drop in temperature below the freezing point when there is
3. Incomplete or inadequate ice cover on the pond of forebay.

Sometimes a period of years would elapse without these coincident conditions, leading to a false sense of security.

The experience of the Laurentide Power Company was a definite case in point. The pond is large,—some twenty-five miles long. The normal velocity through the pond is low. There is a curtain wall upstream from the racks and extending down some 15 feet below the water surface. The bottom of the intake and racks is 60 feet below the water surface. The rack and head-gate chambers are covered by the gate-house, where the air temperature is always well above the freezing point.

During the first nine years of operation there was no trouble from frazil, and scarcely any indication of its presence. It was surprising, therefore, in the tenth year to have an attack of frazil which required two days' hard work to combat. For part of that time a large percentage interruption could not be avoided with the means at hand. There was no structural damage,—merely a large fractional stoppage of flow through the racks.

To produce this tenth year attack, all of the elements combined. There was early winter high water, producing abnormal forebay velocities; there was mild, cloudy weather and no ice cover. And then a bitter north wind carried the temperature down many degrees below freezing and whipped the surface of the pond.

In the twelfth year like conditions prevailed, with somewhat like results. Experience and better protective measures were of material benefit.

Mr. Riddile felt that he should not refrain from citing these adverse experiences at a development where conditions were all thought so favourable that frazil trouble

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(1) This paper was presented at the Annual General Meeting of The Institute, Montreal, February 16th, 1928, and published in The Engineering Journal, April 1928.

(2) Superintendent of Generating Stations, Shawinigan Water and Power Company.

(3) Manager of Power, Laurentide Power Company, Limited.

might never happen. Nine years of smooth sailing had tended to confirm this earlier opinion.

Even to-day, and in important plants, the basis of the design of the rack structure was sometimes too optimistic. Ordinarily, the structure was planned to withstand nearly the entire head that would be imposed if the racks were completely obstructed,—as they could be by frazil. Experience with frazil-producing streams warranted such full protection.

E. V. Caton, M.E.I.C.[4]

Mr. Caton remarked that the information given in this paper would undoubtedly prove of value to those who are troubled with ice conditions similar to those described. His company had had some trouble at the Pinawa plant with frazil owing to the local conditions, and in general their experience had been exactly along the lines outlined by the author. The type of racks installed at Pinawa would, however, necessitate considerable alterations to be suitable for the electrical method of heating.

He had secured very good results by closing in the rack room and heating this partly by air from the generator room and with supplementary steam radiators for extreme weather. Steam radiators were laid along the top of the racks at floor level above the water, and it was found that the heat conducted down through the rack bars effectually prevented frazil formation.

He believed that in many cases closing in the rack room and relying on the conductivity on the part of the rack structure projecting above water to carry the heat down below would satisfactorily serve the purpose, but in the case he had mentioned the racks were comparatively small and the depth of water was around thirty feet, which was quite different to the size of racks and water conditions existing at Shawinigan. The conditions were, in fact, such that the methods which prove satisfactory in this case might not be satisfactory at other plants.

In Mr. Caton's opinion, the prevention of ice trouble was largely a matter which must be given consideration in each individual case, and such papers as that now presented enabled one to profit by the experiences of other companies when laying out new plants or when endeavouring to prevent trouble on existing plants.

John Murphy, M.E.I.C.[5]

Mr. Murphy pointed out that the author had given definite data which should be useful to operators of hydraulic plants troubled with frazil. He had shown how his own racks were constructed, how much electrical energy was required to heat them and the beneficial results of heating them. If he did not have faith in rack-heating, he would not have made the installation.

Had his paper been published a few years ago, he undoubtedly would have heard from Mr. Murphy's solicitors; but, as the patent rights had expired, he would not hear from them now.

Buried in the 1904 Transactions of the Canadian Society of Civil Engineers,—the predecessor of The Engineering Institute of Canada,—under the title "Loss of Heat in Iron Pipe," by Col. R. W. Leonard, M.E.I.C., would be found an interesting paper and discussion relating to the virtue of passing hot water through hollow rack bars, just as the author had suggested at the end of his paper. All, save one, of those who discussed Col. Leonard's paper in 1904 were so saturated with knowledge concerning the immense quantities of *heat required to melt ice and to heat water* that they lost sight of what he advocated altogether; J. G. G. Kerry, M.E.I.C., said: "He is not trying to heat the water or to melt the ice,—he is *heating the metal* so that the ice will not stick to it." Mr. Murphy's own moving pictures, which were staged and photographed in Ottawa just after his ice-prevention demonstrations at the Chateau Laurier at The Institute's annual meeting in 1919, showed clearly the reasonableness of all the author's contentions.

Mr. C. R. Reid.

The author, in referring to Mr. Riddile's discussion, found it not quite clear with reference to a means of calculating the power required to heat the racks for a given installation. The evident intention is to assume that from three to six feet of the total head available will be used in heating the racks. For a head of 150 feet, this would represent from 2 to 4 per cent of the energy developed by the total head. No doubt this method of treating the question would be useful to the hydraulic engineer.

In the paper, the author had brought out the point that it would be possible to keep the energy requirements more or less a constant percentage of the output of the unit by the use of wider rack spacing for the lower heads. Rack spacing should be proportionate to the openings through the runners, and should be a little less than the opening through the runners, so that anything that would go through the racks would go through the turbine. If the spacing were a little larger the bucket openings would soon be blocked up with pieces of wood, and it would be necessary to shut down and punch them out. For lower heads, assuming the size of the unit to be constant, it was necessary to have larger turbines and larger openings between the buckets, and therefore wider spacing between the rack bars would be permissible. The formula which he had developed showed that the power required is proportional to the quantity of water passed, divided by the spacing between the bars; so that for a given power output, if the head is reduced, the spacing can be increased in proportion; further, the percentage of power required for heating would be constant.

Mr. Riddile, indirectly, had criticized his statement that the best means of combating frazil ice trouble was to provide a proper condition in the design of the forebay and rack structure, so that there would be little or no tendency for the frazil ice to gather on the rack bars; having pointed out that at Grand'Mere he had the ideal conditions which the paper indicates as the best means of preventing ice trouble. The author's idea was that prevention is better than cure, and that it is always better to make a favourable layout of the hydraulic structure, forebay and rack, so as to have as little frazil trouble as possible. In his company's later power houses there had as yet been no frazil trouble, but they had been laid out with this point in view.

Mr. Caton had stated that he had found it quite sufficient to heat the rack bars at the top where they project above the water, and no doubt for short bars that would be a very satisfactory solution. It would also be the cheapest solution, and in engineering practice the cheapest solution is usually the best, but at Shawinigan Falls the rack bars extend under the water some thirty feet. The heat should travel at least half of that distance, and he thought it out of the question to convey or conduct that heat so far down the bars from the surface. The gate-house at Shawinigan is heated; there is an arrangement made for hot air to be blown in on top of the rack bars where they project from the water, and no doubt that gave a certain amount of assistance, but it had not proved sufficient for the need.

[4] Chief Engineer, Manitoba Power Company, Winnipeg, Man.
[5] Electrical Engineer, Department of Railways and Canals, Ottawa.

Discussion of Paper on the Foundations of the Royal Bank Building by Mr. C. S. Proctor[1]

Mr. C. S. Proctor.[2]

In presenting his paper, the author remarked that in deciding upon the type of foundation to be employed for a building of this magnitude, it was realized that the monumental character of the building and the ornamental interior would have made the settling of the building a very serious matter. In this case, it was essential that the design provide against the possibility of even a slight difference in settlement between adjacent columns which might have caused unsightly cracks in the structure.

Another feature that had to be taken into consideration, because it was felt that the building was to be of long life, was the possibility of a future subway on St. James street and the possibility of deep cellars or foundations at adjoining sites on either side of the building, which might in the future affect or disturb its foundations.

The original data as to the character of the sub-soil were obtained by drill sample core borings, the usual method, and a centrally located test pit, the test pit being placed where it would not interfere with any future column footings and where it could be used for sump purposes during the operations. This indicated bed rock at approximately 80 feet below St. James street, and, above it, alluvial deposits of sand varying from very fine to very coarse, together with sand and gravel, including a varying proportion of clay and boulders. Ground water was found 25 feet below St. James street, and the presence of this ground water in very considerable quantities largely influenced the decision as to the type of design to be used.

The natural desire on the part of everyone at the start was to have a foundation to rock for this type of building, but it was found impossible to lower the water in the test pit beyond a certain point. Further, the boulder deposits made it impossible by any means to reach rock with sheet piling, in fact, the nature of the ground quite precluded the use of piles; so that the problem reduced itself to the consideration of spread foundations. Pneumatic construction was necessarily discarded if there was any way of providing a suitable foundation by other means, because its cost would be so greatly out of proportion with the cost of spread footings. There were, however, two arguments against the use of spread footings; first, that a spread footing could not be placed sufficiently deep to give the amount of cellar space which could have been used; second, the possibility of disturbance of the soil under the spread footings due to pumping operations for the creation of pits and sumps for this building or for subway operations in the future. Therefore it became a question as to how far the water level could safely be lowered, because the nature of the sand at about plus six became quite fine, and it was a type of sand which would have tended to flow with any major pumping operations carried too deep. The test pit operations were therefore continued to see how far the water level could be lowered without encountering any boil in the sand, and the level of plus six for the maximum depth was then decided upon.

In the actual construction, the test pit was used as a sump and the excavation was gradually carried down so that the work was done in the dry at all times.

All of the original building on the sides of the site had heavy masonry walls, and, by leaving these in place and leaving a berm and excavating from that berm at an angle of about forty-five degrees, it was possible to reach subgrade over approximately 80 per cent of the area without the introduction of any timber.

Having made this central excavation within the berm, the second line of footings were then installed by cutting into the berm at alternate footings to act as heels for the spurs to be used. This being done, the intermediate footings were placed prior to any footings on the property line, then in alternate sections the wall was carried down through the berm to the footings already installed, and was then spur-braced directly to those footings; in this way, all cross-bracing as such was done away with.

T. Kennard Thomson, m.e.i.c.[3]

Mr. Thomson observed that in New York the water level had been lowered in many places as much as from ten to thirty feet by subways, tunnels or buildings, but that on Manhattan Island rock could be reached for foundation, except in a very few places.

It seemed a pity that New York did not amend its building laws, so that the owner would be obliged to complete his own building instead of making his neighbour do so.

For instance, if he did not carry his foundations to solid material, and his neighbour wanted to go deeper with his foundations, the neighbour had to underpin the building. In fact, it had been proposed, (and nothing in the building laws would have prevented), to build the Singer building tower, (612 feet above the sidewalk), on a spread footing on New York quicksand.

The only reason this was not done was because the engineer refused to go ahead with the design for the steel work unless they went to rock for the foundation. Needless to say, if the Singer building tower had been founded on quicksand no one could have put in a rock foundation on adjoining property. As a matter of fact, a thirteen-storey structure was built on adjoining property at the same time, the north side of which settled 4 inches more than the south side during construction. He considered it possible that an excavation a block or more away might endanger such a tower.

A six-storey building had been underpinned by driving four 16-inch pipes to refusal and filling them with concrete,—wedges on top of these underpinning cylinders were driven between granite blocks,—until a hair line crack appeared in the brick work above in each individual case, but when pneumatic caissons were sunk alongside, the friction around the piles was loosened and the building settled.

Mr. Thomson had never found concrete all the way to the bottom of such pipes, which meant that all the weight came on the steel cutting edge, which either buckled or cut into the underlying material.

He had been called upon to underpin a three-year-old building in Pennsylvania which had settled from 2 inches in some places to 2 feet in others. The piles had stopped 20 feet from hard material, and in the bottom 4 feet of one which was removed nothing but water was found.

Subway construction in New York had caused a good deal of settlement, and he had seen many buildings thrown 4 or 5 inches out of plumb, and one as much as 18 inches. In that case, the contractor had to remove the floors and terra cotta of the uncompleted fifteen-storey building and jack it back to place.

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[1] This paper was presented at the Annual General Professional Meeting of The Institute, Montreal, February 15th, 1928, and published in The Engineering Journal, February 1928.

[2] Consulting Engineer, New York, N.Y.

[3] Consulting Engineer, New York, N.Y.

Mr. C. S. Proctor.

The author remarked that, in the case of the Royal Bank building, the foundations were put at a level which was believed to be safe against disturbances by subway construction; the information available having indicated that no subway would be carried deeper than the level selected for the footings. In addition, the walls had been tied together and acted as girders; they were tied into the basement floor, and tied again at the street floor line, so if there should be a tendency to disturbance there could be no lateral movement.

It was, of course, obviously desirable that a building of this character should, if possible, be on rock, but the cost of that would have been quite prohibitive.

Wm. Kennedy, m.e.i.c.[4]

Mr. Kennedy had been greatly interested in Mr. Thomson's remarks on settlement, having had experience on this grave building question.

The Union Bank building in Winnipeg, a ten-storey building, was founded on caissons on concrete pillars, and everybody thought they were safe, but there was a settlement 7 inches in the centre of the building, and his problem had been to get under these caissons and put them down to rock.

In the Winnipeg district there is about from 50 to 70 feet of clay, with a little hardpan, which is a kind of cemented gravel; they had been handicapped in this instance because there was no indication of how deep they had gone. Some of the oldest inhabitants stated that the caissons were only down about 30 feet, others were sure that some of them were down to rock.

A pit was sunk and a drift started, which fortunately happened to hit the right level and did not get too far below the other foundations. In the case of one caisson, the oldest inhabitant had assured him that he had watched the construction, and there was no need to worry because he knew it was down to rock. On this particular occasion, when the drift came near the foundation, rods were pushed ahead and they were surprised to find no resistance at all, in fact, they drifted right into the caisson, and, to their amazement, found the old lagging there and that the unresisting material was nothing but a belt of clay right through the caisson, with concrete below and concrete above. Investigation showed that when the caisson had been sunk about half-wav something went wrong and the clay had been carried in by water. In Winnipeg clay, the cleavage might be vertical, horizontal or at any angle, while the cleavage surfaces looked like oiled silk; and with any water on it the whole countryside might come in; in fact, this clay was extremely treacherous. His personal view was that in Winnipeg it is necessary to go to rock, because of the condition of the clay and the fluctuating ground water level.

F. T. Gnaedinger, a.m.e.i.c.[5]

Mr. Gnaedinger desired to ask the author what method was used in determining the probable uniform settlement of his building. Were there any available data showing the actual settlement found to take place in buildings in which the bearing surfaces were designed according to the method employed in the Royal Bank building?

After a building had been designed, erected and was occupied and in use—had the author ever taken measurements to see whereabouts in the building the maximum settlement was reached?

Mr. C. S. Proctor.

The author replied that such settlements had been measured accurately on two or three occasions. About ninety per cent of the buildings with which he had been connected had gone to rock,—probably ninety-five or ninety-six per cent at least to hardpan. It was rarely possible to float an important structure. He had not been fortunate enough to be connected with an ordinary commercial structure where settlement need not be taken into account, so that he had not had many opportunities to get information. As Mr. Thomson had pointed out, the sand in New York is so fine and so quick that it is not safe to put any building upon it; it was therefore the practice to go through the sand to hardpan, where the action is quite different and where a treatment can be adopted similar to that needed for rock. In the few cases where it had been possible to take measurements, however, the theory had been proved, as he had already indicated.

(4) Consulting Engineer, Montreal, Que.

(5) Engineer, T. Pringle and Sons, Limited, Montreal.

Discussion of Paper on Steel Work for the Royal Bank Building of Montreal by R. M. Robertson, A.M.E.I.C.[1]

F. P. Shearwood, m.e.i.c.[2]

Mr. Shearwood remarked that the designing of complicated steel frames for tall buildings was of increasing importance to Canadian engineers, since our larger cities are being forced to adopt the sky-scraper.

It frequently happened that the preliminary architectural plans supplied for the engineer's design of the structural steel frame presented eccentricities of spacing in the columns and beams. These eccentricities could prove very troublesome and often gave rise to unforeseen difficulties, which must, however, be overcome by the ingenuity of the engineer.

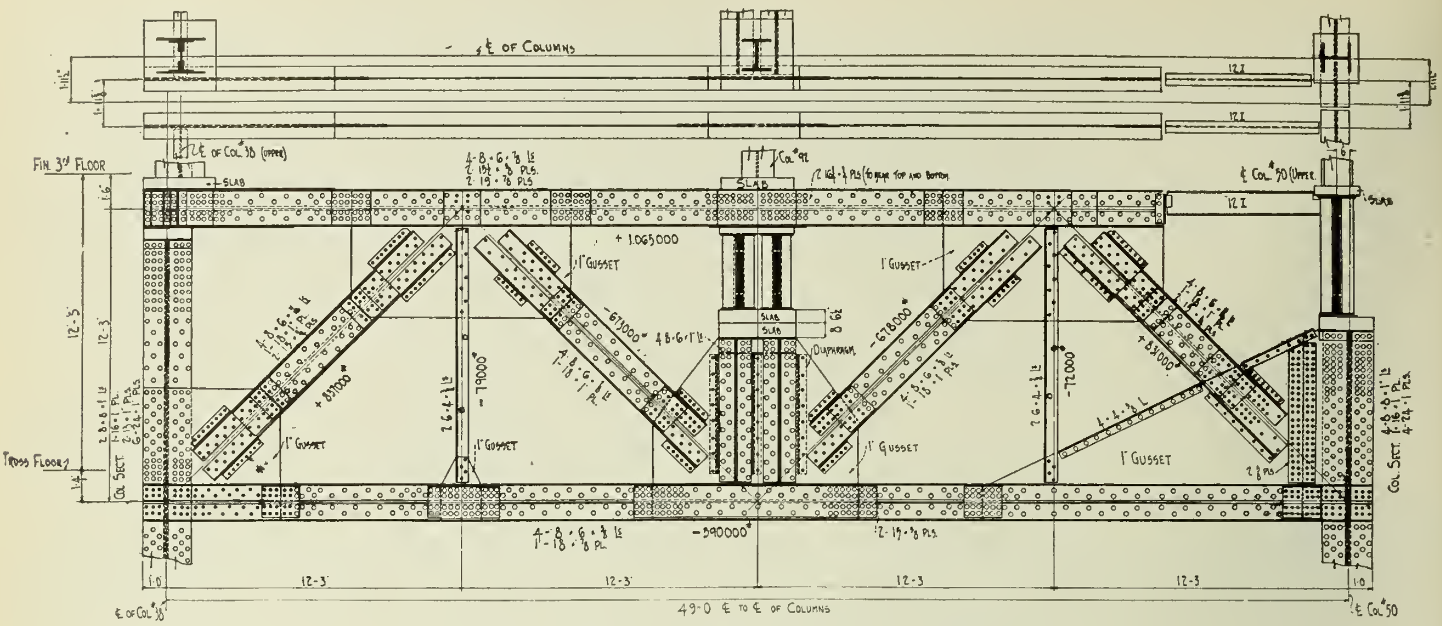
The greatest difficulties were met in the detail designing, and required the engineer to be familiar with the most modern methods of fabrication and erection, and to be conversant with the qualities and composition of the other materials which touch upon or connect with the steelwork. He must not only select sections for the steel members which are efficient, but he must choose those which can be economically fabricated and which can be readily assembled and easily riveted both in shop and field.

Throughout the design of the steelwork of the Royal Bank building, great care had been taken to avoid difficult field connections. This had resulted in rapid erection, and there was a minimum of loose or faulty rivets to be removed. It should be borne in mind that first rate workmanship could only be hoped for if the type of the main sections and the details were such that the workmen could easily reach their work and make the most advantageous use of their tools.

The heavy trusses shown on figure No. 7 illustrated some of the difficulties encountered in designing steelwork

(1) This paper was presented at the Annual General Professional Meeting of The Institute, Montreal, February 16th, 1928, and published in The Engineering Journal, February 1928.

(2) Chief Engineer, Dominion Bridge Company, Ltd., Montreal.



(Figure No. 7 of original paper published in February 1928 Journal)

Figure No. 7.—Details of Truss between Columns Thirty-eight and Fifty.
Material and Stresses are for Half of Truss.

for buildings which had large clear spans in the lower floors. The large thick gussets at the connections would suggest inquiry as to what sort of stress occurred in the rivets and in the surrounding material, as well as the amount of secondary stress in the members between the plates which are relatively weak and short.

Experience had shown that structural steelwork possessed remarkable elasticity and ductility, and adjusted itself with safety to distortions, to unequal stresses, and even to unexpected settlements. This quality was lacking in some of the materials which are popular in replacing steel, but it was generally recognized as permissible to trust to the slip of the rivets, and the elasticity and the ductility of the steel, to adjust the unknown strains. The incompleteness of the computations in showing the real fibre strain on the metal should be appreciated by the careful designer, who would adapt his methods, and allow for this, by detecting and reinforcing any likely plane of weakness where distortions could concentrate and produce excessive strains.

The calculations for what are regarded as wind stresses were a familiar and favourite point of controversy. Very many methods for calculating these stresses had been advocated, and each one had been claimed to give the most accurate solution, but he desired to point out that these are all based, not on actual happenings, but on assumptions of happenings which do not always materialize, e.g., rigid joints, fixed position of point of contra-flexure, no initial erection strains, no stiffening influence from flooring or walls, etc., etc. It should be acknowledged that an exact solution is practically unattainable, on account of the fact that there are several different paths of resistance which are capable of carrying the forces on their way to their final reaction.

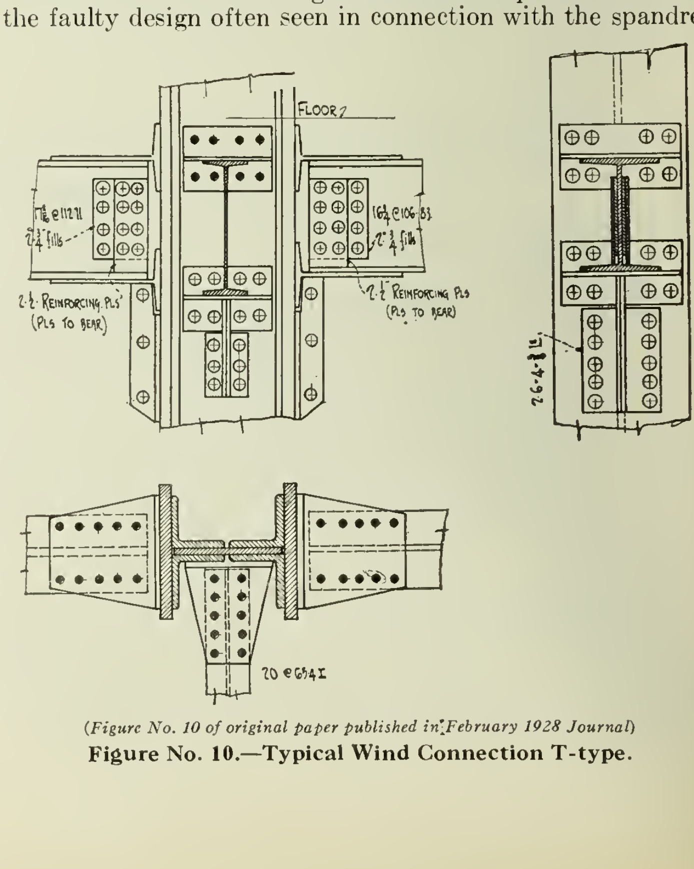
This latter fact, in conjunction with the property of steel to deflect and distort, would enable sufficient resistance from each path to come into play before the most severely strained member became dangerously overstrained, at least in buildings which are of fairly normal type.

While discussing the calculations for the lateral resistance of steel frames, it would be interesting to consider whether the present practice of assuming the steel frame as being independent of the walls and flooring represents the true condition of stress, or if it is an economical and safe assumption.

The steel frame being usually encased in the walls and flooring, these must all act together as a unit until slip takes place between them. If this slip does occur, the steel would then act as an independent frame and its deflection would be greater. The enclosed walls must show a corresponding deflection, but being more rigid than the steel, great strains would be developed in them.

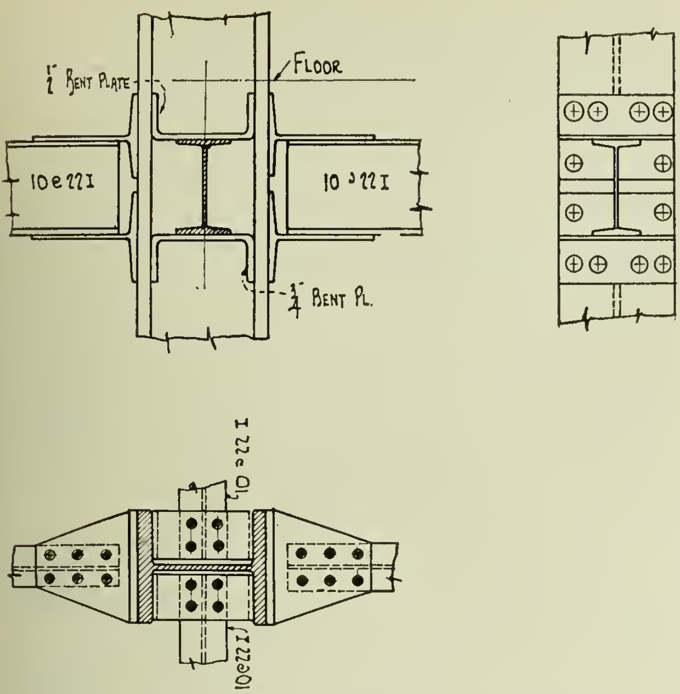
The principles of engineering would seem to indicate that the steel frame should be definitely bonded to the masonry, both acting as a unit, and preventing movement of the masonry on the steel, as well as procuring the maximum resistance and rigidity from the materials in use.

Such efficient bonding would also help to correct for the faulty design often seen in connection with the spandrel



(Figure No. 10 of original paper published in February 1928 Journal)

Figure No. 10.—Typical Wind Connection T-type.



(Figure No. 11 of original paper published in February 1928 Journal)

Figure No. 11.—Typical Wind Connection U-Type.

beams, which are frequently assumed to support the eccentric wall loads independently, whereas, as a matter of fact, they act only as a part of a system composed of walls, floors and beams.

W. B. Dunbar, A.M.E.I.C.[1]

Mr. Dunbar remarked that from the section of the building given in the paper, it would appear that no wind bracing had been provided above the mezzanine floor level. He presumed that the columns of the building above that level were adequate to take any wind stresses that might occur.

[1] Lecturer, University of Toronto, Toronto.

The author in reply said that above the mezzanine floor no cross or portal bracing had been provided. The type of wind bracing used on this floor and also on the main and basement floors was shown in figures Nos. 10 and 11, and it had been found that columns of the size necessary to carry the dead and live loads were adequate to transfer the wind shears, an increase of fifty per cent in the ordinary unit stresses being allowed for a combination of dead, live and wind loads.

P. L. Pratley, M.E.I.C.[2]

Mr. Pratley remarked that in the specifications for bearing there were two sets of figures, one for bearing in double shear and one for single shear. He inquired in what circumstances single shear would occur, and also asked whether consideration had been given to the use of higher strength steel in any of the heavy girders in the building.

The author replied that single shear bearing would occur in the outer plates or angles of any riveted connection. The bearing value of the rivet, however, would only govern when these plates or angles were thin enough to give a bearing value less than the single shear value of the rivet. No consideration had been given to the use of higher strength steels.

D. C. Tennant, M.E.I.C.[3]

Mr. Tennant observed that while the Montreal Building By-laws did not mention higher strength steel, he believed that the Montreal authorities would be willing to consider any intelligent suggestion for bettering their by-laws.

The use of special steel in small quantities in such a building as this would hardly be economical as such steel must be used in large quantities to get economical results. When the mills roll steel of this kind they like to roll it at one mill, at which there would probably not be rolls for all sections required, so that considerable extra expenditure would be involved in trying to get a small amount of special steel of many different sections.

[2] Consulting Engineer, Montreal.
[3] Structural Engineer, Dominion Bridge Co., Montreal.

THE

ENGINEERING JOURNAL

THE JOURNAL OF
THE ENGINEERING INSTITUTE
OF CANADA

VOLUME XI MAY 1928 No. 5

Western General Professional Meeting

Vancouver, B.C., June 7th, 8th, and 9th, 1928.

Fondation George Montefiore Prize

In connection with the Institut Electrotechnique Montefiore, Liege, Belgium, there has been founded a prize, known as the "Fondation George Montefiore," awarded every three years, for the most meritorious original work presented on scientific progress, particularly in the technical application of electricity in all spheres of activity. Works which merely popularize knowledge or are mere compilations are excluded from competition for this prize.

The papers, which may be in English or French, should, of course, be printed or typewritten, and are judged by a committee of ten electrical engineers, of whom five are Belgian and five foreigners, one of the Belgian delegates being, ex-officio, the director of the Institut. The prize is only awarded if, in the opinion of the committee, a work of sufficient merit is submitted, although in certain circumstances the prize may be divided.

The competitor must furnish twelve copies of his paper, which are to be delivered post free to the secretary, George Montefiore Fondation, rue Saint Gilles 31, Liege, Belgium.

Papers submitted in competition, which the committee decide to have printed, are published in the Bulletin of the Association.

For the competition of 1929, the value of the prize is 29,000 Belgian francs, and the last date for the reception of papers is April 30th, 1929.

Such papers should be headed, "Travail soumis au concours de la Fondation George Montefiore, session de 1927-1929."

Further information can be obtained from the general secretary, Institut Electrotechnique Montefiore, rue Saint Gilles 31, Liege, Belgium.

Publications of Other Engineering Societies

As previously announced in the Journal, an exchange arrangement exists between The Engineering Institute of Canada and the American Institute of Electrical Engineers, the American Institute of Mining and Metallurgical Engineers, the American Society of Civil Engineers and the American Society of Mechanical Engineers.

Subscriptions may be sent either directly to New York or through Headquarters. The following list of rates gives in the first column the amounts payable by members of The Engineering Institute for the various publications:—

	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, " "	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 $10.00.

Back Numbers of the Journal

The supply of certain issues of The Engineering Journal is completely exhausted, and as a number of requests have been received at headquarters for copies of these particular issues, principally to complete library sets, it would be greatly appreciated if members who have spare copies would forward them to headquarters.

The issues required are:—

1918:—June, July, August and October.
1919:—March, April and May.
1920:—May, June and July.
1921:—January, March and April.
1922:—September.
1924:—November and December.
1925:—April.

Western General Professional Meeting

Hotel Vancouver—Vancouver, B.C.

June 7th, 8th and 9th, 1928

The Western General Professional Meeting will be held at the Hotel Vancouver, Vancouver, B.C., June 7th, 8th and 9th, 1928. Final details of the programme are being arranged. A number of interesting technical papers will be presented and discussed, and ample provision is being made for the entertainment of visiting members.

The following outline of the programme will give a general idea of the plans for the various functions, details of which will be available to the members at the registration desk:—

Outline of Programme

(Subject to Minor Changes)

Thursday, June 7th.

9.00 a.m. Registration.
10.15 a.m. Address of welcome by His Worship the Mayor of Vancouver.
10.45 a.m. First Technical Session. Presentation and discussion of technical papers.
1.00 p.m. Luncheon (Ladies will be welcome).
2.30 p.m. Cruise around the Harbour and visit to Grain Elevator (by courtesy of the Vancouver Harbour Commissioners).
4.30 p.m. Ladies' tea.
8.00 p.m. Second Technical Session. Discussion of technical papers.
9.30 p.m. Smoking concert.

Friday, June 8th.

10.00 a.m. Third Technical Session. Presentation and discussion of technical papers.
2.30 p.m. Excursion to Lumber Industrial Plant at New Westminster, B.C.
8.00 p.m. Dinner (formal). His Honour the Lieutenant-Governor of British Columbia will be the Guest of Honour.
7.30 p.m. Ladies' dinner and theatre party.

Saturday, June 9th.

10.00 a.m. Fourth Technical Session. Presentation and discussion of technical papers. General résumé of papers and informal discussion on Institute affairs.
1.00 p.m. Luncheon.
2.30 p.m. Motor drive around City and District.
8.00 p.m. Reception and Supper-Dance at Grouse Mountain Chalet (the elevation of the Chalet is 4,000 feet).

Technical Papers

The following technical papers will be presented and discussed at the various sessions:—

"*Forest Conservation in the West*," by Mr. P. Z. Caverhill, Chief Forester, Department of Lands, Forest Branch, Province of British Columbia, Victoria, B.C.

"*The Cariboo Road*," by Patrick Philip, M.E.I.C., Deputy Minister, Department of Public Works, Victoria, B.C.

"*Some Engineering Aspects of the Bridge River Project*," by E. E. Carpenter, M.E.I.C., Consulting Engineer, British Columbia Electric Railway Company, Vancouver, B.C.

"*Irrigation in Mountainous Country*," by F. W. Groves, M.E.I.C., Consulting Engineer, Kelowna, B.C.

"*A Study of Transmission Line Power-Arcs*," by Paul Ackerman, M.E.I.C., Electrical Engineer, The Shawinigan Water and Power Company, Montreal, Que. (To be presented at the meeting by A. C. R. Yuill, M.E.I.C.)

Committees

The committees in charge of the various features of the meeting have their arrangements well in hand and are devoting a great deal of time and energy in their effort to make this Western Professional Meeting even more successful than similar meetings in the past.

The personnel of the main committee and the chairmen of the various sub-committees are as follows:—

Convention and Programme Committee
Chairman—W. Brand Young, A.M.E.I.C.
W. H. Powell, M.E.I.C.
J. Alex. Walker, A.M.E.I.C.
E. A. Cleveland, M.E.I.C.
W. B. Greig, A.M.E.I.C.
Geo. A. Walkem, M.E.I.C.
E. A. Wheatley, A.M.E.I.C.
F. P. V. Cowley, A.M.E.I.C.

Finance
Chairman—A. C. R. Yuill, M.E.I.C.

Registration and Reception
Chairman—E. A. Cleveland, M.E.I.C.

Publicity and Printing
Chairman—E. A. Wheatley, A.M.E.I.C.

Excursions
Chairman—W. H. Powell, M.E.I.C.

Papers and Discussions
Chairman—H. B. Muckleston, M.E.I.C.

Transportation
Chairman—A. E. Foreman, M.E.I.C.

Entertainment
Chairman—A. S. Wootton, M.E.I.C.

Reception and Dance
Chairman—J. Alex. Walker, A.M.E.I.C.

Ladies' Committee
Convener—Mrs. Geo. A. Walkem.

Make a note of the dates—

JUNE 7th, 8th *and* 9th

OBITUARY

Henry Edward Cranmer Carry, M.E.I.C.

It is with regret that we record the death of Henry Edward Cranmer Carry, M.E.I.C., which occurred suddenly in Vancouver on March 16th, 1928.

The late Mr. Carry was born at Leeds, in the province of Quebec, on February 9th, 1854. He served as an articled apprentice with the Northern Railway of Canada during the years 1871 to 1875. His first work after completing his apprenticeship was on the barometrical exploration, north of lake Huron, for the Canadian Pacific Railway in 1876. The following year he was engaged on the trial location surveys for the same company in the French river district. From July 1878 to May 1881 he was with the Canada Central Railway engaged alternatively as topographer on location work, engineer in charge of an exploration party, resident engineer on the construction of two sections, and in the office in the capacity of chief assistant engineer.

In 1881, Mr. Carry returned to the Canadian Pacific Railway and was engineer in charge of exploration, north of lake Superior. During 1884 and 1885 he was engineer in charge of construction of a division in the same district. The following year he was engaged in the location of the section of the Algoma Branch of the Canadian Pacific Railway. In 1887 he undertook the contract of constructing the pile and trestle work between Algoma Mills and Sault Ste. Marie on the Algoma Branch of the Canadian Pacific Railway.

During the year 1888, Mr. Carry spent a few months prospecting for gold in the Sudbury district and in 1889 engaged in private practice. During the next three years he was chief engineer of the Toronto Belt Line Railway, and in this capacity had charge of the preliminary surveys and final construction. His next work was with the Canadian Pacific Railway on preliminary surveys on the Renfrew-Parry Sound Branch, following which in 1894 he became engaged in mining and prospecting in British Columbia. For nine years he continued this work and also private practice in his profession. In 1904 he was again engaged on the Canadian Pacific Railway on reduction of grade location in Ontario, Quebec and New Brunswick, and the location of a section of the Toronto and Sudbury Branch of the same railway. His work with this company continued during the succeeding years and from 1906 to 1909 he was located in British Columbia on preliminary and location surveys of the Cowichan Lake and Merritt-Penticton Branches.

From 1909 to 1912, Mr. Carry was in charge of the development of the residential district of Shaughnessy Heights, Vancouver, B.C., when he once more engaged in private practice, which he continued until 1923, when he retired.

The late Mr. Carry was always an active supporter of The Institute and took a great interest in its affairs and particularly those of the Vancouver Branch. He was elected a Member of The Institute on May 10th, 1888, in the days of the Canadian Society of Civil Engineers, and was made a Life Member by Council in December 1921.

PERSONALS

C. H. F. Donkin, A.M.E.I.C., of Amherst, Nova Scotia, is resident engineer with the Canadian National Railways on the Flin Flon survey at The Pas, Manitoba.

E. R. Millidge, M.E.I.C., has been transferred by the Canadian National Railways from Edson, Alta., to Winnipeg, Man., where he has been appointed division engineer.

Eric C. Molke, Jr.E.I.C., structural engineer with the Trussed Concrete Steel Company, has been transferred by the company from Walkerville, Ont., to Montreal.

J. B. Phillips, Jr.E.I.C., who graduated from McGill University in 1927, has been awarded bursaries by the National Research Council to be held at McGill University in cellulose chemistry.

A. R. Chadwick, S.E.I.C., who until recently has been located at Chicago, Ill., with the Construction Equipment Company, Limited, has been moved by the company to Montreal. Mr. Chadwick is a graduate of the University of Toronto of the year 1924.

Frank Ll. Grindley, S.E.I.C., has accepted the position as resident engineer of the Canadian National Railways on the construction of the Ashmont-Bonnyville line in Alberta. Mr. Grindley graduated from the University of Alberta in civil engineering in 1926.

J. H. Irvine, A.M.E.I.C., has been appointed to represent the Dominion Reinforcing Company, Limited, at Toronto, Ont. He is a graduate of the University of Manitoba in civil engineering of the year 1912 and has had extensive experience in general construction work.

E. L. Johnson, S.E.I.C., has been appointed assistant to the works manager of the Dominion Cartridge Company, Limited, at Brownsburg, Que. Mr. Johnson has until recently been with the American Steel Foundries at Chicago, Ill.

George F. MacRae, S.E.I.C., is located with Johnston and Ward, stock and bond brokers, Montreal. Mr. MacRae graduated in electrical engineering from the University of New Brunswick in 1925, and was for a time engineer in the plant engineer's office of the Bell Telephone Company of Canada, at Montreal.

W. T. Moodie, M.E.I.C., superintendent for the Canadian National Railways at Port Arthur, Ont., has been transferred to North Bay, Ont., where he has been appointed to the position of general superintendent, in accordance with an announcement issued by the company.

Donald A. Killam, S.E.I.C., has accepted a position with the Canada Paper Company, Limited, in Montreal, having resigned his position on the engineering staff of the Abitibi Fibre Company, Limited, at Smooth Rock Falls, Ont. Mr. Killam graduated from McGill University with honours in civil engineering in 1927.

H. H. Snyder, A.M.E.I.C., is located at Kenogami, Que., on the staff of the Alcoa Power Company in connection with the new power development which the company is carrying out on the Saguenay river. Until his recent appointment, Mr. Snyder was with the Hydro-Electric Power Commission of Ontario at Hydro, Ont. He is a graduate of Queen's University of the year 1926.

L. S. Adlard, A.M.E.I.C., who has been located in Punjab, India, for some years as assistant executive engineer of the Public Works Department, is returning to Canada on eight months leave and while here will be located at 60 Howard street, Toronto, Ont. Mr. Adlard is a graduate of the University of Toronto of the class of 1915. His last leave from India was three years ago, at which time he also returned to Canada.

F. H. Kester, M.E.I.C., vice-president of the Canadian Bridge Company, Limited, Walkerville, Ontario, has recently been notified that he has been elected to the New Zealand Society of Civil Engineers. Mr. Kester was elected a director and vice-president of The Canadian Bridge Company, Limited, last year, prior to which he was contracting engineer for the company.

G. Ernest Booker, A.M.E.I.C., has joined the staff of the Metabetchouan Sulphite and Power Company, Limited, at Desbiens, Que. Until recently Mr. Booker was engaged with James Ruddick, M.E.I.C., consulting engineer, Quebec city. He was for a short time in private practice in Halifax and subsequently accepted a position as mechanical engineer with the British-American Nickel Corporation, at Deschenes, Que.

G. W. Volckman, M.E.I.C., has accepted the appointment of chief engineer and representative in India and the Far East of Sir Alexander Gibb and Partners, consulting engineers, of Westminster, England. Mr. Volckman has arrived in Bombay, where he will reside in future. Mr. Volckman resided in Canada for a number of years, having first come to this country from England in 1907. He was for a while engaged on the Georgian Bay Canal investigation as a member of the staff of the Montreal, Ottawa and Georgian Bay Canal Company.

E. L. Zealand, A.M.E.I.C., is located in Hamilton, Ont., where he has accepted a position with the Pigott-Healy Construction Company. Mr. Zealand graduated from the University of Toronto in 1922, and after a short period with the Canadian Pacific Railway, as concrete inspector and instrumentman, he joined the staff of the Quebec Development Company, Limited, at St. Joseph d'Alma, Que., in 1923. Subsequently, in 1926, he was engaged with the Aluminum Company of Canada, Limited, at Arvida, Que., where he remained until the early part of this year.

A. A. Oldfield, A.M.E.I.C., has been appointed director of safety of the Wisconsin Power and Light Company at Madison, Wis., the appointment being a promotion from his former position of engineer of maintenance-of-way for the company. Mr. Oldfield is a native of Leversedge, Yorks, England, and came to Canada in 1906, when he was appointed on the engineering staff of the Electric Railway Company at Winnipeg, Man. He was appointed to the position from which he has just been promoted in 1922, at which time he also held the position of assistant to the manager.

S. H. Frame, A.M.E.I.C., has been appointed field engineer of the Water Rights Branch of the Department of Lands of the Province of British Columbia. He was for a number of years connected with the Department of Natural Resources of the Canadian Pacific Railway Company as assistant engineer on the Eastern Section of the Irrigation Block with headquarters at Brooks, Alta. On his new work Mr. Frame will be in charge, as field engineer, of the investigation of an extensive project of the Chilko river, which now flows eastward into the Fraser river. The scheme is to divert this river through the Coast Range of the Rocky Mountains.

Award of Ramsay Memorial Fellowship

William H. Barnes, S.E.I.C., has again been awarded the Ramsay Memorial Fellowship for research, according to a recent announcement. The award is made by the National Research Council and is the highest award made by the Council. This is the second year in succession that Mr. Barnes has been awarded this fellowship. He is a graduate of McGill University of the year 1927 and is the son of Dr. Howard T. Barnes, M.E.I.C., professor of physics, McGill University. Mr. Barnes will continue the work that he has been carrying on at the Royal Institution of Great Britain in London on the action of X-rays in crystals.

McGill University to Honour President Julian C. Smith, LL.D., M.E.I.C.

At the spring Convocation of McGill University the degree of Doctor of Laws will be conferred upon the President of The Institute, Julian C. Smith, LL.D., M.E.I.C. Mr. Smith, who is vice-president and general manager of the Shawinigan Water and Power Company and director of a large number of utility companies and industrial corporations, will receive this honour in recognition of the high position which he has attained in the public utility and industrial development of this country. Mr. Smith is a graduate of Cornell University of the year 1900 and received the honorary degree of LL.D. from Queen's University in 1923.

Meeting of Council

Meeting of April 20th, 1928

A meeting of Council was held at eight o'clock p.m. on Friday, April 20th, 1928, President Julian C. Smith, M.E.I.C., in the Chair and nine other members of Council being present.

The secretary reported that in accordance with the direction of Council the following examiners had been appointed in connection with the new prize scheme:

Zone A.—	Vice-President S. G. Porter, M.E.I.C.
	Councillor R. J. Gibb, M.E.I.C., Edmonton.
	Councillor W. H. Powell, M.E.I.C., Vancouver.
Zone B.—	Vice-President A. J. Grant, M.E.I.C.
	Councillor R. L. Dobbin, M.E.I.C., Peterborough.
	Councillor T. R. Loudon, M.E.I.C., Toronto.
Zone C.—	Vice-President W. G. Mitchell, M.E.I.C.
(*English*)	Councillor W. C. Adams, M.E.I.C., Montreal.
	Councillor Fraser S. Keith, M.E.I.C., Montreal.
(*French*)	Vice-President J. H. Hunter, M.E.I.C.
	Councillor O. O. Lefebvre, M.E.I.C., Montreal.
	Councillor A. B. Normandin, A.M.E.I.C., Quebec.
Zone D.—	Vice-President F. O. Condon, M.E.I.C.
	Councillor H. W. L. Doane, M.E.I.C., Halifax.
	Councillor J. Stephens, M.E.I.C., Fredericton.

Discussion took place with reference to the place at which the Annual General Meeting for 1929 is to be held, invitations having been received both from Ottawa and Hamilton. After consideration it was unanimously decided that the meeting should be held in Hamilton, the Thursday, Friday and Saturday of the second week in February 1929 being suggested as a suitable date.

Scrutineers were appointed to canvass the ballot for the amendments to By-laws, returnable May 12th, 1928.

On a report from the Board of Examiners and Education, it was decided that in connection with The Institute's examinations it will be desirable to arrange for a proportion of the papers to be set by members conversant with the various subjects and who do not belong to the Board. It was also resolved that the present policy of paying a nominal fee for the setting and reading of papers for The Institute's examinations should no longer be continued. Dr. A. Frigon, A.M.E.I.C., Director of The Ecole Polytechnique, Montreal, was appointed a member of the Board of Examiners in succession to Dr. A. Surveyer, M.E.I.C., who has resigned.

The membership of the following committees was reported and approved:

Engineering Education.
Plummer Medal Committee.
Library and House Committee.

The list of officers of the Calgary Branch for the current year was approved as follows:

Chairman	Thos. Lees, A.M.E.I.C.
Vice-Chairman	F. J. Robertson, A.M.E.I.C.
Sec.-Treas.	W. H. Broughton, A.M.E.I.C.
Executive	B. Russell, M.E.I.C.
	F. M. Steel, M.E.I.C.
	O. H. Hoover, A.M.E.I.C.
(Ex-officio)	S. G. Porter, M.E.I.C.
	P. J. Jennings, M.E.I.C.
	F. K. Beach, A.M.E.I.C.
	H. R. Carscallen, A.M.E.I.C.

Prof. T. R. Loudon, M.E.I.C., reported progress on behalf of the Service Bureau Committee, and stated that that Committee was at present engaged in collecting information on various topics connected with its work.

A resolution was presented, passed by the Executive Committee of the Vancouver Branch, requesting that the subscription to the Journal in the case of Students of The Institute should be made optional, and the secretary was directed to reply that this was a matter which could only be dealt with by an amendment to section 74 of the By-laws.

The secretary reported that communications had been received from a number of councillors indicating that the dates suggested for the forthcoming Plenary Meeting, namely, October 15th, 16th and 17th, 1928, would be suitable.

A representative was appointed to attend the Conference on the Standardization of Fire Hose Connections to be held at Ottawa on May 3rd.

Life membership was granted to J. A. Bell, M.E.I.C., St. Thomas, Ont., as one of the oldest members of The Institute, to which he has belonged since 1887.

The financial statement to March 31st, 1928, was presented and approved.

Four reinstatements were effected; fifteen resignations were accepted, and one removal was effected.

The following elections and transfers were effected:

Elections		Transfers	
Associate Member	1	Junior to Associate Member	2
Juniors	4	Student to Junior	6
Students	15		

Nineteen applications for admission and transfer were scrutinized and classified for the ballot returnable May 18th, 1928.

The Council rose at 11.15 o'clock p.m.

Erratum

In correction of the statement appearing in the report of the Council Meeting of March 13th, on page 283 of the April number of the Journal, it should be noted that H. A. Dupre, M.E.I.C., although resigning the secretaryship of the Canadian National Committee of the International Electrotechnical Commission, retains his membership of that committee.

EMPLOYMENT BUREAU

Situations Vacant

CIVIL ENGINEER

Young civil engineer with some railway experience for general engineering work. Location Montreal. Apply box No. 190-V, The Engineering Journal.

TOWN MANAGER

The position of town manager in a northern Ontario mining town is available to engineers with the required experience. Applicants must speak both English and French fluently. Applications must contain a statement of experience, qualifications, and salary expected. Apply box No. 191-V, The Engineering Journal.

FIELD ENGINEER

Recent graduate with at least two years experience in pulp and paper mill for the position of field engineer. Apply box No. 192-V, The Engineering Journal.

DRAUGHTSMEN

Two draughtsmen for mechanical details, design, and general draughting for a pulp and paper company. Apply box No. 193-V, The Engineering Journal.

MECHANICAL ENGINEER

Recent graduate in mechanical engineering for a pulp and paper company in Northern Ontario. Apply box No. 194-V, The Engineering Journal.

STRUCTURAL STEEL DETAILERS

A company in Ontario has two openings for experienced structural steel detailers. Apply box No. 195-V, The Engineering Journal.

SALES ENGINEER

A manufacturing company requires the services of a graduate engineer with four or five years experience in steam power plant or kindred work, for their sales organization in the province of Quebec. Applicants must speak French fluently. Apply box No. 196-V, The Engineering Journal.

PULP AND PAPER MILL DESIGNER

A pulp and paper company in Northern Quebec has an opening for a competent designer. Preferably one with pulp and paper mill, or at least industrial experience. Preference will be given to an unmarried, university graduate. Apply box No. 197-V, The Engineering Journal.

Situations Wanted

ELECTRICAL ENGINEER

Electrical engineer, 27 years of age, University of Toronto graduate, six years diversified experience, two years Westinghouse engineering course, inspection of electrical equipment, industrial construction and maintenance, testing and research; at present employed in United States; wishes to return to Canada. Available on reasonable notice. Apply box No. 231-W, The Engineering Journal.

MECHANICAL DRAUGHTSMAN

Experienced mechanical draughtsman will be open for a position in the near future, requiring initiative and ingenuity in designing machinery, or layout of steam or hydro-electric power equipment. Present position in Montreal. Accustomed to having charge of design. Apply box No. 234-W, The Engineering Journal.

CIVIL ENGINEER

Twenty years experience in construction, (railway, highway, foundations, etc.), field surveys of all kinds, considerable office experience, general knowledge of accounts and cost accounts. Will go anywhere. Good permanent prospects larger consideration than immediate salary. Apply box No. 235-W, The Engineering Journal.

Specifications for Steel Railway Bridges

The Canadian Engineering Standards Association has issued a third edition of their Standard Specifications for Steel Railway Bridges. The previous editions have for some time been exhausted and the committee, in preparing the revised issue, has taken the opportunity to bring the specification up to date and to make certain desirable improvements.

ELECTIONS AND TRANSFERS

At the meeting of Council held on April 20th, 1928, the following elections and transfers were effected:—

Associate Members

DEWEY, Philip Andrew, B.S.C.E., (Univ. of Vt.), engrg. dept., Can. Ramapo Iron Work, Ltd., Niagara Falls, Ont.

Juniors

BACKMAN, Walter Henry, B.Sc., (N. S. Tech. Coll.), cost engrg., Fraser Brace Engrg. Co., Ltd., Gatineau, Que.

GRIME, Leonard, B.A.Sc., (Univ. of Toronto), structural dftsman. with Am. Bridge Co., Toledo, Ohio.

MIDGLEY, George Henry, B.Sc., (N. S. Tech. Coll.), Dodge Mfg. Co. of Canada, Ltd., Montreal.

Transferred from the class of Associate Member to that of Member

DAVIS, George Sanford, electrical engr., with J. M. Robertson, Montreal.

Transferred from the class of Junior to that of Associate Member

PERRITON, Douglas Eric, B.Sc., (McGill Univ.), estimating and contracting, as asst. to contracting engr., Dom. Bridge Co., Ltd., Montreal.

SHOTWELL, John Stuart Gloshan, B.Sc., (McGill Univ.), chemist, i/c control testing and research chemist, Price Bros. & Co., Ltd., Riverbend, Que.

Transferred from the class of Student to that of Junior

CROSS, George Esplin, B.Sc., (McGill Univ.), structural dftsman., Dom. Bridge Co., Ltd., Montreal.

FLEMING, Canmore Drake, B.Sc., (McGill Univ.), Anglin Norcross, Ltd., Royal York Hotel, Toronto, Ont.

IRWIN, Karl Webster, M.A.Sc., (Univ. of Toronto), transmission dept., plant engr's office, Bell Telephone Co., Toronto, Ont.

JONES, Herbert Cecil, B.Sc., (Univ. of Man.), Can. General Electric Co., Peterborough, Ont.

PLOW, John Foss, asst. engr., mechanical dept., Price Bros. & Co., Ltd., Riverbend, Que.

TRUEMAN, Mark Cecil, B.Sc., (Univ. of Man.), power engr., sales dept., Wpg. Hydro-Electric System, Winnipeg, Man.

Foundry Research at Mellon Institute

Announcement has been made by Dr. Edward R. Weidlein, director, Mellon Institute of Industrial Research, Pittsburgh, Pa., that the Whiting Corporation, Harvey, Ill., has established in the institution an Industrial Fellowship, whose holder, Dr. Edward E. Marbaker, will conduct research on cast iron. The results of these investigations will be published for the general benefit of the foundry industry.

For a number of years the Whiting Corporation has been carrying on a systematic programme of development for the purpose of improving equipment and methods for the production of cast iron. It has recently been determined to expand this work and in consequence the Corporation will sustain research at Mellon Institute. Dr. Marbaker, the Whiting Corporation Fellow, will work in close co-operation with the research committee of the American Foundrymen's Association.

Dr. Marbaker has been a Fellow of Mellon Institute since 1921. Previously he was chief chemist for the Westinghouse Lamp Company and for the Cleveland Wire Division of the National Lamp Works of the General Electric Company. He received his professional training at the University of Pennsylvania (B.S., 1910; Ph.D., 1914).

BOOK REVIEW

Principles of Chemical Engineering

By William H. Walker, Warren K. Lewis and William H. McAdams, McGraw-Hill Book Company, New York, 1927, Second Edition, Buckram, 6 x 9½ in., 770 pp., figs., tables, $5.50.

This volume is one of a series of texts and reference works, (Chemical Texts), published by McGraw-Hill Book Company, Inc.

The writers have selected for treatment basic operations common to all chemical industry rather than details of specific processes. In the first chapter on Stoichiometry emphasis has been put on the utility of the pound mol. as a unit for calculations and the ease with which the units of one system may be transferred into those of another. Problems and their solutions are given showing the advantages derived from this method of calculation and the simplicity thereof.

Chapters on Flow of Fluids and Flow of Heat consider the laws giving these phenomena in detail.

The subject of Fuels with special reference to their economical use in furnaces and kilns is dealt with in a clear and descriptive manner.

Gas producers are treated in a separate chapter, in which certain types are described and the reactions involved discussed at length.

The chapters on "Crushing and Grinding" cover the main principles involved and describe the methods used at some length.

Gas Scrubbing, Filtration, Lixiviation and Filtration are admirably dealt with.

The chapters on Drying and Distillation are complete in theoretical consideration and give excellent examples of the various types of apparatus employed.

The subjects throughout are clearly set forth and easily understandable, the latter through a generous use of problems and their solutions.

The work should form an admirable text book for students of chemical engineering, and an invaluable reference book for the chemical engineer. It should accomplish the wish of the writers that it will "Stimulate engineers to design apparatus adapted for any particular purpose, rather than just to build it and then to rely on large scale experimentation with expensive changes in construction to effect efficient operation."

J. R. Macaulay,
J. T. Donald & Co., Limited.

Foster Wheeler Limited Succeeding Canadian Power Specialty Company, Limited

Announcement is made of a change in name of the Canadian Power Specialty Company, Limited, to that of Foster Wheeler, Limited, which change has been authorized by the Dominion Government. The head offices of the company are in the Canadian Pacific Building, Toronto, and district sales offices are located in the Canada Cement Building, Montreal, and the Board of Trade Building, Vancouver, B.C.

The B. F. Sturtevant Company has issued an attractive book entitled the "Eighth Wonder," which describes the construction of the Holland tunnel which connects Manhattan Island with Jersey City. This book contains sixty-eight pages and is well illustrated and handsomely bound.

The Canadian Ingersoll-Rand Company, Limited, has issued the sixth edition of its book entitled "100 and 1 Ways to Save Money With Portable Compressors." This book, which contains one hundred and forty pages, is well illustrated and embodies comparative cost data on the company's portable air compressors and air-operated tools, the information being compiled in a handy reference, cross-indexed form.

The company has also issued a book of reprint articles entitled "Important Rock Drilling Projects" covering a number of important works carried on during 1927.

Copies of both these booklets may be secured from any of the branches of the Canadian Ingersoll-Rand Company or from the head office, 10 Phillips Square, Montreal, Que.

Combustion Engineering Corporation, Limited, has issued a small pamphlet entitled "The Story of Combustion" which is a reprint from an article appearing in "World's Work." Copies of this booklet may be secured from the company's head office at Montreal.

BRANCH NEWS

Lethbridge Branch

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

The annual meeting of the Lethbridge Branch was held on March 24th, when the season's work and the statement of finances were reviewed. The meeting commenced with a dinner at which about thirty members and affiliates were present, and during which the Rainbow Orchestra rendered delightful selections. Vocal solos by Mr. E. Rannard were greatly appreciated and closed the musical part of the programme.

In closing his term of office as chairman, Geo. S. Brown, A.M.E.I.C., thanked all those through whose help a most successful year's work had been accomplished, and expressed his trust that a continuation of the good work would be carried on. The results of elections under the amended branch by-laws for that work, which proved very satisfactory, were as follows:

Chairman	N. H. Bradley, A.M.E.I.C.
Executive	J. B. deHart, M.E.I.C.
	G. N. Houston, M.E.I.C.
	C. S. Clendening, A.M.E.I.C.
	C. S. Donaldson, A.M.E.I.C.
Ex-officio	Geo. S. Brown, A.M.E.I.C.
Member of Council	R. Livingstone, M.E.I.C.

Mr. Bradley, on being congratulated upon his election, thanked the members for the honour conferred on him and expressed his desire that the good relations and responsiveness of the various committees would be continued.

Oxy-Acetylene Welding

The business being completed, the chairman introduced the speaker of the evening, Mr. J. A. Jardine, who addressed the members on the subject "Oxy-Acetylene Welding," showing pronounced familiarity with the work. Contrary to the general public idea that welding is more associated with repairs, the speaker explained to what extent it is entering into construction work and with what tremendous force there is behind the oxy-acetylene torch. The incessant hammering of rivets now gives way to welding in steel constructed buildings, and even under water such work can be successfully carried on. When it is considered that the toughest metal known to man lays at the mercy of the welder's torch, with its flame at a temperature of 6,000°F., some idea of its great importance in the future can be seen.

Mr. Jardine submitted for the members' inspection samples of ornamentation work in brass, copper and iron, which had been welded in the local plant, and which proved most interesting.

A hearty vote of thanks to the speaker and the singing of the National Anthem brought the meeting to a conclusion.

Moncton Branch

V. C. Blackett, A.M.E.I.C., Secretary-Treasurer.

"Coal, Oil and Wood—Something of Their Past Performance and Future Promise" was the subject of an address given before the branch, on March 30th, by H. E. Bigelow, Ph.D., dean of the Science Faculty, Mount Allison University, Sackville, N.B. The meeting was held in the City Hall, and C. S. G. Rogers, A.M.E.I.C., was the presiding chairman.

Coal, Oil and Wood

The subject is one that ever fascinates, for in these substances the chemist finds the great store of those elements, carbon, hydrogen and oxygen, that he touches with his seeming magic wand, and converts into the multitude of necessities used in the manufacturing processes of modern industry.

Coal was originally distilled to obtain illuminating gas, with coke as the next article of value. The ammoniacal liquor obtained in the process of purifying gas was almost a waste,—the coal-tar residue even more so. In the present manufacturing methods the ammoniacal liquor is the source of supply of many ammonium compounds used as fertilizer and of ammonia itself used in many industries, while coal-tar is the raw material which chemistry turns into the brilliant dyes of commerce and various flavouring essences that flowers and fruits once supplied.

All of us remember the waste that occurred when wood was roasted to form charcoal. All the gases, the watery liquid with its valuable contents, such as the ascetic acids, metheyl alcohol, etc., and the wood-tar and its constituents were driven off,—wasted. Now the charcoal is the by-product and the former by-products are the prizes sought.

In all the modern methods of chemistry in the treatment of coal, oil and wood, at the basis of the reasoning that has brought about such marvellous results, has been the recognition of the fact that these three substances contain in available form the great store of the elements oxygen, hydrogen and carbon that are the components of that great family of compounds with which the study of the so-called organic chemistry deals. The problem facing the chemist is to break up this supply and recombine the elements into the specific compound sought in modern industry. Fascinating indeed, in this regard, has been the discovery of certain agents that by their presence only, with seemingly no change in themselves, cause chemical reaction and compel the union of elements and substances that otherwise refuse to unite. These are the catalysts. Nickel acts on one group of substances, and even water is a great catalyst. In the discovery of other catalysts there is a great opening for further development.

So the future has great promise. No one can doubt this in view of the startling developments and discoveries of recent years.

Bakelite, so familiar to radio fans, is a coal derivative. Gas refrigeration is a very recent discovery that threatens in time to entirely supplant electric refrigeration, owing to its cheapness and absence of moving parts. It is said that German scientists are now able to make wood alcohol from water gas, for sixty cents per gallon. This water gas is obtained by the treatment of coal with steam. It is quite probable that these same scientists have already put on their thinking caps and will soon develop a cheap process for the manufacture of alcohol to be used in intoxicating liquors. A substitute for gasoline, made by forcing hydrogen into coal, heated under pressure, has also been discovered, and this substance is largely used in Germany.

Dr. Bigelow referred briefly to the progress made in the distillation of petroleum. The paint business will in all probability be revolutionized by the recent discovery of a solvent for lacquers that is manufactured from petroleum. Synthetic sugar derived from oils is also a recent discovery, and, strange as it may seem, there is every probability that meat and other foods will be obtained from petroleum.

At the conclusion of the address, a hearty vote of thanks, moved by F. O. Condon, M.E.I.C., was tendered Dr. Bigelow by the chairman.

Election of Officers

Officers for 1928-29 were nominated at this meeting, and the following will carry on the work of the branch during the ensuing year:

Chairman	H. J. Crudge, A.M.E.I.C.
Vice-Chairman	M. J. Murphy, 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.
	J. R. Freeman, A.M.E.I.C.
	L. H. Robinson, M.E.I.C.
	G. E. Smith, A.M.E.I.C.
	H. B. Titus, A.M.E.I.C.
	Frank Williams, A.M.E.I.C.
Ex-officio	F. O. Condon, M.E.I.C.
	G. C. Torrens, A.M.E.I.C.
	F. L. West, M.E.I.C.

Montreal Branch

C. K. McLeod, A.M.E.I.C., Secretary-Treasurer.
W. McG. Gardner, A.M.E.I.C., Branch News Editor.

Harbours of the Great Lakes

(Reported by H. W. B. Swabey, M.E.I.C.)

On March 15th, an interesting paper was read to the branch by Lt.-Col. H. J. Lamb, M.E.I.C., describing the "Harbours of the Great Lakes."

The paper, splendidly illustrated by lantern slides of charts and photographs, opened with a brief description of these great freshwater seas having a combined area of 95,160 square miles and a sailing distance from Kingston to Duluth of 1,160 miles.

The drainage of this system is so well regulated by nature and the supply so balances the discharge that at all seasons a sufficient depth of water is provided over the major portion of the lakes to cover all the requirements of deep water navigation. Further, it has been repeatedly stated that nowhere else on the face of the globe on a comparable scale can such a wonderful combination of freshwater reservoirs be found or can any river comparable in size be found to compare with the St. Lawrence in uniformity of flow.

To utilize these waterways efficiently and in safety, the Dominion government has, since Confederation, expended approximately fifty-two millions of dollars on the construction and maintenance of harbours and other improvements. This work has involved the establishment of a boundary line between Canada and the United States; charting of the whole system and providing aids to navigation; construction of harbours both for traffic and refuge, and of canals and locks to overcome the Niagara and St. Mary's falls. Improvements have also been effected in the connecting channels of the Detroit, St. Clair and St. Mary's rivers and in the channel across lake St. Clair.

On the Canadian shores of the Great Lakes some seventy harbours have been constructed.

The minimum navigable depth of most of the harbours on lake Ontario is 14 feet or the present draft of the St. Lawrence and Welland canals. On the upper portion of the Great Lakes many of the harbours have been dredged to provide for an average navigable draft of 20 feet which obtains throughout the greater portion of the waterway above the foot of lake Erie.

Various types of harbour design have been introduced to the Great Lakes. Sometimes the discharge of rivers has been confined between two parallel piers or between piers diverging from the entrance to provide turning space for vessels. Frequently the piers are of uneven length, the longer pier giving increased protection. Occasionally detached breakwaters are constructed beyond these piers to further reduce wave action in the inner harbour and are sufficiently extensive at times to provide an outside harbour. Many of the harbours are more or less protected by being located in deep bays, or are practically landlocked.

Formerly the general type of harbour structure on the lakes was timber cribwork filled with stone ballast, but for some years the tendency has been to build the superstructure of concrete. In some instances, where the bottom was soft, pile structures, all timber, have been used or pile substructures with concrete superstructures. Reinforced concrete cribs filled with sand, gravel or stone have been successfully utilized in the breakwater and lately the rubble mound has been frequently adopted.

Here the author described in detail the more important Canadian harbours on the lakes from Port Arthur and Fort William down to Kingston, in most instances illustrating his remarks by lantern slides, some of which were taken from aerial photographs. In referring to the harbours at the head of the lakes, aptly termed the Gateways of the Canadian Northwest, in regard to shipping, he mentioned that these two ports combined lead the world in grain capacity, the combined storage capacity of the twenty-six elevators being approximately 72,500,000 bushels. During the past season 280,500,000 bushels of grain left these ports, although this did not approach the 1926 record of 323 million bushels. During the 1927 season 5,756 vessels of a combined registered tonnage of over 16,000,000 tons arrived and departed from these ports. As an instance of the quick dispatch in loading grain for which these ports are noted, 130,000 bushels of grain had been loaded into a steamer in exactly one hour, while on the 28th of November, 1922, twenty-eight vessels loaded nearly 7,000,000 bushels at these twin ports during twenty-four hours.

Sault Ste. Marie, the world renowned gateway of lake Superior, with its five great locks, its unsurpassed volume of traffic and important compensating works for controlling the water level of lake Superior, forms one of the most important links in the chain of navigation on the Great Lakes. Some 85,500,000 tons were carried by vessels through these locks during the season of 1926.

Many other harbours were described by the speaker, among the more important being Port McNichol, Midland and Tiffin, Goderich, Sarnia, Windsor, Port Burwell, Port Colborne, Hamilton, Toronto and Kingston.

That the expenditure on the lakes by the United States and Canadian governments was amply justified was illustrated by the growth of the fleet from 320 steamers and 1,152 sailing vessels of 383,309 gross tons in 1862 to 885 vessels totalling 3,245,000 tons in 1927.

In conclusion, the author expressed, as his considered opinion, that the possibility of future trade and development on the lakes was almost beyond estimation.

After a short discussion, Fraser S. Keith, M.E.I.C., expressed the appreciation of the meeting, over which R. deL. French, M.E.I.C., presided.

Utilization of Metallurgical Gases

(*Reported by W. R. McGlaughrin*)

An original paper of outstanding importance to all interested in the conservation of Canada's natural resources was presented to the branch on March 22nd, by W. H. deBlois, M.E.I.C., who spoke on the "Utilization of Metallurgical Gases."

In introducing his subject the author referred to a specialist as "one knowing more and more about less and less." Then, at the risk of coming within this description, proceeded to limit his subject to the metallurgical gases containing sulphur.

The chief sulphur bearing minerals of economic importance found in Canada are pyrite, pyrohotite, galena, sphalerite, chalcopyrite and such less widely known sulphides as pentlandite, the principal ore of nickel in the Sudbury district.

As the sulphur common to these ores must be largely expelled either before or during smelting, vast quantities of this element in the form of sulphur dioxide gas are discharged into the atmosphere, there to constitute a menace to surrounding vegetation, besides being forever lost to any useful purpose. A conservative estimate of this waste in Canada amounts to 1,500 tons of sulphur daily.

A further incentive to the study of this problem arises from the fact that Canadian pulp mills and users of sulphuric acid are importing close to 500 tons of sulphur per day, representing a trade balance adverse to Canada of some four million dollars per year. There is thus created a problem of major importance.

The Mond Nickel Company at Coniston, Ont., has already proceeded to solve this problem with the only plant in existence using the contact process for manufacturing sulphuric acid from the escaping sulphur dioxide, but the consumption in the form of acid in Canada is so limited that but 75,000 tons per year is marketable, representing only some 70 tons of sulphur per day or less than 5 per cent of the total amount wasted.

The author then proceeded to describe the manufacture of sulphuric acid, which was first produced on a commercial scale in England. The acid was obtained by introducing sulphur dioxide obtained from burning sulphur into a lead chamber, together with steam and oxides of nitrogen. The latter act as promoters for the oxidization of the sulphur dioxide and are recoverable.

The largest plant in the world of this type is situated at Copperhill, Tennessee, operated by the Tennessee Copper Company. It is capable of producing 1,000 tons of sulphuric acid per day.

Originally operated as a copper smelter, this plant installed a chamber process in 1904, following vigorous complaints from surrounding agricultural interests, and the gases are recovered completely for the manufacture of sulphuric acid, copper becoming but a by-product of the operation. This acid is employed in the production of acid phosphate which is sold locally in this cotton district as a fertilizer. Unfortunately, Canada has hardly the beginning of a fertilizer industry and no phosphate deposits of economic importance are within reach.

As a chamber plant is limited to the production of 80 per cent acid, and as several industries have created a demand for oleum and 98 per cent acid, the art of chemical engineering has attained an outstanding achievement by developing the contact or catalytic process for the production of strong acid.

The contact process consists essentially in the combination of SO_2 and O_2 in the presence of a catalyst which, while it does not appear among the products of the change, alters the velocity of the reaction. Platinum in a finely divided form is usually considered to be the most active catalyst and has been almost exclusively employed, though it is very susceptible to the presence of poisons, such as arsenic.

The contact process involves the production of sulphur dioxide gas; its purification from dust and mist with attendant cooling and drying; its subsequent conversion to the trioxide by catalysts and finally its absorption to form 98 per cent sulphuric acid. The reactions may be stated as,

$$2\,Fe\,S_2 + 5\tfrac{1}{2}\,O_2 \rightarrow 4SO_2 + F_2O_3$$

$$SO_2 + \tfrac{1}{2}O_2 \rightarrow SO_3\ (catalytic)$$

$$SO_3 + H_2O \rightarrow H_2\,SO_4$$

The mist is one of the most troublesome factors of the process and must be completely removed, for it is mainly responsible for carrying the poisons to the catalyst. The converting temperature of 750°F. at which the oxidization of the sulphur dioxide is performed is sustained by the heat of the reaction and the trioxide gas formed can be absorbed most efficiently in sulphuric acid, already of 98 per cent strength.

As the market for sulphuric acid is strictly limited, other means have been sought to utilize this daily waste. Several economic means of recovering the elemental sulphur from the gases have been suggested but the difficulties and expense of these solutions have prevented a satisfactory development.

However, one of the most favourable is now in use for refrigerating plants. The sulphur dioxide, on being cleaned, is dissolved in water from which it is expelled by heat as 100 per cent dioxide gas. This gas is compressed to the liquid state for convenience of transporting and storing. Nevertheless it is only economical to employ this process where waste heat is available, such as in those smelters using reverberatory furnaces.

A distinct advantage to the paper mills of such a 100 per cent gas so readily available in place of the 16 per cent usually obtained from burning sulphur is the notable reduction of plant. In conclusion the speaker emphasized the importance of the problem and the need for careful and thorough investigation.

Dr. Alfred Stansfield, M.E.I.C., expressed to the speaker the appreciation of the meeting, which was presided over by J. R. Donald, M.E.I.C.

Papers and Meetings Committee

The personnel of the Papers and Meetings Committee of the Montreal Branch for the year 1928-1929 is as follows:

Chairman ....H. Massue, A.M.E.I.C.
Vice-Chairman ....J. L. T. Martin, A.M.E.I.C.
Civil Section
Chairman ....A. Plamondon, A.M.E.I.C.
Vice-Chairman ....L. L. O'Sullivan, A.M.E.I.C.
Electrical Section
Chairman ....N. L. Morgan, A.M.E.I.C.
Vice-Chairman ....A. S. Runciman, A.M.E.I.C.
Mechanical Section
Chairman ....G. H. Dickson, A.M.E.I.C.
Vice-Chairman ....H. G. Thompson, A.M.E.I.C.
Municipal Section
Chairman ....J. F. Brett, A.M.E.I.C.
Vice-Chairman ....P. E. Jarman, A.M.E.I.C.
Railway Section
Chairman ....F. F. Clarke, A.M.E.I.C.
Vice-Chairman ....H. B. Montizambert, A.M.E.I.C.

The committee was appointed by the executive of the branch to make arrangements for the fall programme. The members of the branch are earnestly requested to suggest subjects of interest. This offers an opportunity for the members who have felt that past programmes have been inadequate to present their ideas. Such suggestions will be greatly appreciated by the committee.

Niagara Peninsula Branch

Walter Jackson, M.E.I.C., Secretary-Treasurer.
C. G. Moon, A.M.E.I.C., Branch News Editor.

The Uses of Structural Steel in Engineering Practice

On March 27th this branch had a very well attended meeting at St. Catharines to hear Mr. Lee H. Miller, chief engineer of the American Institute of Steel Construction, speak on the subject of "The Uses of Structural Steel in Engineering Practice," with special reference to the new Handbook issued by that Institute, and experiments which have been conducted.

Mr. Miller began by emphasizing the part played by steel in our present-day civilization. The exact periods of the stone age, the copper age and the iron age are lost in the mists of antiquity, but the steel age definitely started between the years 1885 and 1890. Since then the progress of civilization has been phenomenal. The world has advanced further and faster in scientific and economic developments than ever before.

The speaker referred to steel as the "perfect metal" about which there is no guesswork. The modulus of elasticity, the elastic limit and the yield point are exactly known quantities and within these limits it's behaviour does not vary. Up to the elastic limit it is absolutely and uniformly elastic and to the yield point it is also elastic but not necessarily uniformly elastic.

The "hot" steel industries such as smelting works, etc., and the "cold" steel industries,—the manufacturers,—are now working together and the old 16,000-pounds working stress will soon be a thing of the past. It was devised in the first place to cover errors due to ignorance of the exact behaviour of the Bessemer product and ignorance of designers.

The A.I.S.C. have now adopted 18,000 pounds per square inch as its basic working stress and the new specifications for railway bridges will allow 20,000 pounds, and in some cases as high as 24,000 pounds, for scientifically designed structures.

Tests have proved that the lines of stress lie always at an angle of 45° with the neutral axis. Consequently stiffeners spaced further apart than the depth between flanges are valueless. On the other hand, by using the proper formula they can now be so spaced as to save as much as 50 per cent in the web thickness without any weakening of the girder as far as buckling is concerned.

Wind loads have never been thoroughly understood and the empirical formulæ used today are good only for high velocities. Mr. Miller doubted very much whether wind loads of 30 pounds or more are ever attained and illustrated his point by remarking that he, himself, presented an area of some six square feet to the wind and theoretically a 10-pound wind would be sufficient to blow him along like a leaf,—but he had never encountered such a wind. The highest recorded pressure was only 16¾ pounds per square foot. Differences in barometric pressures were probably just as important, if not more so, than actual wind pressures. At sea level a change of one-seventh of an inch reading will give a pressure of 10 pounds per square foot, and between the windward side and the leeward side of a tall structure there may easily be that difference. The whole question is now under investigation and one new building has been especially fitted with extensometers for the purpose of observation.

Fire protection and danger temperatures are also being studied with the object of limiting the quantity of combustible material in rooms and offices. With 20 pounds of such material per square foot a temperature of 1,850°F. will be attained in the two hours in which the material will burn. The highest recorded temperature during the San Francisco fire was 2,200°F. after a period of eight hours.

Steel welding is a matter that must have the attention of engineers. It has come to stay and undoubtedly has great usefulness. However, at the present time no fair and proper method of inspection has been devised, and until this is discovered welding will remain in what Mr. Miller described as the "bootleg stage." Costs of completed buildings indicate that the welded structure is no cheaper than the riveted.

In conclusion, Mr. Miller mentioned a revolutionary idea presented recently by an English scientist who suggests that the moment of inertia may be replaced in the investigation and design of structural members. The moment of inertia does not take shear into account and therefore is in error to that extent. By following along this new train of thought it is just possible that the long sought "Coefficient of Elasticity in Shear" may be mathematically determined.

Alex. J. Grant, M.E.I.C., thanked the speaker on behalf of the branch for his excellent address and intimated that many of these investigations would be of great value not only in the design of buildings but also in canal construction.

Chairman Carl Scheman, M.E.I.C., then asked for discussion and mentioned that in steel tank construction with skilled mechanics and careful supervision welding had proved a complete success.

Mr. Miller then replied to various questions as follows:—

To A. T. C. McMaster, M.E.I.C.:—The behaviour of steel beams embedded and haunched in concrete is not yet fully understood. The steel will absolutely recover its original form if the elastic limit has not been passed, whereas the concrete will not. There has not been any conclusive test to show that bond still exists after such a beam has been subjected to repeated loadings which stress the steel near the elastic limit.

To Mr. Krumm:—The question of internal tension stress in rivets is under investigation by Professor C. R. Young, M.E.I.C., of Toronto. Unquestionably rivets that are cold driven fill the hole better and are stronger than rivets driven while hot, but on account of the pressures required the method is impracticable for field work. Heating steel naturally causes internal stresses and at certain temperatures a molecular change occurs in the steel whereby these stresses are relieved. At about 1,250°F. such a change occurs,—steel is nonmagnetic at this temperature. Again at 600°F. there is this molecular transformation,—steel is stronger at 600°F. than when cold. At 800°F. steel has about the same strength as when cold and then the strength falls off rapidly as the temperature rises. It is practically certain that some such molecular change does help to relieve the tension in hot rivets.

To Walter Jackson, M.E.I.C.:—There are many reasons for the high cost of welded structures at the present time. Welding causes the maximum bending moment to lie at the support,—right at the weld,—the beading or welding wire costs seven or eight times as much per pound as rivets, although there is less used,—some one per cent of wire as against three per cent of rivets. It is found that practically nothing can be saved in the draughting room. Just as much detail must be given for the weld as for the riveted joint.

To M. B. Atkinson, M.E.I.C.:—Silicon steel flanges might be used economically with carbon steel webs if some method can be devised to prevent the web being stressed beyond the yield point. Otherwise there is no advantage in this method of construction.

To Walter Jackson, M.E.I.C.:—Gas heated rivets appear to be best if gas can be easily obtained. The rivets can "soak" better and attain a more uniform temperature. Electric heating may cause the core of the rivet to burn if not closely watched and forge heating may cause the skin to burn.

Aircraft

Under the auspices of the Engineering Society of Buffalo, about seventy members of this branch spent the afternoon and evening of April 17th inspecting aeroplane factories and airports in the city of Buffalo. The dinner meeting, however, was held on the Canadian side and the membership met and welcomed R. J. Durley, M.E.I.C., general secretary of The Institute. Mr. Durley was late; entirely due, he explained, to the fact that our vice-chairman insisted on taking him up into the clouds in an airship and getting them both lost in a blizzard. There was but little time before the evening session at the Hotel Statler, but he wished to assure the membership of the branch that The Institute was flourishing. It has prospered during the last year and was in an exceedingly sound state of health, financially, mentally, morally and scientifically.

During the afternoon, visits were made to the factories of the Curtis Aeroplane and Motor Company, the Consolidated Aircraft Corporation and the Municipal Airport. The Curtis plant was assembling an order of some 156 fighting two-seater biplanes, for the

Type of Plane purchased by the Canadian Government for Training Purposes at Camp Borden.

United States government. The planes are all equipped with the most modern safety and offensive devices, machine guns fore and aft and mounted in the wings, bombing and camera attachments. Part of the order is equipped with Liberty motors, water cooled, but the balance has the new Curtis D.12 engine, also water cooled but much lighter in pounds per horse power and occupying less space than the Liberty motor.

At the Consolidated factory an entirely different type of plane was inspected—two-seater instruction biplanes equipped with the "Wright whirlwind" air cooled engine. At this plant, where they are producing about one plane a day, some three hundred and fifty men are employed. The machines are the standard training planes for the United States army and navy services.

Two types are produced, the P.T.3, army type with landing wheels, and the N.Y.2, navy type with pontoons. Both types are dual control, and are built of welded steel tubular fusilages.

Orders have been filled for Cuba, Peru, Brazil and the Canadian governments, and in the last three years more than 8,000,000 flying miles are credited.

At the Airport, members were invited to test the air at a nominal charge. Four-passenger, enclosed biplanes were used and the enthusiasm was such that all reservations were quickly booked. Some seventy-five members experienced a new sensation, including the vice-president and general secretary, as previously noted. Fortunately the branch news editor arrived late at the field and was allowed to depart in peace.

The evening meeting at the Hotel Statler was addressed by Mr. C. R. Keyes, president of the Curtis Company, who reviewed recent progress in aeronautics, and by Mr. H. C. Ritchie, of the General Electric Company, who showed some excellent pictures illustrating the lighting of airports. Of great interest also were some slow motion pictures of air currents taken by a special camera having a speed of some 20,000 pictures a second. One picture, showing the action of bullet piercing an electric light bulb, was truly remarkable.

Ottawa Branch

F. C. C. Lynch, A.M.E.I.C., Secretary-Treasurer.

The Palm Room of the Chateau Laurier was filled to overflowing at luncheon on April 12th, when the members of the Ottawa Branch gathered to listen to Mr. Dexter P. Cooper describe his project for the development of power from the tides at Passamaquoddy bay.

The Passamaquoddy Bay Power Development

Mr. Cooper described in a general way the main features of the proposed tidal power development which has for its object the generation of 600,000 to 700,000 horse power of electrical energy. Passamaquoddy bay, where it is proposed to harness the tides of the Bay of Fundy, is situated at the mouth of the St. Croix river, the lower reaches of which form the international boundary between New Brunswick and the state of Maine.

The project has been studied by Mr. Cooper for nine years and during the last two years he has been actively engaged in investigation work, including the working out of the principal features of design of dams, control gates and the power house.

The mammoth development, to cost from $50,000,000 to $60,000,000, which the Dexter P. Cooper Company proposes to carry out, unique as it may seem to develop power from tides, involves nothing radically different from the ordinary hydro-electric enterprise, explained Mr. Cooper, except that it will be a varying low-head development utilizing salt water instead of fresh water. There will be two pools or reservoirs, the upper one to be filled at high-tide and the lower one to be emptied at low-tide. The power house situated between would utilize the head thus created.

With a large wall map, Mr. Cooper pointed out the natural features in the way of islands and headlands which will permit of the development by constructing three main dams and two gate sections. The project extends, from one end to the other, a total distance of 16 miles. The area of the upper basin, which lies almost entirely in New Brunswick, would be 110 square miles, and the lower basin, in Maine, 35 to 40 square miles. While the lower basin has a much smaller area, the deeply indented bays give it a total shore line of 176 miles, compared with 150 miles for the upper basin.

Explaining the operation of the scheme, Mr. Cooper pointed out that the total interval elapsing between low and high tide is six hours. When the water outside the gates rises to the level of the upper pool the gates are opened. A large gate section is required for rapid filling. With gates aggregating 220,000 square feet in cross-section, it is calculated that the upper pool will fill to within 2 or 3 feet of maximum tide. The filling period is about two hours. The gates of the lower pool function similarly in quickly discharging the water at low-tide. At some time within the six-hour period the level of the lower pool may be lowered to within about 6 inches of low-tide.

The scheme, Mr. Cooper said, figures out as potential power of 3,000,000 horse power, or 18,000,000,000 kilowatt hours theoretically available, but not all can be developed as that is on the basis of lowering the upper pool and filling the lower pool until they come to the same level. Practically on the basis of a minimum head of 8 feet, the development is expected to yield between 600,000 and 700,000 horse power continuous throughout the twenty-four hours. It is proposed to install thirty turbines of 25,000 horse power each. These would be of the propeller type with no governors but with the blades of some arranged at a different angle than others to get the greatest efficiency for varying heads. The power house would be about 2,500 feet long and in the interests of economy the design involves no superstructure, the top of the power house being about 8 feet above high-water level.

Forty engineers and field men are at work, Mr. Cooper said, and they have a well equipped laboratory for testing materials and trying out experimental models of gates, etc. He intimated that all the principal problems have been solved. The experimental work has included elaborate tests of the effect of salt water on concrete.

Dealing with the building of the dams, Mr. Cooper said that these would be rock, with clay in the right proportions mixed with it. These materials would be taken from the excavation for the power house and conveyed to the dam sites in bottom-dump barges. The maximum depth to be filled in is at the main channel of the St. Croix, where the water is 185 feet deep but of a narrow V-section. Another dam will have a maximum of 50 feet, and the third principal dam 40 feet. The gate sections which are across separate channels from the dams will have to be built behind coffer dams. So as not to obstruct navigation, locks are necessary at the main St. Croix channel and at the gate section of the upper pool.

Mr. Cooper also gave a short review of the political features in the United States and Canada. In the state of Maine one of the principal obstacles was the legislation on the statutes against the export of power. In 1925 a bill to permit the export of power, (the power house is to be located in Maine), was passed after a referendum to the people. In 1926 a Dominion charter was obtained. A permit had also been obtained at Washington, and just recently the legislature of New Brunswick passed a bill relating to the project.

At the conclusion of his address, Mr. Cooper answered many questions. Replying to one member he said that he was of the opinion that the division of the power as between the province of New Brunswick and the state of Maine was a matter for the International Joint Waterways Commission. He also stated that the project would be financed as a private enterprise.

Several of the members emphasized the importance of the project for the development of industries in New Brunswick, especially pulp and paper.

In the absence of the chairman, Dr. Chas. Camsell, M.E.I.C., K. M. Cameron, M.E.I.C., presided and thanked Mr. Cooper for coming to Ottawa and giving the members of The Engineering Institute first-hand information on such an important project.

Peterborough Branch

W. E. Ross, A.M.E.I.C., Secretary.
B. Ottewell, A.M.E.I.C., Branch News Editor.

Montreal Harbour Bridge

About two years ago, P. L. Pratley, M.E.I.C., of Messrs. Monsarrat and Pratley, consulting engineers, Montreal, addressed the Peterborough Branch on the subject of "The Montreal Harbour Bridge," outlining the general design of the bridge and the work on the substructure up to that time. This proved of such interest that Mr. Pratley was invited to make a second visit to the branch in order to describe the progress of the bridge during the past two years. The meeting was held on March 22nd, 1928, under the chairmanship of A. E. Caddy, M.E.I.C., and was well attended. A large number of fine lantern slides were used to illustrate the address.

The greater part of the address dealt with the piers, eight of which were of the pneumatic type. For pier 25 at the north end of the 1097-foot main span, two steel caissons 29 by 47 feet were used. Each caisson had two material locks and one man lock, and a pressure of 23 to 24 pounds per square inch was used. Twelve "sandjacks" were operated in alternate sets of six to lower the caisson in steps averaging 20 inches.

A chart showed the nature of the material passed through and the regularity of the steps. After the two caissons had reached their final position, an 8-foot thick slab of reinforced concrete was laid across them, upon which the stone work and upper portion of the pier was built. Pier 25 has a total load of 51,000 tons or 11 tons per square foot.

Mention was made of the north anchor pier, built on gravel hard pan, with a permanent load of 3.2 tons per square foot, and the speaker then passed on to pier 24 at the south end of the main span, considered the most important. One of the largest steel caissons ever built, 127 by 50½ by 47 feet, containing 453 tons of steel and constructed by Vickers, Ltd., was shown being towed up-stream to the site by six powerful tugs. After dredging the overburden this caisson was then lowered in the same manner, using twenty-four sandjacks.

Similar descriptions were given of all the other piers from 1 on the south shore to 23. Some of these, for example, 13, 14 and 21, were of the pneumatic type whilst others required only simple cofferdams for their foundations.

The speaker concluded with the work on the steel, showing illustrations of the erection of the main cantilevers by means of falsework truss, traversing derrick and 300-ton traveller. Considerable progress had meanwhile been made with the steel on the southern approach spans. Brief mention was also made of the economics of the structure, illustrated by charts.

An interesting discussion ensued and Mr. Pratley was formally and enthusiastically thanked for his address.

The Toronto Waterworks

The next regular meeting of the branch was held on April 12th, 1928, at which William Gore, M.E.I.C., of Messrs. Gore, Nasmith and Storrie, consulting engineers, Toronto, gave an illustrated address on "The Toronto Waterworks." R. H. Parsons, M.E.I.C., city engineer, Peterborough, acted as chairman.

Mr. Gore commenced with a description of the old pumping plant on Toronto island, with a capacity of 100,000,000 gallons a day and the distribution to the various parts of the city, explaining the necessity for pumping as many as three or four times to serve certain districts at high levels. He then dealt with the new plant, on the lake shore at Victoria Park, east of the city, having a capacity of 200,000,000 gallons per day. The consumption of water in Toronto is very high and the city waterworks supply the largest quantity of any single plant in the British Empire.

The problem of pure water supply for the city is a difficult one owing to the contamination of the lake water by sewage and the fact that this contamination varies from hour to hour due to movement under varying winds. The speaker detailed the various steps taken to ensure a pure supply of water at all times. The intake at the new plant is some 7,500 feet out from shore and in 50 feet of water, the first 3,000 feet being a tunnel cut in the shale and the remainder a pipe laid on the lake bottom. Views of the intake end, the knuckle joints and the laying of the pipe were shown.

Passing to the filtration plants, Mr. Gore showed that there are two radically different types, the slow sand filter and the drifting sand filter. Each installation deals with approximately the same quantity of water, but the difference in the area covered is very marked.

The slow sand filters have 30 inches of fine sand over gravel in which there are perforated underdrains. Illustrations were shown of the scraping of these filters and the special methods of sand washing, this being done every three weeks.

The drifting sand type filters, of which there are ten, each with a normal capacity of 6,000,000 and a maximum of 7,200,000 gallons per day, consist of cylindrical steel tanks, beneath which are thirty automatic ejector type sand washing devices. The sand and water are forced upwards through these and overflow at the tops of thirty vertical pipes. At each of these the sand forms a continually drifting conical filter bed through which the water passes. The sand travels through a complete cycle around the filter in about one day. These filters are normally run for a week but have been run for as long as five weeks in emergency. The sand is cleaned at these intervals by forcing water through perforated pipes in the bottom of the tank, up through the sand to outlet troughs at the top.

An interesting automatic chemical feed device, with electrically operated valves, is used to regulate the addition of alum, which is necessary for proper functioning of this type of sand filter. The benefits of chlorination were mentioned and a diagram showing the great reduction in deaths from typhoid fever since the water was first chlorinated, some thirty years ago, was proof of this.

It is a curious fact that while the normal amount of chlorination gives a somewhat objectionable taste to the water, super-chlorination and the subsequent removal of the excess chlorine overcomes this and produces palatable water. The Toronto plant first chlorinates to ten times the extent necessary, and then removes the excess chlorine by means of sulphurous acid.

Power for the pumping station is normally obtained from the Hydro-Electric Power Commission, but a 1,200-kv.a. steam turbine standby unit is available. The various types of pump drives include slow speed steam engines, geared steam turbines, and electric motors.

After an interesting discussion, a vote of thanks was proposed by R. L. Dobbin, M.E.I.C., and cordially approved by those present.

Saint John Branch

W. J. Johnston, A.M.E.I.C., Secretary-Treasurer.

Meeting at University of New Brunswick

On April 3rd, 1928, a joint meeting of the Saint John Branch of The Engineering Institute of Canada and The Engineering Society of the University of New Brunswick was held at Fredericton, N.B. This is one feature of the yearly programme of the branch which Papers Committee tries to meet and is eagerly looked forward to by our branch members. The trip is taken to keep in touch with the scattered membership of this branch and as part of the policy of The Institute to maintain contact with the engineering students attending the universities.

A party of fourteen left Saint John by train at 4 p.m. for the 65-mile run to Fredericton. Arrangements had previously been made for stopping the train in Fredericton at the University Avenue crossing and the members went directly to University buildings. The Saint John men were guests at supper of the engineering students and later the hydraulic laboratory installed several years ago was visited.

The meeting was opened with G. W. Babbitt, S.E.I.C., president of the Engineering Society of the University of New Brunswick, acting as chairman. In a brief address the members of the Saint John Branch were welcomed and S. R. Weston, M.E.I.C., chairman of the branch, was asked to preside.

The Substructure of the Buctouche River Bridge

An illustrated address on "The Substructure of the Buctouche River Bridge" was given by C. S. G. Rogers, A.M.E.I.C., of the Canadian National Railways, Moncton. This bridge is on the Moncton-Buctouche subdivision of the Canadian National Railways in New Brunswick and its replacement at a reasonable figure called for considerable engineering ingenuity. Situated on a branch line of railway producing a limited revenue it was not desirable to spend a greater amount than absolutely necessary on this bridge. As this bridge site crossed a river entering an inland bay or harbour it was found that in this protected area the teredo was particularly active and wooden piles had been destroyed in a few months. For a pier foundation steel pipes were driven through mud to rock and filled with concrete, while the concrete in the pier began at 2½ feet below low water. To overcome danger of disintegration of the concrete in salt water the piers were sheathed with creosoted hardwood plank.

Public Address Systems

A demonstration of a Public Address System was given by A. A. Turnbull, A.M.E.I.C., on apparatus kindly loaned by the New Brunswick Telephone Company. A short address was first given describing the principles of public broadcasting and amplification of sound. The tuning up of the instrument so that finally the ticking of a watch could be clearly heard throughout the room proved particularly interesting.

Sanitary Drainage

A paper on Sanitary Drainage by G. G. Murdoch, M.E.I.C., gave an outline of the earliest known forms of sewerage systems and in turn traced all improvements down to the present. Speaking of modern practice in this specialty, a number of examples of installations with which the speaker was familiar was referred to.

A vote of thanks on behalf of the Saint John Branch, E.I.C., to the Applied Science Faculty for permission to use the college buildings and invitation to hold the joint meeting and to the Engineering Society of the University of New Brunswick for their hospitality was moved by J. N. Flood, A.M.E.I.C., and Geoffrey Stead, M.E.I.C. The branch meeting was then adjourned.

With the president of the Engineering Society resuming charge of the meeting, a vote of thanks to the three speakers of the evening was moved by M. E. Dines, S.E.I.C., and seconded by C. A. Wakeham, S.E.I.C.

Saskatchewan Branch

R. W. E. Loucks, A.M.E.I.C., Secretary-Treasurer.

The Flin Flon Mine Area

W. H. Hastings, A.M.E.I.C., geologist with the Bureau of Labour and Industries, of the Province of Saskatchewan, delivered an address at the January meeting of the Saskatchewan Branch on the "Flin Flon Mine Area of Northern Saskatchewan and Manitoba." His address was illustrated with maps.

"Occasionally," said Mr. Hastings, "we hear the cry that Saskatchewan and Manitoba are making a gift of their resources to the United States. In my opinion this is a rather unreasonable attitude to take. Canadian and English capital have had an opportunity of carrying out this development but have not been willing to accept the risks involved. Without capital, no development could take place, and capital from whatever source is surely entitled to a fair return on investment. That profits will not be out of proportion is evident.

"At the Flin Flon, for instance, the ore is comparatively low grade. Mining costs, milling costs, smelting costs, marketing costs and the cost of financing will make the profit per ton small, and only by large scale operations can over-all profit be made," said Mr. Hastings. "Only the interest on the investment will go to the United States, while the greater percentage of income from the mine will be turned back to the people of Saskatchewan, Manitoba and Canada generally, for wages and supplies. Work will be made available for a large number of our people and a new market for a great variety of products will be created. Our engineering college graduates will find a new field of employment and one that is near home.

"The investors are gambling on the future, on the continued prosperity of Canada, on their ability to overcome obstacles which are sure to arise, for they are dealing with a new combination of minerals and must develop a new process for their treatment. In my opinion the Flin Flon is the greatest prospective mine on the continent and the Flin Flon and adjacent area will in the next fifteen to twenty years constitute Canada's greatest mining camp and will not be excelled by any in British Columbia, northern Ontario or northern Quebec," said Mr. Hastings. "The 16,000,000 tons of Flin Flon ore which average in mineral values $13.00 represent a total of $200,000,000. This is only the ore so far tested by diamond drilling.

"The wages of several thousand workmen will be earned and spent in Canada and large quantities of mine supplies will be bought from Canadian firms. Our railways will benefit directly from increased freight and passenger traffic. Machinery and supplies will be carried into the mining area and mine products will be brought out. New industries must follow the mineral development," declared the speaker, in summing up the advantages which would quite ordinarily follow mining development, even on a small scale. An important link would be formed between the water power of the north and the population area of the south, he believed. "The mines themselves will require large blocks of electrical power and the fur and fishing industries will grow and expand," he said.

"There were wide areas of timber and pulp wood to be also brought within development range," Mr. Hastings observed, "and with the completion of the line to The Pas by Sturgis, Regina would become 130 miles closer to the mines than Winnipeg."

It was not to be expected that the mining industry will surpass the agricultural industry, when Saskatchewan alone produces wheat valued at $37,000,000 more than the value of the total mineral production in Canada last year, but the mines could do much to alleviate the present periodical employment condition of the prairies during the quiet seasons in agriculture.

The Constitution of Matter

R. N. Blackburn, M.E.I.C., in opening his address on "The Constitution of Matter," explained briefly the theories held by the ancients on "Matter." Democritus came to the conclusion that matter was made up of atoms combined in various ways. When Dalton's atomic law became generally accepted efforts were made to determine the size of atoms. Films of oil were experimented with and it was found that films one fifty-millionth of an inch could be produced, hence the conclusion was arrived at that atoms were not more than one hundred-millionth of an inch in diameter.

A cubic centimetre of air contains about twenty-seven million million million atoms. Atoms of all the known elements have now been measured.

An atom of oxygen consists of a nucleus containing sixteen protons, (positive charges of electricity), and eight electrons, (negative charges of electricity). The eight electrons revolve in orbits around the central nucleus. The diameter of an atom of oxygen is about 1.3 Angstrom units. (An Angstrom unit is 1/10,000 millionth part of a meter.) If an atom of oxygen were magnified ten billion times the atom would appear about 60 inches in diameter with a central nucleus about one hundredth of an inch in diameter and eight electrons revolving around the nucleus each about one thousandth of an inch in diameter. The weight of an atom is principally in its protons as the electrons have relatively little weight.

The electrons are separated by relatively immense spaces and are continually in motion. Electrons can in some cases travel at the rate of 150,000 miles per second. Professor Bohr states that the electron of an hydrogen atom travels around its orbit at a velocity of 1,300 miles per second. At this rate it would make about 6,000 billion revolutions per second around the nucleus. The electrons do not move in circles but in ellipses and probably in more than one plane. Under certain circumstances an electron may leap outward into a new orbit about four times its original diameter. When the atom reacts to its original size light rays are propagated.

By passing an electric current through a vacuum tube and causing the current to jump from one electrode to another a luminescence is produced. In this manner it was discovered that there was an emission from the negative electrode,—some energy was passing through the tube which has since been proven to be a discharge of electrons. Prior to this time electric current was considered as passing from the positive pole to the negative pole. This test proved the opposite to be the case. By using a concave electrode, the stream of electrons can be focussed to a point.

Experimenters were able to calculate the mass and velocity of the electrons and later on the charge of an electron was calculated. This test proved the electrons to be travelling at rates of order of 18,000 miles per second. This immense speed causes electrons to fly outward from other atoms.

Some years ago there were supposed to be sixty-four elements. At the present date it has been proven that there are ninety-two elements, five of which are still unknown.

By means of spectroscopic analysis the elements can be separated and classified. The elements bear a distinct ratio one to the other and in this scale there are still five undiscovered elements.

The various elements are classified according to the number of protons and electrons of which each is constituted. The atomic number is the number of electrons in the outer orbits and the atomic weight is the number of protons in the nucleus.

As elements only differ one from another in the number of protons and electrons in each element it has been discovered that one element reduces to another by "knocking off" some of the electrons and protons from the nucleus of an atom. Uranium changes to radium and finally to lead.

In this change of elements rays are given off. Such rays are classified as Alpha, Beta and Gamma rays. The Alpha rays are a stream of helium nuclei. The Beta rays are a stream of electrons. The Gamma rays are electro-magnetic waves of very short wave length, much shorter than the X-ray.

By bombarding atoms with Alpha rays Rutherford has knocked electrons out of various elements. In this manner others have claimed to have knocked helium atoms out of mercury and produced gold.

We do not know what electrons are other than "negative charges of electricity" nor do we know what electricity essentially is. An electric current is a stream of electrons. These pass through an ordinary 50-watt electric bulb at the rate of three millions of millions of millions of electrons per second.

We cannot see "force" nor do we know what "gravity" is, although we can measure force and the co-efficient of gravity. We have not the faintest idea of the real nature of the forces represented in the various kinds of energy, such as heat, electricity, mechanical energy, etc., although they are all essentially the same. We cannot destroy energy nor can we create it.

Due to the great speed at which electrons move, the possibilities of the energy locked up in atoms can be realized. The energy in the atoms of one ton of coal has been calculated to be sufficient to produce enough heat, power and light to supply forty million people for 100 years. The unlocking of this great source of energy is thought by scientists to be within the range of possibility. Sir Oliver Lodge has expressed the hope that this great secret will not be discovered by man until he has attained sufficient mental balance to use this power sanely.

Atoms are not permanent. A number of substances are radioactive and it is possible that many if not all atoms are undergoing a process of degeneration. The heat of the sun is supposed to be maintained in considerable measure by this effect. We appear to be now in a period of the degradation of the atom, the period of *creation* having been passed.

Matter is thus a form of energy and it is this energy which gives rise to the sensations we all experience such as sight, feeling, taste, smell, etc. Matter, as ordinarily thought of, then does not exist.

Probably the whole physical universe can be resolved into force, mind and, (possibly), ether. Scientists are not agreed as to the existence of ether. Light which travels over immense distances at the rate of 186,000 miles per second is usually considered to travel by wave motion and presumably through ether, which is assumed to fill all the spaces of the universe. If we assume the ether to exist, it must have certain physical properties. It must be infinitely rare and frictionless. It must be a solid since light is transmitted by a transverse wave, and transverse waves cannot pass through liquids. It is through this medium that the immense forces of gravity are assumed to act. The pull of the sun on the earth is equal to the tensile strength of one million million columns of steel, each 17 feet in diameter. It is difficult to conceive of such a substance as ether and consequently many scientists are now trying to explain such phenomena as gravity and transmission of light without postulating the existence of the ether.

Social Evening

A very enjoyable social evening was spent at the home of Mr. and Mrs. H. N. Macpherson, on February 14th, when the members of the branch were the guests of the ladies at a Valentine party. The game of "Klondyke Whist" provided much in the way of entertainment and suitable prizes were distributed to those having the highest scores and also to the lowest scores. Other games, together with music, were interspersed during the evening. After refreshments were served those present concluded the evening with dancing. About sixty guests were present and all voted the function a very successful event.

Kinks and Notions in Engineering Office Practice

At the February meeting of the branch the chairman introduced the subject of the evening, "Kinks and Notions in Engineering Office Practice," and called on W. W. Perrie, A.M.E.I.C., of the provincial highways department, to lead the discussion. Mr. Perrie outlined the filing system used for correspondence in the office of the chief field engineer, Department of Highways, showing the convenience and facility of indexing correspondence, plans and field notes according to the locations referred to. The speaker showed how the office could be kept in close touch with the work in all parts of the province by means of progress charts and force reports. He also showed how the use of suitable scales simplified the estimating of quantities. In conclusion, Mr. Perrie illustrated the points dealt with by reference to specific examples.

R. W. Allen, A.M.E.I.C., assistant city engineer, Regina, was then called on to give his paper on the same topic. Mr. Allen outlined the general requisites for efficient office work, laying special stress on the need for co-operation, incentive, consistency and uniformity. Reference was made to a labour saving lettering device and to the handiness of reducing plans to foolscap size by a photographic method. The office work and system of a city engineer department was described and an outline given of the steps connected with a programme of capital expenditure.

Nearly every member present took part in the discussion of the two papers referred to above and much information was exchanged regarding the merits of different filing systems.

Engineering Education and Training

P. C. Perry, A.M.E.I.C., division engineer, Canadian National Railways, Regina Division, being called upon for his paper, explained that with the approval of the Papers and Library Committee he had chosen as his subject,—"Engineering Education and Training." Mr. Perry spoke of the duty incumbent on an engineer to assist in the training of the juniors on his staff both for their benefit and his own. He advocated the placing of responsibility with the younger men and giving them a varied experience. Mr. Perry classified engineering education under the heads of physical, social and cultural, describing what he meant by each. The speaker urged that one's education should continue after graduation, particularly along social lines and in matters of public affairs. He illustrated his remarks by many references to The Engineering Journal and voiced the criticism that The Institute as a whole did not appear to be sufficiently interested in sociological subjects.

Mr. Perry's paper was well discussed and the speaker was complimented on the thought promoting value of its contents.

A vote of thanks to the speakers of the evening was sponsored by R. N. Blackburn, M.E.I.C., and heartily endorsed by the meeting.

The chairman then introduced a visitor, J. T. Farmer, M.E.I.C., of Montreal, Que. Mr. Farmer remarked that it was fifteen years since he had been in Regina and complimented the branch on the evident success of its meetings. Mr. Farmer said he was particularly impressed with the readiness of the discussion given the papers presented. Speaking of Institute matters, Mr. Farmer urged that the best interests of The Institute would be served by allowing the proposed increase in fees to apply to Members only, although appreciating the fairmindedness of those who advocated wider distribution.

Annual Meeting

The eleventh annual meeting of the branch was celebrated by a banquet at the Saskatchewan hotel, Regina, on the evening of March 28th, 1928. M. B. Weeks, M.E.I.C., of Regina, presided over the gathering, which numbered fifty-two. Members of the Saskatchewan Section of The American Institute of Electrical Engineers attended the meeting in considerable number.

The chairman opened the meeting by proposing a toast to "The King," after which the minutes of the last annual and last regular meetings of the branch were read and adopted. P. R. Genders, A.M.E.I.C., and J. G. Schaeffer, A.M.E.I.C., were appointed scrutineers to count the ballots and report the election of officers.

The Rev. M. G. Melvin, pastor of Knox United Church, Regina, delivered an inspiring address on the life and work of Robert Louis Stevenson. The speaker outlined Stevenson's early life and training and mentioned that his parents had planned for him an engineering career which was the profession followed by his ancestors. He referred to the various works produced by Stevenson and indicated wherein these works portrayed the character of the man.

Mr. W. G. Laird delighted the audience with a rousing song, which was followed by an encore.

M. B. Weekes, M.E.I.C., the retiring chairman, made a few brief remarks on "The Conditions of the Engineer To-day and Yesterday."

Visit of Councillor J. L. Busfield, M.E.I.C.

J. L. Busfield, M.E.I.C., of Montreal, member of Council and ex-chairman of the Montreal Branch, spoke first on the affairs of The Institute. He referred to matters dealt with at the recent annual meeting in Montreal. The question of increase in fees of members has been held over for another year for further consideration and modification. Changes have been made in the method of awarding Students' prizes. He referred to the probability of holding the next annual meeting in Winnipeg.

The speaker then introduced his subject, "The Relation of the Engineer to the Community." Most professions are founded on human interests but the engineer deals with physical and material resources. He is not trained to properly sell his services to the community. The engineer is mainly employed by corporations, whereas doctors, lawyers, etc., are serving individuals. Mr. Busfield suggested that the individual engineer himself is largely responsible for the condition of his profession.

Mr. Busfield spoke on the question of an Association of Professional Engineers in Saskatchewan. Several of the other provinces of the Dominion have Acts which are not restrictive or effective. Engineers can in a friendly way often accomplish more than can be effected by legislation.

The speaker asked for a full discussion of Institute matters in order that he might obtain the views of the various branches on matters affecting the welfare of The Institute and the profession in general.

A general discussion on matters of interest to members of The Institute followed and Mr. Busfield suggested that the branch submit its recommendations to the next Plenary meeting, which will probably be held in Montreal during October next.

H. R. MacKenzie, A.M.E.I.C., councillor for this branch, corroborated the remarks of Mr. Busfield relating to the care given to classification of members when considering applicants for admission and transfer. He was of the opinion that the engineer must not consider his profession inferior to any other profession. Engineers in this province are holding as responsible positions and are as highly valued as members of any other profession represented in the province.

A hearty vote of thanks was tendered Rev. Mr. Melvin and Mr. Busfield for the addresses of the evening, on motion of R. N. Blackburn, M.E.I.C., and H. S. Carpenter, M.E.I.C.

Mr. LaPointe performed some clever tricks with cards, etc. He produced some excellent music, using a violin bow on an ordinary hand saw. He also rendered a violin solo.

Election of Officers

The scrutineers presented their report as showing the election of officers to be as follows:—

Chairman:—A. M. Macgillivray, A.M.E.I.C., Saskatoon.
Vice-Chairman:—H. R. MacKenzie, A.M.E.I.C., Regina.
Secretary-Treasurer:—R. W. E. Loucks, A.M.E.I.C., Regina.

Executive Committee (2 years).

J. M. Campbell, A.M.E.I.C., Moose Jaw.
J. W. D. Farrell, A.M.E.I.C., Regina.
Stewart Young, A.M.E.I.C., Regina.

Nominating Committee.

C. J. Mackenzie, M.E.I.C., Saskatoon, (chairman).
R. N. Blackburn, M.E.I.C., Regina.
W. H. Greene, M.E.I.C., Moose Jaw.
D. W. Houston, A.M.E.I.C., Regina.
H. McIvor Weir, M.E.I.C., Saskatoon.

Representative on Senate of the University of Saskatchewan.

H. S. Carpenter, M.E.I.C., Regina.

Auditors.

C. S. Cameron, A.M.E.I.C., Regina.
E. A. Duschak, A.M.E.I.C., Regina.

Mr. Weekes then vacated the chair and called on the newly elected chairman, A. M. Macgillivray, A.M.E.I.C., to preside.

Mr. Macgillivray referred to the place of the engineer in the community and humorously referred to the possibilities in this connection. The development of the natural resources in this province is now opening up great opportunities for the engineer. He thanked the members for the honour conferred upon him in electing him to the chairmanship of the branch and expressed his desire to do all within his power for the success of the branch.

R. N. Blackburn, M.E.I.C., chairman of the Legislation Committee, made a verbal report. The time for legislation in this province is not considered opportune and hence very little has been accomplished during the past year by his committee.

The report of the Executive Committee was presented by R. W. E. Loucks, A.M.E.I.C., secretary-treasurer of the branch, and adopted on motion of Mr. Loucks and D. W. Houston, A.M.E.I.C.

D. A. R. McCannel, A.M.E.I.C., chairman of the Papers and Library Committee, reported on behalf of that committee. This report was adopted on motion of Mr. McCannel and H. N. Macpherson, A.M.E.I.C.

The chairman then called on the Hon. Geo. Spence, Minister of Railways, Industries and Labour in Saskatchewan, for a few remarks. Mr. Spence stated that we have in this province the agricultural engineer. He referred to the progress which has been made in this province in the last decade. He first passed through Regina and Moose Jaw en route to the Klondyke twenty-eight years ago. The gold he had been seeking was passed by on the prairies. Mr. Spence stated that the newly formed department, of which he is head, intends to co-operate with the Dominion government in the investigation and development of northern Saskatchewan. In the last four or five years greater results in prospecting have been made than in the past one hundred years, due principally to the ease of modern transportation. He also referred to the possibilities of using the tar sands of northern Alberta and Saskatchewan for road construction in this province.

Report of Executive Committee

Your Executive Committee respectfully submits the following report covering the conditions of the branch and its operation during the past year:—

The membership is 113 as compared with 107 reported at the last annual meeting, and is made up as follows:—

Honorary Members	1
Members	17
Associate Members	70
Juniors	9
Students	7
Affiliates	2
Branch Affiliates	7
Total	113

The executive held six meetings for the transaction of branch affairs. There were five regular meetings of the branch, one social evening arranged by the ladies and one summer meeting in the nature of a picnic. The picnic was held at River park, in the town of Lumsden, in conjunction with the members of the Saskatchewan Section of The American Institute of Electrical Engineers. The ladies arranged a very successful Valentine party, which was held at the home of Mr. and Mrs. H. N. Macpherson, on February 14th.

Our councillor, H. R. MacKenzie, 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. The major items consisted of the proposed changes in the By-laws of The Institute. The executive, as you are aware, passes upon and makes recommendations on all applicants for admission and transfer within Saskatchewan, and a number of these were dealt with. One applicant was given an examination and successfully passed the test, your branch secretary acting as presiding examiner.

Negotiations carried on by your executive have resulted in the Saskatchewan Branch of The Engineering Institute of Canada being allowed representation on the Senate of the University of Saskatchewan. Elections to the Senate take place in May each year, the representative elected holding office for three years.

The average attendance at the branch meetings has been 35. 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 activities of the various committees and 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 $510.55, being an increase of $91.76 over the surplus shown last year and an increase of $192.94 over the surplus of the previous year. Accounts payable this year are $19.69 as against $48.75 last year and $156.47 the previous year. Branch News produced a revenue of $30.40. The meetings have been practically self-sustaining.

Financial Statement—1927-28.

Revenue

On hand from 1927	$115.54	
Headquarters rebates	208.50	
Branch dues	86.00	
Branch News	30.40	
		$440.44

Expenditure

Office expenses	$ 48.71	
Meeting expenses	62.53	
Honorarium	100.00	
Scholarship	50.00	
Sundries	9.55	
Bank balance	169.65	
		$440.44

Assets

Bank balance	$169.65	
Est'd. Headquarters rebates 1928	226.80	
" " arrears	122.29	
" Branch dues 1928	15.00	
" " " 1927	5.00	
" " assessments—arrears	14.50	
Furniture and library	50.00	
		$603.24

Liabilities

Branch dues paid in advance	$ 23.00	
Scholarship for 1928	50.00	
Accounts payable	19.69	
Surplus	510.55	
		$603.24

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) D. W. Houston, A.M.E.I.C., D. H. Lunam, } Auditors.

On behalf of the Executive,

R. W. E. Loucks, A.M.E.I.C.,
Secretary-Treasurer.

Sault Ste. Marie Branch

A. H. Russell, A.M.E.I.C., Secretary-Treasurer.

A regular meeting was held on Friday, March 30th, 1928. C. H. Speer, M.E.I.C., acting chairman, called the meeting to order and the business was disposed of. The secretary was instructed to get in touch with the Carpenter-Hixon Company, of Blind River, to arrange for a trip through their plant in June.

Construction of Transmission Lines

J. L. Lang, M.E.I.C., of the firm of Lang and Ross, contractors and surveyors, of Sault Ste. Marie, Ont., gave a most interesting paper on the "Construction of Transmission Lines." He gave the early history of transmission lines, showing the improvements during the last few years since high voltages have become universal, and also enumerating some of the outstanding lines on the continent.

A transmission line consists essentially of three parts, the conductor, the supporting structure and the insulating material, he said, and then he explained the different types of conductors in use and their special values. Aluminum cable, steel reinforced, is somewhat lighter and stronger than copper of equal conductivity and is, moreover, cheaper by a percentage varying from 8 to 15 per cent.

The material used for the supporting structures are wood, steel and concrete. Temporary lines and those of low voltage are usually supported on wooden poles or on wooden H-frame construction.

On long spans, and where permanency is essential, steel lattice poles and steel towers are used. These are usually built on steel grillages and concrete foundations, he stated, and also that spans in current practice range from 800 to 1,000 feet for rigid tower lines, from 400 to 600 feet for H-frame wood pole lines and from 200 to 300 feet for single pole lines.

The largest span on this continent is one of over 5,000 feet on the line of the Knoville Power Company of Tennessee. Mr. Lang has built one on the Seine river power line crossing Rainy lake, a distance of approximately 2,900 feet. It was supported on steel anchor towers 160 feet high, and he pointed out that the height of the towers depend upon the span, as a minimum distance from the ground must be maintained by law, and that this distance varies depending upon the locality. The insulators carrying the lines are of two classes, the pin type and the suspension type, and he said that the present practice is to use the suspension type for all voltages over 40,000 volts.

Getting down to the details of the actual construction of a transmission line, Mr. Lang said that, as a preliminary, aerial surveys are often desirable if possible and are being increasingly used, especially in the northern parts of the country, or anywhere that is thinly settled. These surveys assist greatly in choosing the location, which is very important, as some of the factors entering into the work are accessibility for delivery of materials for construction, the construction road costs and the ease and cost of maintenance.

The speaker then clearly outlined some of his own experiences in building power lines and described some of the unforeseen difficulties met with by a contractor on such work through a country unsettled and without roads for transporting his material in.

A general discussion followed and Mr. Lang was kept busy explaining and answering questions. A hearty vote of thanks was tendered to Mr. Lang for his most instructive address by A. E. Pickering, M.E.I.C., and Carl Stenbol, M.E.I.C.

Toronto Branch

J. J. Spence, A.M.E.I.C., Secretary-Treasurer.
J. W. Falkner, A.M.E.I.C., Branch News Editor.

DINNER TO RETIRING CHAIRMAN, R. B. YOUNG, M.E.I.C.

Preceding the annual meeting of the branch, on March 29th, an informal dinner was arranged for by the branch executive at Hart House in honour of the retiring chairman, R. B. Young, M.E.I.C., some thirty members being present.

Prof. Peter Gillespie, M.E.I.C., vice-president of The Institute, in a happy speech expressed the sentiments of those present, and the appreciation of branch members at the success attending Mr. Young's year of office, and the good work done by him.

Mr. Young suitably replied, thanking the members for the support which they had accorded him, and bespeaking the same support for the chairman-elect, L. W. Wynne-Roberts, A.M.E.I.C. After a few remarks from Mr. Wynne-Roberts the members present then adjourned to the annual meeting.

It was a great pleasure to welcome at this dinner the genial personality of our general secretary, R. J. Durley, M.E.I.C.

ANNUAL MEETING

The annual meeting of the Toronto Branch was held in the Mining building of the University of Toronto on Thursday evening, March 29th. There were about 35 members present.

Following the reading of the notice calling the annual meeting, the secretary read the minutes of the previous annual meeting, which were confirmed.

After a few opening remarks, the chairman, R. B. Young, M.E.I.C., called for the secretary-treasurer's report and the financial statement of the year. The adoption of this report was moved by the secretary, seconded by Prof. T. R. Loudon, M.E.I.C., and carried without further discussion.

It was moved by L. W. Wynne-Roberts, A.M.E.I.C., seconded by J. G. R. Wainwright, A.M.E.I.C., that F. N. D. Carmichael, A.M.E.I.C., and E. C. Higgins, S.E.I.C., act as auditors. Having examined the books and checked the same with vouchers and rebate statements, they reported everything in order and correct with vouchers supplied and Bank Pass Book. It was then moved by R. O. Wynne-Roberts, M.E.I.C., seconded by R. B. Young, M.E.I.C., that the report be adopted.

Prof. T. R. Loudon, M.E.I.C., suggested, in order to have record in the minutes, that the principle of sending the councillors at least once to Montreal, be continued.

Reports were then called for from the chairmen of various committees, as follows:—

Papers Committee.

R. B. Young, M.E.I.C., reviewed the various papers given throughout the year and strongly recommended continuance of the policy of welcoming the out-of-town speakers at dinner the evening of the meeting.

Finance Committee.

L. W. Wynne-Roberts, A.M.E.I.C., brought out the fact that after all outstanding indebtedness against the branch was cleared there remained a small surplus in spite of a somewhat reduced income.

Publicity Committee.

J. W. Falkner, A.M.E.I.C., reviewed reports in the Press, news and papers in The Journal, and publicity matter for monthly programme post card.

Membership Committee.

L. W. Wynne-Roberts, A.M.E.I.C., reported various interviews and correspondence with members who had resigned from The Institute.

Meetings Committee.

T. Taylor, M.E.I.C., reported the work done in securing and organizing discussion for the regular meetings.

Library Committee.

C. S. L. Hertzberg, M.E.I.C., reported the moving of the library to the Electrical building of the University of Toronto, and the arrangements which had been made, and also the list of periodicals added during the year.

Student Relations Committee.

W. B. Dunbar, A.M.E.I.C., reported no further work than keeping The Institute before the student body.

These reports all indicated the good work done and the interest taken in the activities of the branch, and the adoption of each in turn was moved and seconded by members present.

A letter was read from the secretary-treasurer of the Niagara Peninsula Branch expressing appreciation of the branch's attitude by reason of which A. J. Grant, M.E.I.C., was elected vice-president of The Institute.

Members of the Nominating Committee, consisting of G. A. McCarthy, M.E.I.C., chairman; A. E. Nourse, A.M.E.I.C.; F. M. Byam, M.E.I.C.; F. B. Goedike, A.M.E.I.C.; J. C. Higbee, Jr.E.I.C., who had acted as scrutineers of the ballots, reported the results as follows:—

Chairman	L. W. Wynne-Roberts, A.M.E.I.C., (acclamation).
Vice-chairman	T. Taylor, M.E.I.C.
Committee	G. H. Davis, M.E.I.C.
	A. B. Crealock, A.M.E.I.C., (2 years).
	H. N. Mason, A.M.E.I.C.
	J. W. Falkner, A.M.E.I.C., (1 year).

The remaining members of the committee are:—

	J. J. Traill, M.E.I.C.
	C. S. L. Hertzberg, M.E.I.C.
(Ex-officio)	R. B. Young, M.E.I.C.
	W. B. Dunbar, A.M.E.I.C.
	J. G. R. Wainwright, A.M.E.I.C.
	T. R. Loudon, M.E.I.C.
	J. M. Oxley, M.E.I.C.

A vote of thanks moved by Prof. C. R. Young, M.E.I.C., and seconded by G. A. McCarthy, M.E.I.C., was tendered to the old executive for the good work done and the very successful year. This was replied to by R. B. Young, M.E.I.C.

The installation of new officers was then proceeded with. The chairman, L. W. Wynne-Roberts, A.M.E.I.C., thanked the members for the honour and asked the support of the incoming executive. Appropriate speeches were also made by T. Taylor, M.E.I.C., J. J. Spence, A.M.E.I.C., H. N. Mason, A.M.E.I.C., J. W. Falkner, A.M.E.I.C.

A vote of thanks to the nominating committee was then moved by J. W. Falkner, A.M.E.I.C., and seconded by J. J. Traill, M.E.I.C., and was replied to by G. A. McCarthy, M.E.I.C.

A vote of thanks to auditors was moved by R. B. Young, M.E.I.C., seconded by W. B. Dunbar, A.M.E.I.C.

R. J. Durley, M.E.I.C., the general secretary, was then called on. He spoke on The Institute membership and finances. He also suggested that it might be possible to supply missing volumes of periodicals, transactions, etc., to the branch library from duplicate sets at Headquarters.

Vancouver Branch

F. P. V. Cowley, A.M.E.I.C., Secretary-Treasurer.

At the regular meeting of the branch held at the Board of Trade auditorium on March 15th, Mr. Harland Bartholomew, of Harland Bartholomew and Associates, town planning consultants to the city of Vancouver, gave a most interesting talk on the "Vancouver City Plan."

This meeting was called as an open meeting, the reeves and councils of the adjoining municipalities having been invited, as well as kindred organizations and boards of trade and service clubs. An attendance of 141 testified to the interest taken in the address, and in the subject of town planning for the city.

The outstanding points of the subject were touched on by the speaker, and at the conclusion of his remarks, many excellent slides were shown and explained by H. L. Seymour, M.E.I.C., of the Vancouver Town Planning Commission.

THE VANCOUVER CITY PLAN

Mr. Bartholomew described town planning as engineering plus other necessary considerations such as the aesthetic; not only planning bridges, but planning where they should be placed. Town planning is to do what has to be done to fulfill the requirements of the whole of a growing town; a town being a growing organism, which should be attractive and should provide for the best development of its citizens. The laying out or designing of a city plan is much more than surveying, as it means a study of the purpose to which each section will eventually be put.

The complete planning of a city is composed of five phases. The programme for Vancouver is now two-thirds complete, and the whole will be completed this year. Two phases are now complete, (1) streets, (2) zoning.

The future population of the city must be studied, not only as to the probable numbers, but how they will be distributed; natural, unguided distribution not being satisfactory. Excluding that portion north of Burrard inlet, the estimated population in 1960 is 1,000,000. In studying the distribution of this number, one point to be considered is the slope of the ground. In Vancouver the ground lends itself admirably to a satisfactory distribution, the low land being suitable for industries and the high land for residences.

Where must the business district be, and how large? Study shows that if False creek had been land, that would have been the business centre. As matters are, Hastings and Granville and parallel streets will be the business district, and will be large enough for the estimated population of 1,000,000. The present feeder streets, however, to this district are not sufficient, and more must be developed, such as Burrard, Oak and Kingsway.

Consider the business district as a gridiron with a distribution street around it. Radial streets must enter at different points on the gridiron. The present layout of wider streets for intra district traffic is at present quite good. But a comprehensive plan of street widening is essential, or much money will be wasted in widening indiscriminately.

How is a street widening scheme to be carried out and how is it to be paid for? First, by establishing building lines or "set back" lines. Second, in subdividing new areas allow for expected growth. Third, expropriation to get desired width. Dealing with present conditions there are 335 miles of streets in the city of Vancouver. Of these 9 per cent are to be major streets; 55 miles are at present wide enough; 30 miles need to be widened, but of these many are not built upon.

Dealing with the second phase, "zoning," the following interesting facts were brought out. Of all growth, 75 to 80 per cent places itself in its logical location. It is the remaining 25 per cent which causes all the trouble by locating in the wrong position. Where zoning is in force, 95 per cent of all growth easily and readily adjusts itself to the controlling plan. There are now 4,425 stores in Vancouver. There are 662 apartments housing 13,000 people, and only occupying 90 acres or one per cent of the area of the city. In one extreme case there is only allotted 100 square feet of ground space per family. In the zoning plan there are 140,000 people allowed for in the apartment house area. In preventing crowding and congestion, leading to ill-health, there are three types of regulations in force, (1) allowable uses of property, (2) limitation of heights of buildings, (3) open spaces requirements.

THE MODERN TREND OF ENGINEERING PRACTICE

At a regular meeting of the branch on April 4th, J. L. Busfield, M.E.I.C., of Montreal, addressed the members on "The Modern Trend of Engineering Practice" with specific reference to the personal side of the situation. Mr. Busfield is a member of Council, member of the Finance Committee, and chairman of the Papers Committee of The Institute, and in his remarks dealt almost exclusively with Institute affairs, throwing light on many subjects with which the Vancouver members were not thoroughly familiar.

The need of the proposed $5.00 increase in the fees of Members was explained, but as general opinion seemed to favour an increase also in the fees of Associate Members, the motion was being withdrawn for one year.

Dealing with the activities of the Papers Committee, it was pointed out that its function is now to help branches get speakers, and to arrange for the interchange of speakers. Last year $200 was voted to help defray the expenses of speakers going from branch to branch. P. L. Pratley, M.E.I.C., had visited Halifax, St. John, Fredericton and Moncton, on a lecturing tour. This year a somewhat larger grant is available, and arrangements for a visit from some eminent speaker are being made by some of the branches.

The annual meeting, held in Montreal February 14th to 17th, had been a great success. A record had been established at one meeting when over 400 were present. The possibility of holding the next annual meeting in Winnipeg was mentioned and the speaker suggested that branches might send representatives to the annual meeting and members club together to meet the expense.

Many subjects of great interest to the branch and to The Institute in general were touched on by Mr. Busfield, such as classification, which is being studied by a special committee; the new prize regulations now in effect; modern trend of engineering practice; the difference between the engineering profession dealing with the forces of nature and sister professions dealing with human interest; relationship between The Engineering Institute of Canada and the Professional Engineers' Associations; need for a new policy for The Institute; more encouragement for research work, and the admission of companies to membership in The Institute.

In a general discussion following Mr. Busfield's address it was brought out that the suggestion of the branch "That the subscription to the Journal on the part of Students actually attending a University be made optional," had not been accepted by Council, and grounds for its non-acceptance were made very clear.

The branch regrets to record that on March 15th there suddenly passed away Henry Edward Cranmer Carry, M.E.I.C., in his 75th year. Mr. Carry had, for many years, taken an active interest in the affairs of The Institute in general and of the branch in particular, being a constant attendant at all meetings. He was a Life Member of The Institute and will be sorely missed by the branch.

The efforts of all members of the branch are being directed toward making the Western Professional Meeting, to be held in Vancouver, June 7th to 9th, an unqualified success. The general committee and necessary sub-committees have been appointed, and an outline programme for the three days decided upon. Some excellent papers will be given, and an interesting convention is in prospect.

Student Section of the Vancouver Branch

VISIT TO HARBOUR GRAIN ELEVATOR NO. 2

The Student Section of the branch held a trip on Saturday, March 10th, to the Vancouver Harbour Commissioners' grain elevator No. 2. Eighteen students visited the elevator and were shown through the building and shipping galleries. The details of grain handling methods and equipment were explained by members of the staff.

The party was also conducted through the Ballantyne pier and was shown the grain and freight handling cranes and the equipment of the freight sheds.

TOWN PLANNING

A regular meeting of the Section was held on Wednesday, March 14th, at the University, when an address was given by Mr. Harland Bartholomew, of Bartholomew and Associates of St. Louis, town planning consultants to the city of Vancouver. Mr. Bartholomew gave a general outline of town planning, its objectives, its field, and its causes and effects. He outlined the conditions which govern town planning as a science, forming a background which becomes the objective of the town planner.

About eighty students, members of the faculty, and visitors were present.

THE FIRE UNDERWRITERS' LABORATORIES OF CHICAGO

At a meeting held on Wednesday, March 21st, 1928, at the University, an address was given by Mr. J. L. Noble, British Columbia representative of the National Fire Underwriters' Association, who spoke on the Fire Underwriters' Laboratories of Chicago. Mr. Noble gave an interesting description, together with views on the screen, of the work carried on in the testing laboratories. He showed the elaborate and very severe tests to which products of every description are subjected before being stamped with the approval of the Fire Underwriters' Association. Such products can be relied upon to possess the highest degree of durability even under the extreme conditions of a fire. About sixty students and members of the faculty were present.

THE ENGINEERING INSTITUTE OF CANADA

At the meeting held on Wednesday, March 28th, at the University, a short address was given by W. H. Powell, M.E.I.C., on "The Engineering Institute of Canada." Mr. Powell gave his conception of The Institute and its value to the members, student or otherwise. He also outlined its relations to the various engineering societies in Canada and the United States, with special reference to the provincial licensing bodies.

A vote of thanks was accorded Mr. Powell for the interest which he had shown in the Student Section in its first year.

Following Mr. Powell's address the annual elections were held. The following executive was elected:

Hon. President,	Prof. William E. Dickering, A.B., B.S. in C.E., C.E.
President,	A. Peebles, S.E.I.C., Sc.' 29.
Vice-President,	J. H. Legg, S.E.I.C., Sc.' 29.
Secretary-Treas.,	R. L. Morrison, S.E.I.C., Sc.' 29.
Assistant Secy.,	(to be chosen by the Secretary-Treasurer.)
Ex-officio,	E. Bebb, Sc.' 30, (Past President).

This was the last meeting of the year, and the hope was expressed that proportionate success would attend the efforts of the Students during the next session. During the past session thirteen meetings were held, the average attendance being about 80. The maximum attendance at any meeting was 130. One trip was held at which eighteen members were present.

Winnipeg Branch

James Quail, A.M.E.I.C., Secretary-Treasurer.

ELECTRICAL CHARACTERISTICS OF THE GREAT FALLS-TO-WINNIPEG TRANSMISSION LINE.

At a meeting of the Winnipeg Branch, held on December 15th, 1927, L. M. Hovey, S.E.I.C., of the Winnipeg Electric Company, presented a paper on the "Electrical Characteristics of the Great Falls-to-Winnipeg Transmission Line." This line was built to meet the requirements of the increased power load, and after careful investigations it was decided by the company to purchase an entirely new right-of-way from the Great Falls to the northwest section of Winnipeg and to build a new terminal station. A width of 200 feet is provided throughout the right-of-way except where it passes through the town of Selkirk and the city of Winnipeg, where it is reduced to 150 feet.

The initial installation consists of one steel tower line with two 3-phase circuits and a wood pole telephone line. The towers are of galvanized steel. The conductors, of which there are six carried by each tower, have a vertical spacing of 10 feet with the centre conductor offset 3½ feet horizontally.

The size of the conductors is 266,800 C.M., A.C.S.R., six strands aluminum and seven strands steel, having an overall diameter of 0.633 inches with an ultimate strength of 9,385 pounds and an elastic limit of 6,470 pounds. The safe working tension is 4,100 and the current carrying capacity is 305 amperes with a 40°C. rise in temperature.

The insulators are of the ball socket suspension type; seven units per string for 110-kv., vertical, and five units per string for 60-kv., vertical. On dead ends eight units are used for 110-kv., and six for 60-kv., strings.

Suspension clamps which grip the cable are provided with arcing horns for the protection of the insulators in case of flashover to the tower. The minimum conductor clearance to ground is 4 feet, the dry flashover value for seven units is 340,000 volts, and with heavy rains this is reduced to 280,000 volts. Lightning arresters and choke coils are installed at each end of the lines.

At the power house each 21-000-kv.a., 3-phase generator is connected to three 7,000-kv.a. transformers, then on to the main bus. The resistance and reactance cannot be so lumped in with that of the line in determining the overall performance. All calculations refer to the high tension bus voltage only.

At the receiver end three 10,000-kv.a. transformers will be installed per line; 30,000-kv.a. being the load at 100,000 volts.

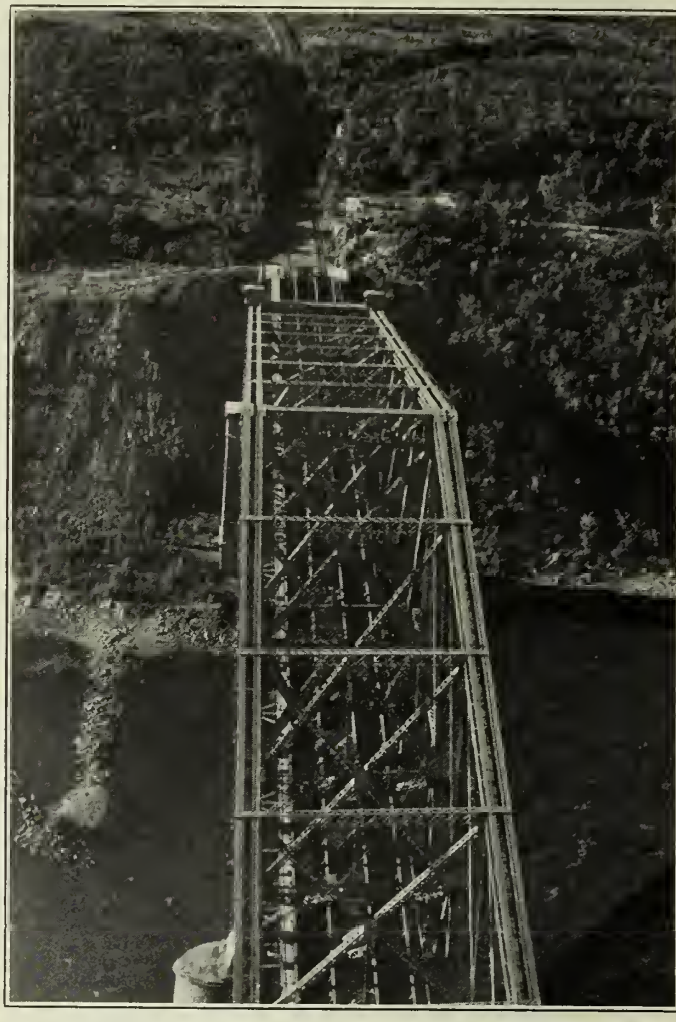
The circle diagram was used for the calculation of efficiency and voltage regulation. Power loss circles, sending end power factor circles, were obtained in a similar manner to those shown in 1926 issue of The American Institute of Electrical Engineers, "Circle Diagram of a Transmission Network," by F. E. Terman.

The ultimate capacity of the lines will call for a 15,000-kv.a. synchronous condenser per circuit, based on a 30,000-kv.a. load at 95 per cent power factor per line; power house voltage 110-kv., and receiver voltage 100 kv. Under emergency conditions the circuit should be capable of carrying 52,000 kv.a. without exceeding the carrying capacity of the conductor.

At the Red River crossing at Selkirk the span is 2,045 feet, copper clad cable, the equivalent of 0000 B. & S. copper was used. The ultimate strength of the cable is 14,000 pounds, the elastic limits is 7,000 pounds, and the maximum allowable working tension under class "B" conditions is 7,000 pounds.

There are nine transposition towers, two sectionalizing towers, and one sectionalizing and tap-off tower for a branch line for each circuit on this line.

A number of very interesting slides were shown of the circle diagram used in the calculations, and various photographs taken on the line.



An Interesting Aerial View of the Quebec Bridge.

Preliminary Notice

of Applications for Admission and for Transfer

April 17th, 1928.

The By-laws now 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 election 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 1928.

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 or 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.

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.

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

BARNES—FRANK HARVEY, of Sault Ste. Marie, Ont., Born at Port Hope, Ont., Nov. 27th, 1890; Educ., B.Sc., McGill Univ., 1912; 1912-14 and also during college vacations apptce. in C.P.R. shops and roundhouses; 1914-17, shop foreman at Dom. Arsenal, Quebec; 1917-20, mech'l. supt. and production mgr. at Dom. Arsenal; 1920-21, asst. to head of Planning Dept. Laurentide Co.; 1922, shop supt. Can. Brill. Co., Preston; 1923, operating an auto electric service station at Oshawa; 1924, plant mgr. Thomas Watson Ltd., Woodstock; 1924-26, designer on paper machinery for Charles Walmsley & Co. Ltd.; 1926 to date with Northern Foundry & Machine Co. as 1926-27, designing engr. and 1927 to date, designing engr. and asst. manager.

References: W. G. Mitchell, A. A. MacDiarmid, A. H. Russell, H. Kay, J. Carnwath J. E. Daubney T. R. Ballantyne

BUNCKE—HARRY JACOB, of Iroquois Falls, Ont., Born at Whitestone, L.I., N.Y., Nov. 27th, 1892; Educ., C.E., Columbia Univ., 1915, M.S., Univ. of Maine, 1916; 1913 (summer) Ashokan Reservoir road work; 1914 (summer) Kensico Dam Contsrn.; 1915 (summer) instructor, field work, Columbia Univ. summer school; 1916 (6. mos.), dftsman and general asst. to master mech., Abitibi Power & Paper Co. Ltd., Iroquois Falls; 1917, supt. groundwood mill same company; 1918, design and field supervision of camp drainage and wooden crib dam at Camp Wheeler, Ga. 1st lieut. U.S. Engrs.; 1919-20, technical studies, investigations, reports and organization on various engrg. problems, as tech. asst. to mgr. Abitibi P. & P. Co. Ltd.; 1920, editor, section on groundwood pulp mfr. text books published by Can. & American technical associations of pulp and paper industry; 1921 to date, with Abitibi Power & Paper Co. Ltd.; 1921-22, mech'l dept. supervision of engrg. field, office and all plant and equipment operation, plant engr; 1923 to date, chief engineer.

References: G. F. Hardy, H. O. Keay, J. S. Bates, F. O. White, W. B. Crombie.

COOPER—DEXTER PARSHALL, of Welchpool, N.B., Born at Rushford, Minnesota, July 10th, 1880; Educ., Mech'l Engr. Royal Tech. Inst. Karlsruhe, Germany, 1907; 1911-14, div. engr. Keokuk Project, Keokuk Iowa; 1914-16, engr. i/c reconaissance Pendoreille River Z Canyon project, Washington; 1916-17, ch. of reconnaissance, Chile, S.A.; 1917-18, Salmon River development, Niagara; 1919-20, Western New York Utilities Co., Medina, N.Y.; 1921, engr. i/c, Hugh L. Cooper & Co., St. Lawrence River investigation; 1917-22, periodical work on muscle shoals, H. L. Cooper & Co.; 1922 to date, ch. engr. Quoddy Power Project, Eastport, Maine.

References: G. Stead, S. R. Weston, C. R. Coutlee, W. J. Johnston, V. C. Blackett.

DREW—ALFRED WILLIAM, of Edmonton, Alta., Born at Sherbrooke, Que., Feb. 28th, 1904; Educ., B.Sc. Univ. of Alta. 1927; May 1927 to date, office asst. and dftsman with Div. Engr. of constrn. C.N.R.

References: R. S. L. Wilson, R. W. Boyle, C. A. Robb, R. W. Ross, R. J. Gibb.

LANGLOIS—RAOUL, of Montreal, Que., Born at Quebec, July 3rd, 1888; Educ., C.E., Ecole Polytechnique, 1912; 1909 (6 mos.), chainman, Transcontinental Ry.; 1910-11 (6 mos.), levelman, Donaconna Hydraulic Co.; 1913 (8 mos.), transitman, F. C. Laberge; 1913-18, in technical office, City of Montreal; 1918 to date, asst. ch. engr. Montreal Tramways Commission.

References: A. Duperron, P. Seurot, O. O. Lefebvre, F. C. Laberge, G. R. MacLeod, P. S. Gregory, K. B. Thornton.

MERRIMAN—HORACE OWEN, of Ottawa, Ont., Born at Hamilton, Ont. Nov. 21st, 1888; Educ., B.A.Sc., Univ. of Toronto, 1911; 1911-12, dftsman, Can. Westinghouse Company, Hamilton; 1912-14, asst. engr., Hamilton Hydro-Electric system; 1914-15, demonstrator in elect'l engrg. Univ. of Toronto; 1915-19, Captain, R.N.A.S. and R.A.F., testing aircraft and designing aircraft instruments; 1919-23, research engr. i/c development of Guest & Merriman system of recording sound; 1924, research engr. i/c investigation of radio inductive interference under Prof. T. R. Rosebrugh at Univ. of Toronto for Nat. Research Council; at present, inductive interference engr., Dept. of Marine & Fisheries, under the director of radio service, i/c research investigation and suppression of radio inductive interference throughout Canada.

References: C. P. Edwards, W. A. Rush, L. E. Allan, H. E. M. Kensit, A. N. Fraser, A. B. Lambe, F. G. Smith.

MURPHY—MAURICE EDWARD, of Glace Bay N.S. Born at Bay St. Lawrence C.B. 1868; locomotive driver, fireman, engr. Sydney and Louisburg Ry., heating and ventilation engr., Whiting's Machinery Works, Whitingsville, Vt.; 1900-20, mech'l dept. and mech'l supt., Dom. Iron and Steel Co.; 1920-28, mech'l supt., Dominion Coal Company.

References: W. Herd, W. L. Hay, W. E. Clarke, W. C. Risley, J. J. McDougall.

PAPINEAU—GUSTAVE JOSEPH, of Montreal, Born at St. Ours, Que., Feb. 21st, 1890; Educ., B.A.Sc., C.E., Ecole Polytechnique, 1912, Q.L.S., 1914; 1910 and 11 (summers), municipal engr's. office, city of Outremont, Que.; 1912-13, levelman on survey, North. Ry. Co.; 1913-14, instrumentman, transmission line and surveying, constrn, Shawinigan Water & Power Co.; 1914-15, general engrg. with Surveyer & Frigon; 1915-19, municipal engrg., city of Outremont; 1919-21, roadway dept., P.Q., div. engr. i/c Terrebonne, Argenteuil, Two Mountains counties; 1921 to date, municipal engrg., surveying, as asst. engr., technical service, city of Montreal.

References: G. R. MacLeod, F. C. Laberge, O. O. Lefebvre, A. Frigon, E. Lacroix, H. Dessaulles, A. Lalonde, A. Duperron.

RHODES—FREDERICK NORMAN, of Calgary, Alta., Born at Hagley, Eng., Nov. 3rd, 1882; Educ., private tutor and residential college, taking South Kensington exams in chemistry, physics and art; 1899, with Tangyes & Sons, Handsworth, Eng.; 1901-04, head engr. and supt., Thos. Rhodes & Sons, iron plate workers and mfrs. of machinery; 1904, elect'l dept., C.P.R., Winnipeg; 1905, Bell Telephone lines, Southern Manitoba; 1908, Enterprise Electric; 1909-16, supt., electric dept., town of Pincher Creek; 1922 to date, with Institute of Technology, i/c elect'l testing dept and instructor of electricity.

References: J. H. Ross, C. C. Richards, F. Steel, W. H. Broughton, W. Anderson, G. H. Morton, L. L. Johnson, R. MacKay.

FOR TRANSFER FROM ASSOCIATE MEMBER TO MEMBER

GAMBLE—CLARKE WILLIAM, of Cairo, Ill., Born at Lachute, Que., Oct. 31st, 1877; Educ., B.Sc., McGill Univ., 1907; 1907-08, asst. to ch. engr., Pro. B.C., reports, surveys for roads, supervising constrn roads, bridges, wharves, etc.; 1908-15, employed by F. Darling & Co., Vancouver, on design and supervising constrn. of grain sacking plant for C.P.R., etc., also, on design and erection of bridges for Govt. of B.C.; 1916-18, serving with Can. Rly. troops and Can. Engrs. overseas, lieut.; 1918-19, head surveyor, Soldiers' Civil Re-establishment Dept., Victoria, B.C.; 1919-24, member, firm Layard Swan & Gamble, Ltd., design and constrn, mostly mech'l and marine, also, surveys, design and installation, farm drainage projects; 1924-26, private practice, mostly surveys and reports; 1926 to date, res. engr. for Waddell & Hardesty, on bridge over Mississippi river at Cairo, also, preliminary work on proposed bridge over Ohio river at Cairo.

References: J. A. L. Waddell, A. B. Ritchie, J. E. Griffith, F. J. O'Reilly, J. C. Kemp

JONES—WILLIAM JONES, of London, Eng., Born at Taffs Well, South Wales, Nov. 7th, 1887; Educ., B.Sc., Univ. of Man., 1914; 1914-19, military training and active service with Can. Engrs. and R.A.F.; 1904-14, ry. engrg. with C.P.R., rodman, inspector, instrumentman, municipal engrg., asst. city engr., Medicine Hat, Alta.; 1919-22, various temporary occupations, manager and superintendent on organization and construction work, including housing, factories, roads, railway structures, also part time demonstrating and lecturing in engrg., Univ. of Man.; 1922, Roxana Petroleum Corp., St. Louis, Mo., as ch. surveyor i/c field work for refinery constrn and as head of the cracking dept.; 1924, supt., London office, M. W. Kellogg Co., refinery contractors, etc., N.Y., i/c engrg. constrn and technical work, European contracts; 1926, sr. asst. engr. i/c development work refineries, Anglo-Persian Oil Co., London office; at present, asst. mgr. i/c production, Medway Oil & Storage Co., Isle of Grain, England.

References: B. Ripley, G. L. Shanks, A. McGillivray, E. P. Fetherstonhaugh, J. R. C. Macredie, E. E. Brydone-Jack, H. Rindal.

LEES—THOMAS, of Calgary, Alta., Born at Girvan, Scotland, Mch. 15th, 1881; Educ., Associate, Royal Tech. College, Glasgow, 1904; 1904-05, asst. engr., North British Railway Co., Glasgow; 1905 to date, with C.P.R., as follows; 1905-12, div. engr. at various places in Western Canada; 1912-14, asst. engr., double tracking B.C. district; 1914-16, asst. dist. engr., Calgary; 1916-18, div. engr., Calgary; 1918-23, engr. of water service, Winnipeg; 1923 to date, dist engr., Calgary.

References: S. G. Porter, F. W. Alexander, F. J. Robertson, A. R. Ketterson, P. B. Motley, W. A. James, J. C. Holden.

PROCTOR—EDWARD MOORE, of Toronto, Ont., Born at Sarnia, Ont., May 11th, 1888; Educ., B.A.Sc., Univ. of Toronto, 1909; field survey work for C.P.R. navig. dept., Nat. Transcontinental, Willis Chipman, structural detailer, Can. Foundry Co.; 4½ yrs. bridge and structural designer, Dept. of Railways and Bridges, Toronto; 1916 to date, member of James Proctor & Redfern, Ltd.; 1918-27, managing director; 1927 to date, president; general consulting work on waterworks, sewerage work, pavements, bridges, bldgs., etc.

References: T. H. Hogg, J. M. R. Fairbairn, F. S. Keith, C. H. Scheman, P. Gillespie, C. H. Mitchell.

FOR TRANSFER FROM JUNIOR TO A HIGHER GRADE

FRASER—ISAAC MATHESON, of Saskatoon, Sask., Born at Pictou, N.S., Nov. 1, 1890; Educ., B.Sc., McGill Univ., 1919, 3 mos. millwright, 1 yr. dftsman, N.S. Steel & Coal Co., Ltd., New Glasgow, N.S.; 3 mos. iron worker, Dom. Iron & Steel Co., Ltd., Sydney; 1 session lecturer and demonstrator, mech'l dept., McGill Univ.; 1 yr., dftsman, Dom. Engrg. Works, Ltd., Montreal; 1921-28, asst. prof., mech'l engrg., Univ. of Saskatchewan, Saskatoon

References: A. R. Roberts, C. M. McKergow, R. B. Stewart, C. J. Mackenzie, A. R. Greig, G. M. Williams.

JOSLIN—JAMES ALEXANDER, of Toronto, Ont., Born at Bexhill-on-Sea, Eng., Oct. 24th, 1893; Educ., 3 yrs., Duncombe High School, Eng., I.C.S. structural engrg.; 1913, shop experience with Dom. Bridge Co., Toronto; 1916, dftsman with R. Simpson Co., Ltd., Toronto; 1917-22 and 1923-25, structural checker, squad leader and i/c contracts of various kinds, both bridges and bldg. works, Dom. Bridge Co., Toronto; 1922-23, with Standard Steel Constrn Co., Welland, Ont., and American Bridge Co.; 1925-27, Can. Bridge Co., Walkerville; 1927, resigned, owing to ill-health; Nov. 1927 to date, with Dom. Bridge Co., Ltd., Toronto; from 1919, has had charge of all kinds of bldg. and bridge work in the preparation of detail drawings and general supervision of the work in the dfting office.

References: G. E. Evans, W. W. Gunn, J. W. Smith, A. Pedan, A. E. West, F. Stevens.

KEITH—WILLIAM HARGREAVE, of Islington, Ont., Born at Newmarket, Ont., March 28th, 1900; Educ., B.A.Sc., Univ. of Toronto, 1924; 1916 and 17 (summers), rodman, chainman, etc., James, Proctor & Redfern, Toronto; 1918, in R.A.F.; 1922, cost accountant, Warren Paving Co.; 1919-20-21-23, res. engr. on various waterworks, sewer, pavement and bridge contracts for James, Proctor & Redfern; 1924-27, asst. engr., twp. of Etobicoke, Ont., i/c waterworks and pavement design and constrn, topographic surveys and concrete designer; May 1927 to date, dist. engr., municipal roads, Dept. of Public Highways, Ont.

References: J. A. Lumsden, J. A. P. Marshall, A. T. Byram, W. B. Redfern, A. L. McPhail, R. J. Griesbach.

FOR TRANSFER FROM STUDENT TO A HIGHER GRADE

GAUVIN—HERVE ALFRED, of Ottawa, Ont., Born at Lewiston, Maine, U.S.A., Nov. 7th, 1900; Educ., B.Sc., Univ. of Sask., 1922, B.Sc. (C.E.) McGill Univ., 1926; summers previous to 1922, utility man, general constrn, Saskatoon, Sask.; 1922 (summer), i/c insulating crew, Capital Contractors, Ottawa; 1922-23, dftsman, Ottawa Car Mfg. Co.; May to Oct. 1924, design and estimates, same company; May to Oct. 1925, design and estimates, Gauvin, Ltd., general contractors, Ottawa; 1926 to date, sec.-treas. and i/c design and estimates, Gauvin, Ltd.

References: N. Cauchon, F. C. C. Lynch, C. J. Mackenzie, H. M. MacKay, E. Brown, R. de L. French.

McBRIDE—ERNEST WILLARD, of Iroquois Falls, Ont., Born at Churchville, Ont., July 24th, 1901; Educ., B.A.Sc., Univ. of Toronto, 1923; 1923 (7 mos.), research at Can. Paper Co., Windsor Mills, Que.; 1924 to date, Abitibi Power & Paper Co.—one yr. efficiency dept.—the department of records, where all mill data is compiled both for mill, operation and accounting purposes; 9 mos. i/c efficiency dept.; 1 yr., 9 mos. asst. to control dept.—this dept. covers stock testing in the sulphite, groundwood and paper mills, waste control, etc.; July 1927 to date, i/c control dept.

References: T. R. Loudon, L. E. Kendall, J. P. Freeman, W. B. Crombie.

MOON—GEORGE DOUGLAS, of Quebec, Que., Born at Port Hoyse, Ont., Nov. 20th, 1900; Educ., B.A.Sc., Univ. of Toronto, 1923; 1923-25, Can. Westinghouse Company's apptce. course in elect'l engrg; 1925-26, demonstrator in elect'l engrg., Univ. of Toronto; May to Oct. 1926, constrn. dept., Bell Telephone Co., Montreal; 1926 to date, asst. field engr., Bell Telephone Co., Quebec, Que.

References: J. A. Loy, A. M. Reid, A. Lariviere, H. W. R. Shepherd, W. F. McLaren, J. R. Dunbar.

SMYE—GORDON RENFREW, of Galt, Ont, Born at Ayr, Ont., Nov. 3rd, 1900; Educ., B.A.Sc., Univ. of Toronto, 1923; 1923-27, analytical chemist, Dom. Tire Factory, Kitchener; at present, asst. to ch. chemist, Firestone Tire & Rubber Co., Hamilton, Ont.

References: L. W. Gill, P. Gillespie, C. R. Young, T. R. Loudon, H. W. Angus, A. M. Reid.

THWAITES—JOSEPH TAYLOR, of Hamilton, Ont., Born at Bolton, Eng., Mch. 2nd, 1901; Educ., B.Sc., Queen's Univ., 1925, post-grad. work term of 1925-26; 1916-21, Can. Westinghouse Company; 1926-27, instructor in physics, Queen's Univ.; 1927-28, sales engr., Smart Turner Machine Co., Hamilton; Feb. 1928 to date, i/c service dept., Wentworth Radio and Auto Supply Co., Hamilton.

References: W. J. McLelland, F. B. Goedike, D. M. Jemmett, A. Jackson, W. P. Wilgar.

VICKERSON—GEORGE LOCKER, of Montreal, Que. Born at Montreal, Sept. 6th, 1904; Educ., B.Sc., McGill Univ., 1925; changes from steam to electric plant of peat bog machinery, Alfred, Ont.; estimator and asst. foreman of the G. R. Locker Co., tile contractors and fireplace bldrs.

References: E. V. Moore, R. de L. French, E. Brown, H. M. MacKay, A. J. Kelly, C. A. Norris.

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The First Commercial 1,200-Pound Steam Plant in the World

Features of the Ultra-High Pressure Steam-Electric Generating Station of The Edison Electric Illuminating Company of Boston, Mass.

Irving E. Moultrop,
Chief Engineer, The Edison Electric Illuminating Company of Boston.

Paper read before the Montreal Branch of The Engineering Institute of Canada, January 19th, 1928

The real reason for building a 1,200-pound steam plant was the belief, backed by conservative estimates of the cost of construction, that enough coal could be saved to pay a handsome profit on the money invested. In other words, we were after dollar efficiency and not thermal efficiency alone.

The territory of The Edison Electric Illuminating Company of Boston is almost a circle with the city of Boston on its eastern periphery. It has an area of approximately 604 square miles.

Before the construction of the new Edgar station at Weymouth the system was served principally by our L street station located in South Boston. Municipal laws require that all transmission in this district must be underground. Cables limit the transmission voltage and underground construction is expensive. This meant that the cost of the transmission lines to the outlying districts was unusually high. To remedy this condition the new station was located on the south shore at Weymouth and the first section of a 110,000-volt overhead transmission line was built. It is expected eventually to extend this line so as to circle our system. This will allow the outlying territory to be served from the Edgar station and leave the L street station to carry the highly concentrated downtown load near which it is located.

Progress in Increasing Thermal Efficiency

The curve on the left of figure No. 1 shows what has been accomplished in the past fifteen years toward increasing the thermal efficiency of steam-electric generating stations. The period since the war has been one of accomplishment of which all should be proud. As may be seen, the B.t.u. required to generate a kilowatt hour has been reduced approximately 30 per cent. In fact, it is believed at this time that the maximum commercial possibilities of the steam cycle is being approached.

Curve No. 5, on the right, shows that the result of the increase in thermal efficiency has been a decrease in the total cost of power generation. Curves Nos. 3 and 4, however, show that this reduction has been due to coal saving alone. Curve No. 4, however, shows that the fixed charge cost of generating has not been reduced along with the coal cost. Attention should be turned from thermal efficiency to dollar efficiency. If attention is focussed on the problem of reducing the cost of construction with the same enthusiasm that has been shown in pursuing the elusive B.t.u. much can be accomplished toward further reducing the cost of generation.

As an average in the United States, for over 70 per cent of the days during the year, the daily system peaks are less than 60 per cent of the annual peak. The cost of the boiler plant of a generating station is approximately 40 per cent of the total cost of the station. This indicates that by building steam generating units capable of operating at very high steaming rates a high annual overall thermal efficiency can still be maintained and also a material reduction in the cost of construction effected.

Steam Pressures and Temperatures Studied

In the design of the new Edgar station an exhaustive study was made of the possibilities of various steam pressures and temperatures.

It was found that it was economical to use steam at as high a temperature as possible irrespective of the pres-

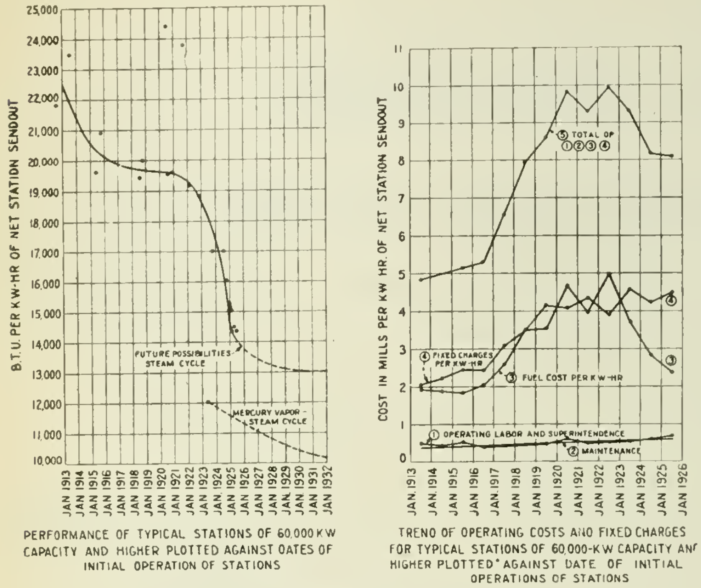

Figure No. 1.

sure. The materials available for construction show a decided falling-off in strength at temperatures above 750°F., and for the sake of safety it was decided to use a steam temperature of about 700°F. for the initial installation. It is expected to go to a higher temperature just as soon as suitable materials were available at reasonable prices.

The question of the proper pressure was next studied, and it was found that for a station employing the regenerative cycle but no reheating there appears to be no economic justification in going to pressure higher than 350 pounds at the turbine throttle. For pressures much higher than this the studies indicated that for our conditions the coal saving would not justify the additional cost of construction.

When the problem was studied from the standpoint of the regenerative reheat cycle, however, it was found that there was a decided advantage in raising the throttle pressure to somewhere between 1,200 and 1,500 pounds. In fact, the studies indicated that a net coal saving of 12 per cent could probably be obtained by raising the throttle pressure from 350 to 1,200 pounds, if the steam was reheated at about 350 pounds.

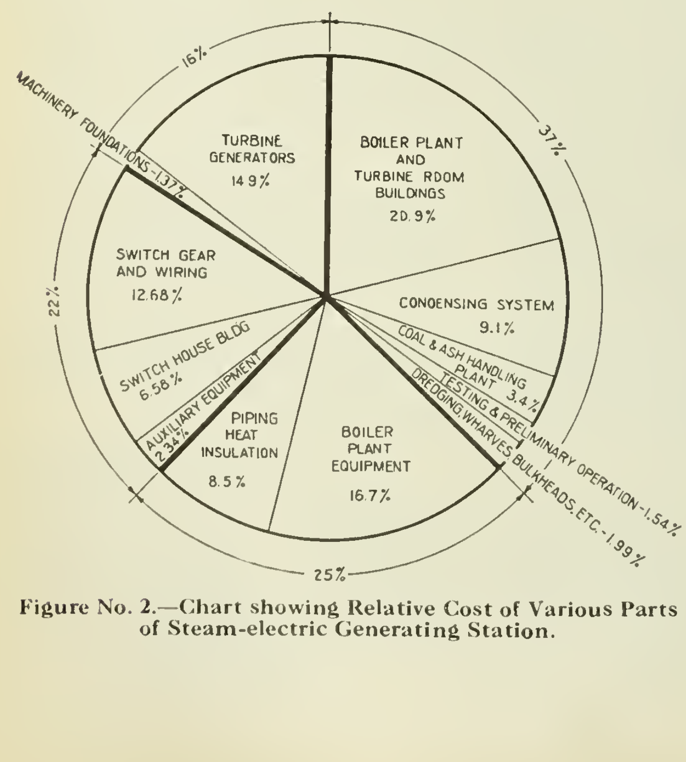

Figure No. 2.—Chart showing Relative Cost of Various Parts of Steam-electric Generating Station.

The more the possibilities of this arrangement were studied the more attractive it looked. It would allow us to build a first-class 350-pound station and confine our experiments in high pressure to a single boiler and a single small size turbine-generator unit. Our estimates indicated that the kilowatts generated by the high-pressure turbine would justify the additional cost of the high-pressure boiler and turbine. It was possible, furthermore, to operate the high-pressure installation at full load whenever it was available for service. In this way we were reasonably sure that we could experiment without losing money and the chances were good that the high-pressure equipment could be made to pay a handsome dividend on the money invested.

Figure No. 2 shows the B.t.u. per kilowatt-hour possibilities in the turbine room for several pressures and temperatures. On the left is shown the comparison for stations that do not extract steam from the main turbines for heating the feed water, and on the right the comparison on the basis of extracting steam to heat the feed water to a temperature of 340°F.

As can be seen, there is a chance of obtaining an improvement of 14.9 per cent by going to 1,200 pounds and reheating. When this is corrected for additional auxiliary

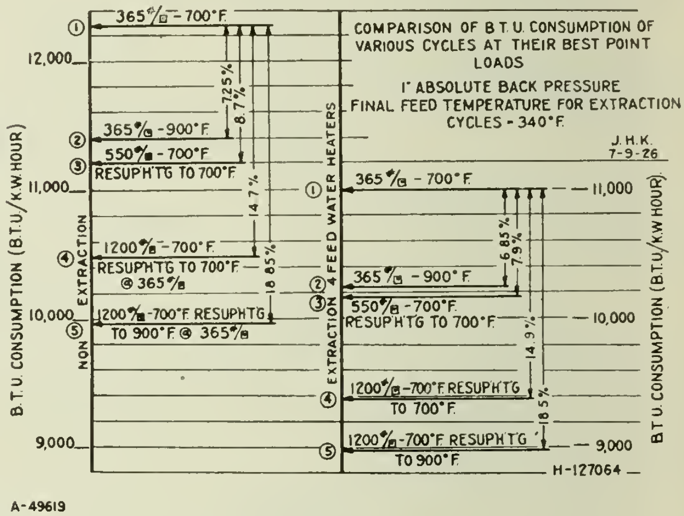

Figure No. 3.—Relation between Costs of Various Parts of a Steam-electric Generating Station.

power, etc., a net improvement of about 12 per cent can be expected.

Comparison of Costs

Many are of the opinion that the cost of a high-pressure station is too great to be justified by the coal saving. To satisfy these "doubting Thomases" let us analyze the cost of a steam-electric generating station and see what the various items which are affected by pressure costs as compared to the whole. Figure No. 3 shows the approximate relation between the costs of the various parts of a steam-electric generating station.

Since a high-pressure boiler will generate more kilowatts than a boiler of the same size operating at normal pressure at same rating, it is obvious that the cost of the main buildings, the preparation of site, coal and ash handling equipment, etc., will be less per kilowatt of generating capacity. Since the turbine-generating unit will use less steam per kilowatt hour it is also obvious that the cost of the condensing plant, including the intake and discharge tunnels, will be less.

The turbines and their foundations will cost more for the high-pressure equipment. The switch house, switch

Figure No. 4.—View of the Edgar Station at the Present Time.

gear and wiring, and auxiliary equipment, should cost about the same. In the boiler plant the pressure parts will cost more while those parts which are not subjected to pressure will cost less.

This, in general, is the picture. The summary of these costs shows that the cost per unit of station capacity is about the same for a 1,200-pound as for a 350-pound plant.

Description of the Station

Taking all of these factors into consideration, the construction of a first-class 350-pound station consisting of two 32-000-kw. turbine-generator units and three 425-pound boilers was undertaken.

Figure No. 4 shows the Edgar station as it stands today, and figure No. 5 a plan of the first section showing the two 32,000-kw. turbine-generator units, the three 425-pound boilers and the high-pressure installation, while a cross-section of the station is shown in figure No. 6.

Outside of the question of pressure, this design of boiler plant is particular to the stations of The Edison Electric Illuminating Company of Boston. By placing the stokers in the outside aisles the major work of the boiler room oper-

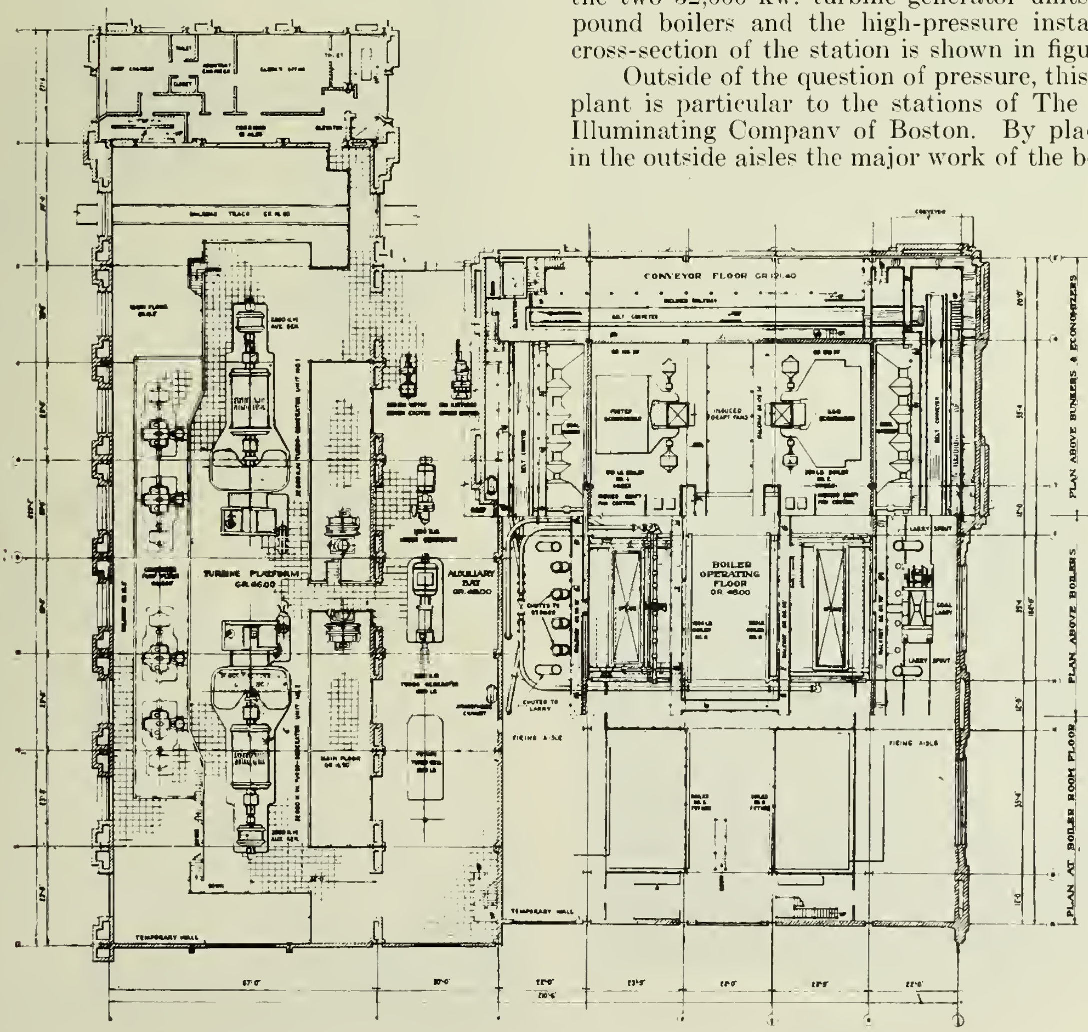

Figure No. 5.—General Plan of the Weymouth Power Station.

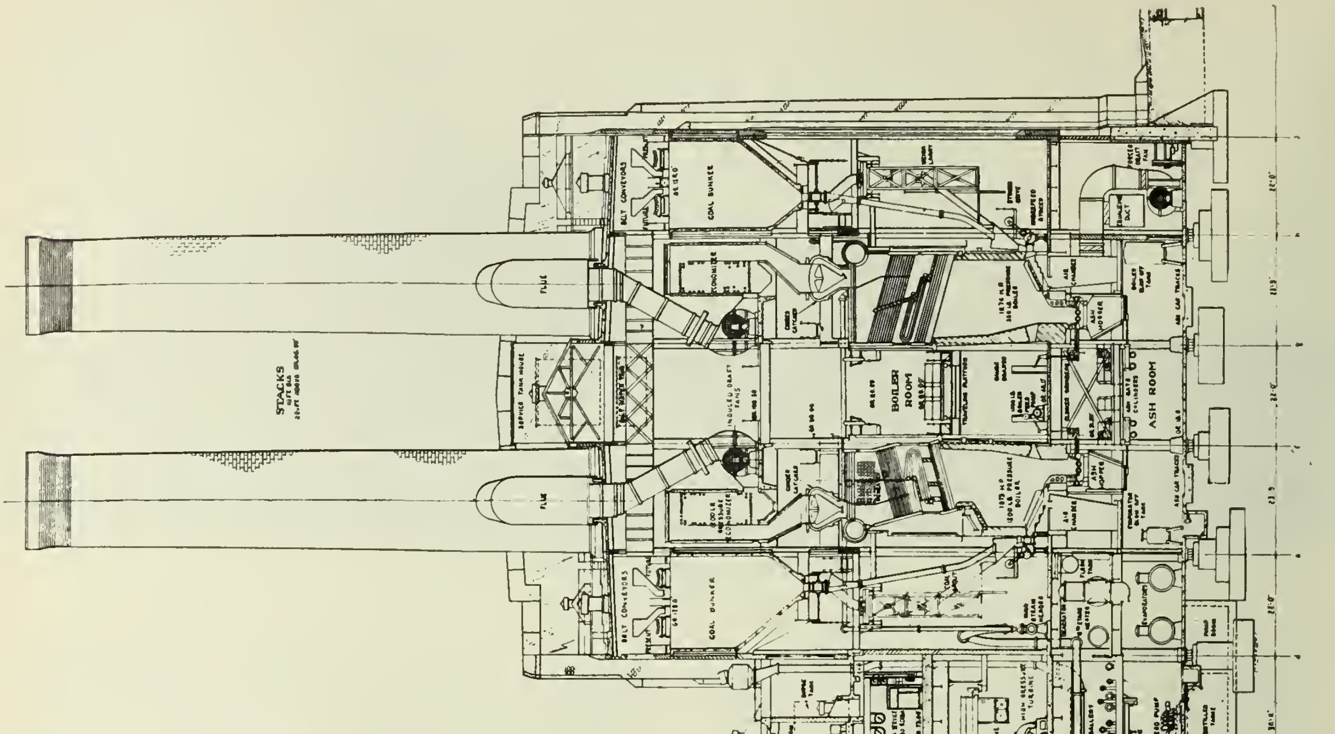
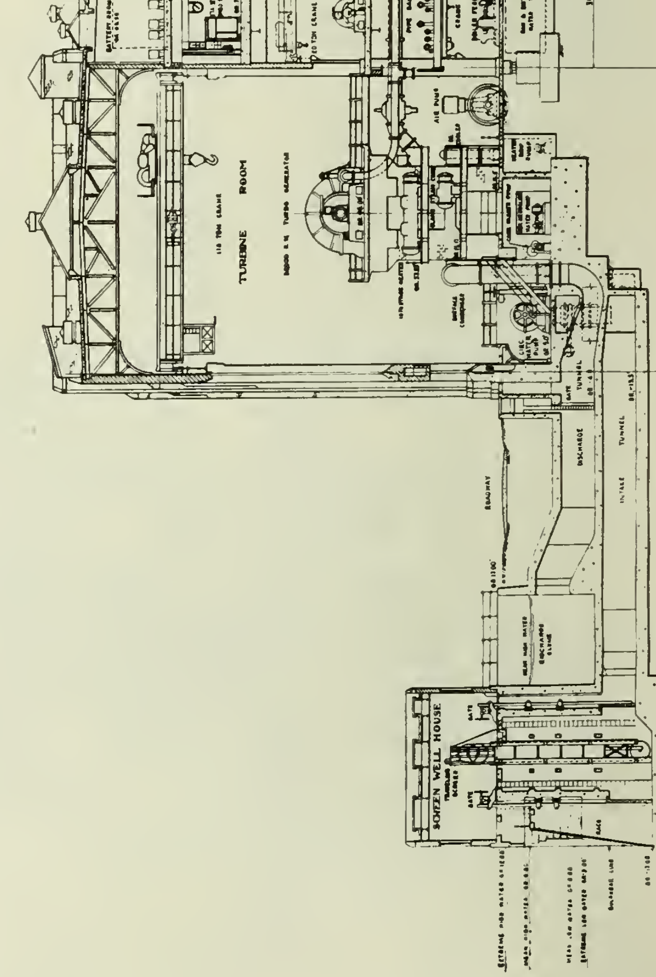

Figure No. 6.—Cross-section of the Weymouth Power Station.

ators is confined to one central aisle. In this aisle are located the instruments for controlling the operation of the boilers and the boiler room operator can supervise the operation of the boilers with the minimum amount of moving around. He can keep in touch with what is going on much better than if the controls were located in several aisles.

The two outside aisles are closed off from the central aisle so that the operating aisle can be kept clean. The roof over the operating aisle is of glass so that the men work in a sunlit, cheerful room instead of the dark aisles so often found in large boiler plants. Plenty of daylight does much to improve the morale of the boiler room operators and makes them better operators.

Figure No. 7 is a cross-section of the first 1,200-pound boiler. It contains 15,732 square feet of water evaporating surface. The tubes are 2-inch O.D., No. 5 B.W.G., and are 15 feet long.

As will be noted, the 1,200-pound superheater is located interdeck above the seventh row of tubes and the 375-pound reheater for the exhaust of the high-pressure turbine is located above the tubes in the first pass. There is a movable baffle in the gas path through the reheater that allows the outlet steam temperature to be regulated. So far it has not been found necessary to use this feature.

The furnace under the boiler is fired by a 15-retort, 29-tuyere underfeed stoker. Due to the short boiler tubes it was necessary to use an arch over the front of the stoker to get in a stoker of sufficient length. Unfortunately, an inclined arch at a wrong angle was installed. The reflection from this arch overheats the rear wall unless it is operated with higher excess air than desirable. It is believed that if the arch was horizontal there would not be this trouble.

The boiler drum was made from a solid forging. It is 48 inches inside diameter, 4½ inches thick, and weighs 96,000 pounds. If it were not for the cost, that is how we would like to have all boiler drums made irrespective of pressure. It would materially reduce the explosion hazard.

Operating Features

This was the first commercial 1,200-pound boiler ever built and many possible troubles were visualized. As it turned out, practically every trouble that was looked for failed to materialize.

No one had had any experience with safety valves at this high pressure and it was feared that when the safety valves operated they might destroy their seats. To guard

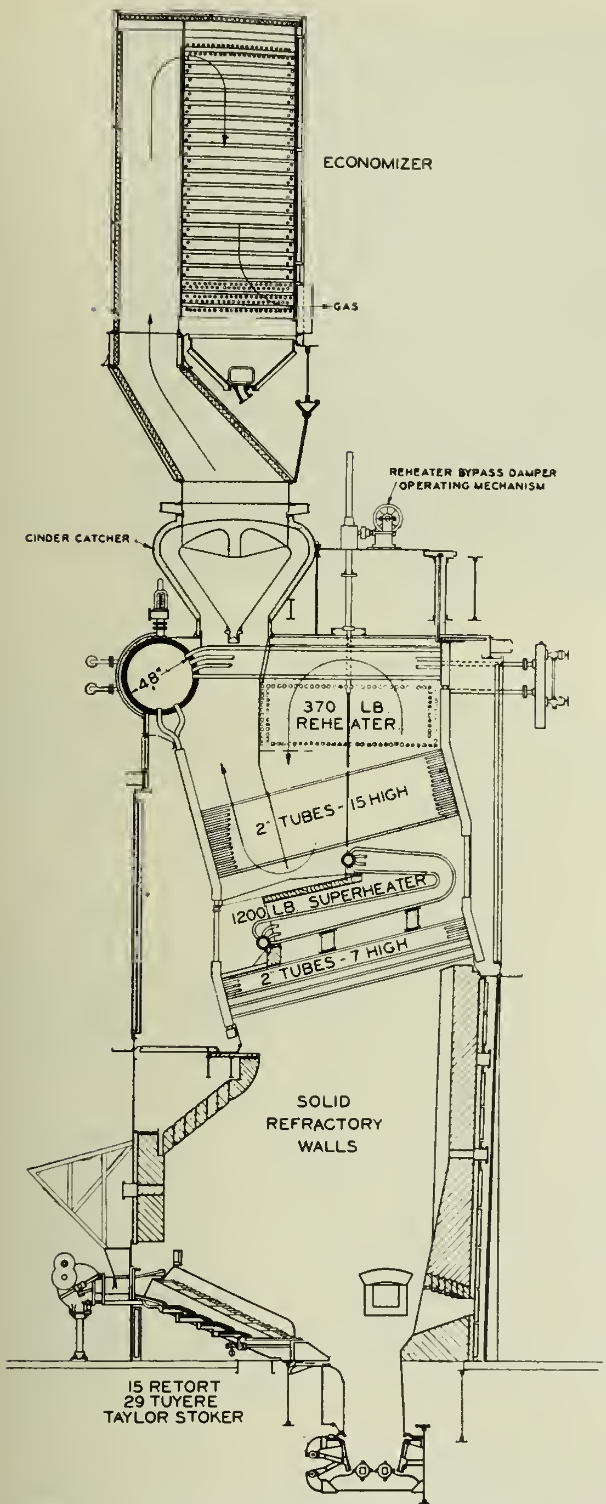

Figure No. 7.—Cross-section of 15,732 square feet, 1,200-pound Boiler, Edgar Station.

against this two small safety valves with shut-off valves between them and the boiler were installed. These valves were set at a pressure below the setting of the main valves. It was thought that these would give warning of the pressure approaching the blowing pressure of the main valves and steps could then be taken to reduce the pressure and prevent the main valves from lifting. It was actually found out that the main valves operate just as satisfactorily as normal pressure safety valves and do not destroy the seats, and it has been possible, therefore, to dispense with the small valves and operate the boiler nearer the pressure setting of the main valves.

A lot of trouble has been experienced with steel castings, in the past, at 200 and 300 pounds. To be sure of sound castings for the 1,200 pounds pressure all castings were examined by means of an X-ray. Some porous ones were found and rejected. As a result there was no trouble with steel castings operating at 1,200 pounds. Some trouble was experienced with the castings for the 350-pound part of the station which were not examined by X-ray.

It was not known how the water level in the 1,200-pound drum would act. No one had manufactured feed water regulators for this pressure so it was arranged for hand control of the feed water. It was found that the water level in the 1,200-pound drum is just as steady as in the 425-pound boilers. The 1,200-pound boiler has been equipped with feed water regulators and they are now operating satisfactorily.

The only thing that has happened to the 1,200-pound boiler, out of the ordinary, is the warping of the boiler tubes exposed to the radiant heat of the furnace. Many of these tubes have warped but some in one direction and some in another. They did not fail and now the warping seems to have stopped.

Another trouble that was experienced is the slagging over of the lower row of tubes. This, it is believed, is due to too close spacing of the tubes exposed to the furnace and to stoker and furnace operation.

Figure No. 8 shows the 3,150-kw., 1,200-pound turbine installed in connection with the boiler just described. It is a 20-stage, 3,600-r.p.m., General Electric Company turbine.

When this turbine was designed it was not known whether its governing characteristics would be such that it could be synchronized easily. Therefore, the generator field was designed so that the turbine could be brought up to somewhere near synchronous speed and the generator put on the bus as induction generator.

When the turbine was finally installed it was found that it responded to its governor just as well as any normal pressure turbine but the special field was the cause of some vibration. The manufacturer therefore replaced the special field with one of standard design and the vibration troubles were cured.

Carbon shaft packing was originally installed outside the labyrinth packing. This packing failed before the machine was placed in commercial operation and was re-

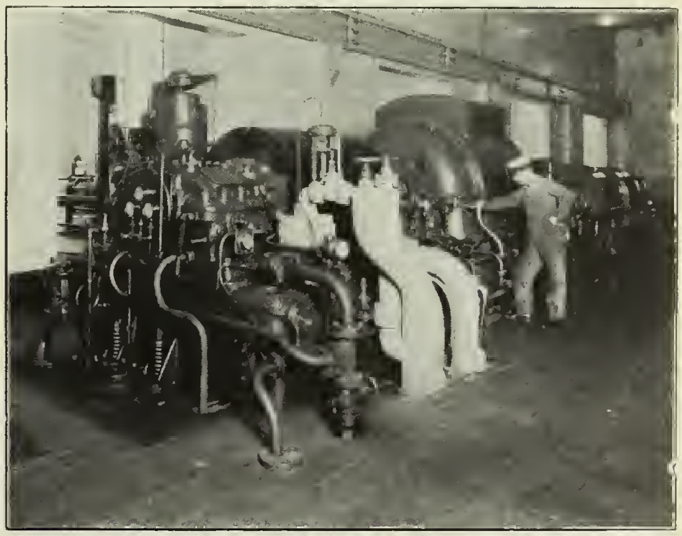

Figure No. 8.—3,150-kw., 1,200-pound Turbine Generator Unit at Edgar Station.

placed with labyrinth packing and no further trouble has been experienced. The thrust bearing was found to be too small and was replaced with a larger one, and has since operated satisfactorily.

The radial diaphragm packing was damaged when the carbon packing failed and has been replaced with axial packing.

Inspection After Operation

In May, 1926, after 1,600 hours of service, the turbine was opened up for inspection. In general the interior of the turbine was as might be expected of a normal pressure turbine with the following interesting exceptions.

The first two rows and the last two rows of buckets on the rotor were bent in as if they had come in contact with some hard object. The nozzles were not injured nor were the other sixteen rows of buckets. So far no satisfactory explanation of this trouble has been advanced. The buckets were trued up and the turbine has operated satisfactorily ever since.

Another thing that was discovered when the turbine was opened up was the fact that the whole interior of the casing and the buckets were covered with a light deposit of iron oxide. This deposit was also found in the valves, fittings, and all the boilers in the station, both normal pressure and high pressure. In certain spots this deposit was built up in little mounds and when these were removed evidence of the start of pitting was discovered.

A motor-driven pump and a turbine-driven pump were installed for boosting the feed water pressure from 450 to 1,350 pounds. These pumps have operated satisfactorily except for some trouble with the hydraulic thrust balancing surfaces of the motor-driven pump.

Taking the plant as a whole, none of the troubles that have been experienced have been due to the pressure.

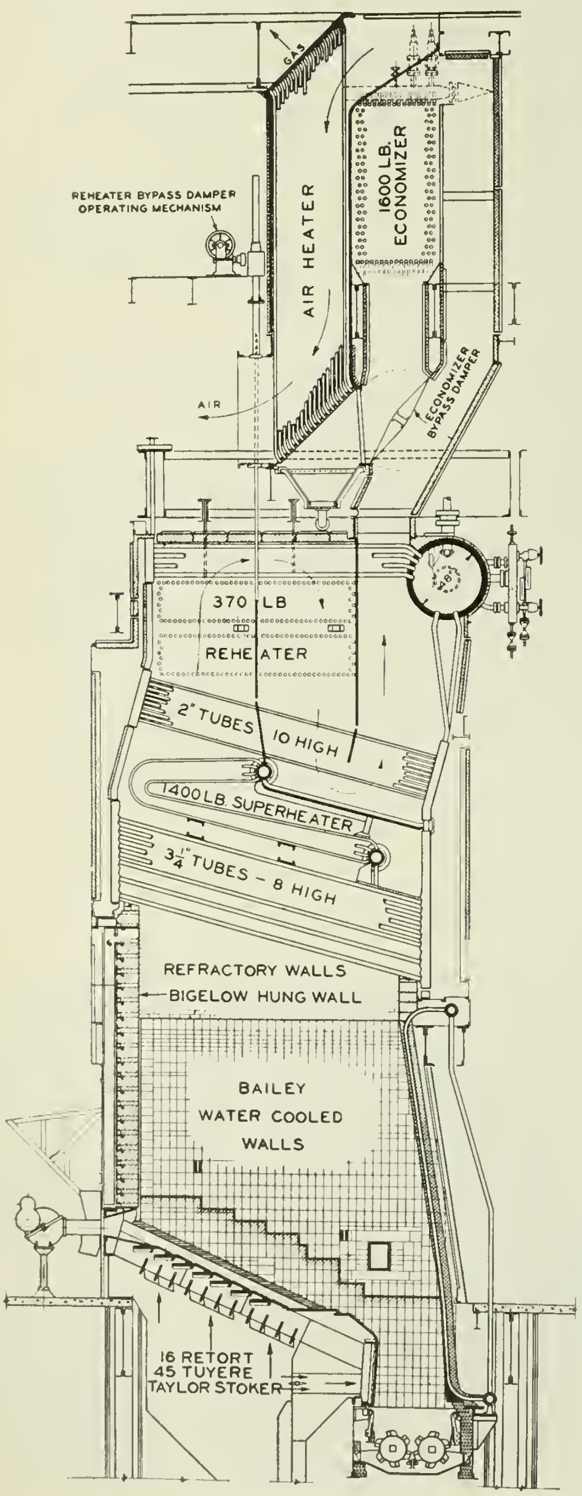

Figure No. 9.—Cross-section of 15,093 square feet, 1,400-pound Boiler, Edgar Station Extension.

Extension to Edgar Station in 1926

In 1926 it became necessary to start an extension to the Edgar station. In the light of our experience with high-pressure equipment an exhaustive study was made to determine the proper pressure for the extension. Three schemes were studied, as follows:

(1) All 350-pound.
(2) All 1,200-pound.
(3) One-half 1,200-pound and one-half 350-pound.

This study showed that the second scheme, all 1,200-pound, would give the lowest cost per kilowatt hour on the station bus when all things are considered. It appears at this time that all boilers in the extension of this station will be built for a maximum working pressure of 1,400 pounds per square inch.

It was also considered going to a steam temperature of 900°F. The turbine manufacturers assured us that they could build a turbine for any temperature steam which could be delivered to the throttle. The problem of handling steam at higher temperatures in the turbine, however, is far simpler than the problem of designing superheaters to deliver the steam. The superheater tubes must be at some temperature above the temperature of the exit steam and "there's the rub." With first pass gases on one side and very hot steam on the other, the superheater tube is subjected to very severe service. However, the investigations of the characteristics of metals at elevated temperatures are bound to produce in time a metal or alloy which will be suitable for the service and salable at a price that will make it economically justified. The superheater manufacturers are ready to supply superheaters designed for a temperature of 900°F., but they are frank in saying that some operating troubles must be expected, the seriousness of which they cannot definitely predict.

The valve and fitting manufacturers have given assurance that they can safely handle steam at 1,000°F. Station designers in the United States, however, seem to feel that 750°F. is about the limit at this time. They feel that those who have gone beyond this limit have not given due consideration to the characteristics of the materials being used when maintained at the high temperatures over long periods.

When it came to the purchase of the two boilers for

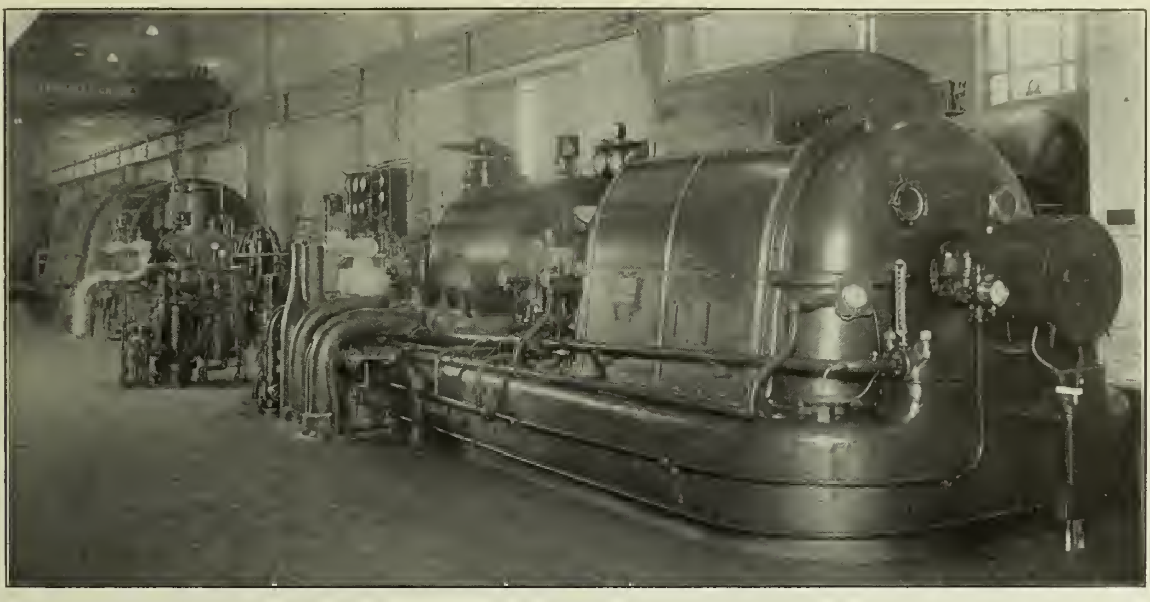

Figure No. 10.—General View of 1,200-pound Turbine Generator Units at the Edgar Station.

the extension to the station it was found that the thickest steel plate that could be forged into headers by the Babcock and Wilcox Company would give a safe working pressure of 1,400 pounds per square inch. As this additional pressure could be obtained at very little increase in cost, the new boilers were designed and built for this pressure. Figure No. 9 shows a cross-section of the new 1,400-pound boilers.

As mentioned previously, the first high-pressure boiler was built with 2-inch tubes throughout. It was found that the tubes were spaced too closely and resulted in slag bridging across between the tubes next to the furnace. The new boilers have eight rows of 3¼-inch tubes in the lower bank and they are spaced 8¼ inches centre line to centre line, giving a space of 5 inches between tubes. No trouble with slag has been experienced with these boilers. The upper bank of tubes is made up of 2-inch tubes and is ten tubes in depth. It was also found possible to use 19-foot 3¼-inch tubes, and 18-foot 2-inch tubes instead of the 15-foot tubes used in the first boiler. The new boilers each contain 15,093 square feet of water evaporating surface. The superheaters are located the same as in the first boiler but are designed for higher outlet steam temperature. The 1,200-pound superheater is designed for an outlet temperature of 725°F., and the 375-pound reheater is designed for an outlet steam temperature of 750°F.

A 5,596-square foot economizer and a 32,032-square foot air heater have been installed in connection with each of the new boilers. The air heater is designed to give an air temperature of 400°F., but the stoker is designed for a maximum air temperature of 600°F. A by-pass for the economizer has been installed so that the performance of the stoker with air temperatures in excess of 400°F. can be studied.

The first high-pressure boiler was fired by a 15-retort, 29-tuyere Taylor underfeed stoker and has a continuous capacity of approximately 121,000 pounds of steam per hour. The new boilers are fired by 16-retort, 45-tuyere Taylor stokers and are designed to generate 270,000 pounds of steam per hour continuously. These stokers are the largest underfeed stokers in service today.

Some trouble has been experienced with the refractories in the furnace of the first high-pressure boiler and

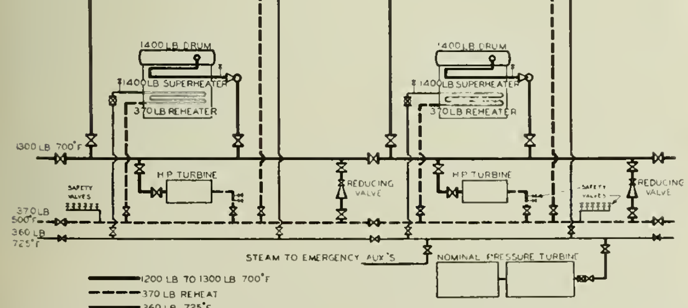

Figure No. 11.—Piping Arrangement at Edgar Station Extension.

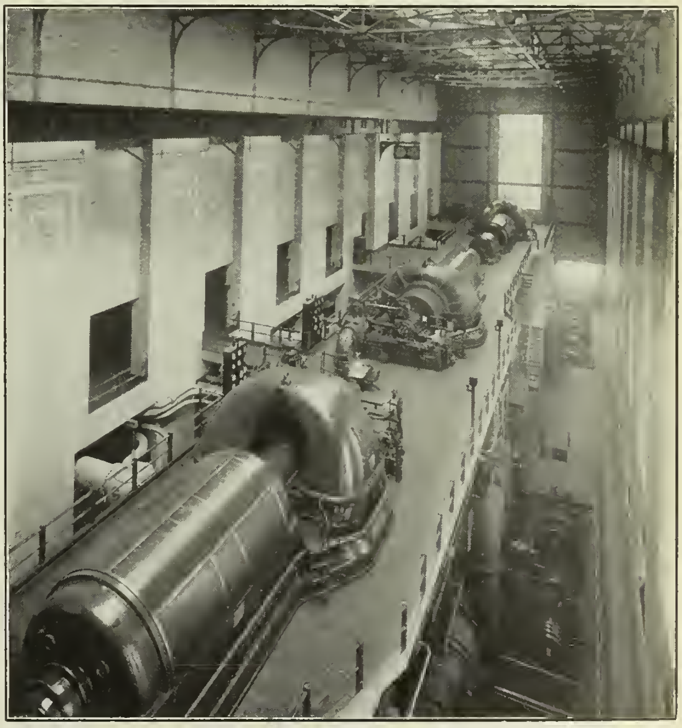

Figure No. 12.—350-pound Turbine Room at Edgar Station.

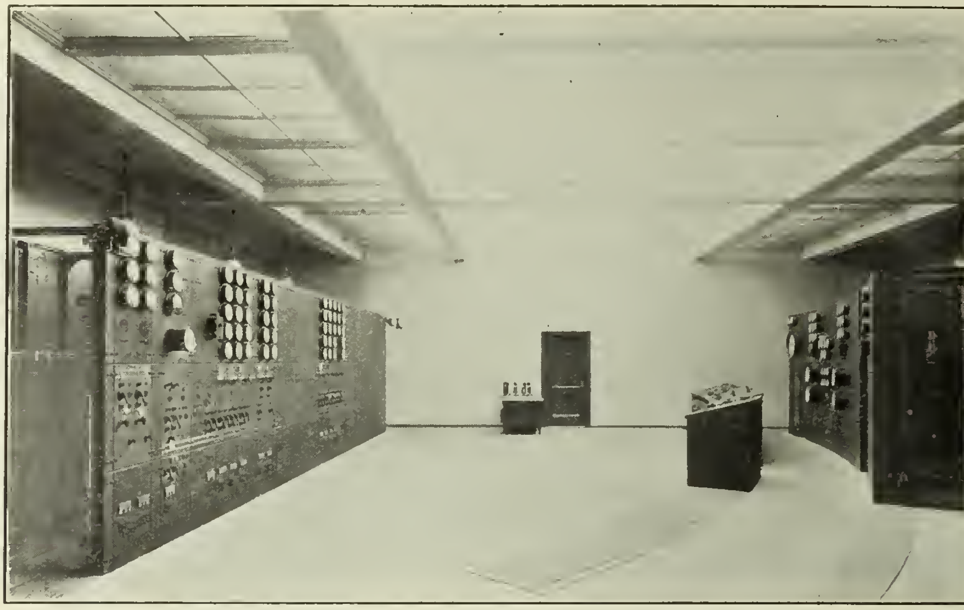

Figure No. 13.—View of Operating Room at Edgar Station.

this has necessitated operation with higher excess air than desirable. With the use of preheated air and such high heat liberation per cubic foot of furnace volume, the problem of a satisfactory refractory furnace seems hopeless and so the new furnaces are provided with water-cooled refractory-faced Bailey water walls on the side and rear walls. The front walls are Bigelow hung walls ventilated in the rear.

From this it will be seen that the problem of lowering the cost of construction by building the furnaces and fuel burning equipment to operate the boilers at higher capacities is being actively attacked. It is believed that in this way the cost of the station per unit of generating capacity is going to be materially reduced.

Equipment of Extension

In the extension to the station a 10,000-kw., 1,200-pound and a 65,000-kw., 350-pound General Electric Company turbine-generator unit has been installed. Both of these units are of special interest. The 10,000-kw., high-pressure unit is the largest 1,200-pound unit in the world and the 65,000-kw., 350-pound unit is the largest single-barrel single-flow 1,800-r.p.m. unit in the world.

The new 10,000-kw. unit is in the background in figure No. 10. As can be seen, it is not much larger than the 3,150-kw. unit which appears in the foreground.

The casing of the new turbine is of forged steel, while the casing of the first turbine was of cast steel. The new turbine has sixteen stages instead of twenty and will have a 4 per cent better water rate than the first one. It is equipped with water-sealed glands outside the labyrinth packings on both the high-pressure and exhaust ends of the shaft.

The governing of this high-pressure turbine presented a problem which was much more difficult than when there was only one boiler and one turbine. The design adopted after careful study is as follows. The turbine will be brought up to speed and synchronized by means of a speed-actuated governor of standard design. After the turbine is on the line a pressure-actuated governor will be put into operation and the speed-actuated governor set for some speed above 3,600-r.p.m., where it will act as an emergency governor. The pressure-actuated governor will control the load on the high-pressure turbine so as to maintain a constant pressure in the 360-pound 725° header supplying steam to the 350-pound turbines.

The problem of piping up several high-pressure boilers and their reheaters in parallel is considerably more complicated than the piping of a single boiler and turbine. Figure No. 11 shows how the new boilers and high pressure turbine have been piped up.

As will be seen, a reducing nozzle is provided between the 1,200-pound header and the reheat header. If the high pressure turbine is out of service the steam can be expanded through this nozzle and the boiler kept on the line.

This system of piping is rather expensive and it is hoped that in the future extensions it can be materially simplified and the cost of construction thereby reduced.

For all of the high-pressure pipe joints the welded Van Stone joint known as the "Sargol" joint has been used. There has not been any trouble experienced with any of these.

The problem of pumping sufficient boiler feed water for a load of 85,000-kw. to a maximum pressure of 1,600 pounds per square inch is a pumping problem such as has never before been encountered in steam-electric generating station design. To accomplish this, three boiler feed pumping units of very interesting design have been installed. Two are motor-driven and will be used for normal operation. The third is turbine-driven and will be used for emergency service. Each unit has a capacity of 900,000 pounds per hour.

Each of the motor-driven units consists of four pumps in series. The first two pumps of each unit are piped in series and are driven by a 625-h.p. motor. The second pump of this unit delivers water at a maximum pressure of 500 pounds per square inch and pumps through the high-pressure bleeder heaters to the suction of the third pump. The third and fourth pumps are piped in series and are driven by a 2,030-h.p. motor.

The motors are all 1,800-r.p.m., 2,300-volt, wound rotor induction motors and their speed is automatically regulated. The 625-h.p. motors are regulated to maintain a constant discharge pressure. The 2,030-h.p. motors are regulated to maintain a constant differential between the discharge pressure and the pressure in one of the boiler drums.

The turbine-driven boiler feed pump is designed for a maximum speed of 3,570-r.p.m., and pumps the water from

Figure No. 14.—Aeroplane View of Proposed Completed Edgar Station at Weymouth, Mass.

approximately 50 to 1,600 pounds in one casing. The turbine is differentially controlled and is also arranged for automatic starting when the pressure in the 1,600-pound boiler feed headers drops below a set pressure. The turbine is rated at 2,450-h.p. This boiler feed pump is the largest one in the world by far from the standpoint of the power required to drive it.

It is hoped that the boiler feed pumps can be materially simplified in the extensions to the station. The limiting factor so far appears to be in the motor. None of the manufacturers to date have manufactured a 3,600-r.p.m. wound rotor induction motor of the size required.

A study of the heat balance of the extension showed that it was economical not only to bleed the 350-pound turbine at three points but also to bleed the exhaust of the high-pressure turbine for heating the feed water. This means that steam at approximately 370 pounds will be used for heating the feed water. The heater is designed so that water at approximately 420° will be fed to the economizers. So far as the writer knows, this is the highest steam pressure used for this purpose.

No doubt some will wonder why the 1,200-pound steam is not used in a live steam reheater to reheat the steam from the exhaust of the high-pressure turbine. The reason for this is that the saturation temperature at 1,200 pounds is about 570°F. If a live steam reheater was used and the 350-pound steam delivered to the normal-pressure turbines at 570°F. there would be lost in economy practically all that is gained by going from 350 to 1,200 pounds. There is a real possibility, however, that a live steam reheater and a tandem compound 350-pound turbine can be used to advantage in extensions to the station. This possibility will be studied when the next 350-pound turbine is installed.

Figure No. 12 shows the three 350-pound turbine-generator units in the main turbine room. The two 32,000-kw. units are in the foreground and the 65,000-kw. unit in the background. The space advantage of the larger unit can easily be seen.

Figure No. 13, made from an architect's picture, shows the general arrangement of the ultimate station on the property. It also shows the location of the station in reference to the coal field and the outgoing 110,000-volt lines. The 14,000-volt and 25,000-volt lines go out underground and under the river through a tunnel.

In reference to the growth of the use of 1,200-pound pressure in the United States, it might be interesting to know that there are now in service 79,362 square feet of boiler surface operating at 1,200 pounds or higher. There is also in service 20,150-kw. of turbine-generator capacity for this pressure. In addition to this, there is 17,000-kw. of turbine-generator capacity on order and no doubt boilers for these units are also on order.

In building a high-pressure steam-electric generating station the question of design is of paramount importance. If the design is correct a high-pressure station will operate just as satisfactorily as a low-pressure station and it will be just as flexible, and will pay a handsome dividend on the money and effort expended. On the other hand, a poorly designed high-pressure station may be very uneconomical and the cause of many operating difficulties. Each project should be carefully studied and the decision made on the merits of the particular case.

The most important facts brought out by the present high-pressure installations in the United States are that in a properly designed station the high pressure does not decrease flexibility or incur any serious operating difficulties; furthermore, that a high-pressure plant of the proper design need not cost any more per unit of generating capacity than a low-pressure plant and will actually show a substantial improvement in thermal efficiency.

The first experience of The Edison Electric Illuminating Company of Boston with high-pressure steam was at the L street station in South Boston. In 1921 the operating pressure of a part of that station was raised to 300 pounds. It took as much courage to go from 200 to 300 pounds as it did to go from 350 to 1,200 pounds. All kinds of troubles were visualized but no troubles due to the pressure were experienced.

Stress has been laid on the economics of the various things that have been done which are different. This has been done purposely in order to emphasize the fact that we are not interested in thermal efficiency that lowers our dollar efficiency. Some one has jokingly said that designing engineers today are getting to be " financial engineers." There is more truth to that statement than the joker probably realized.

Forest Conservation in British Columbia

A Résumé of the Work being carried on by the British Columbia Forest Service

P. Z. Caverhill,
Chief Forester, Forest Branch, Department of Lands of British Columbia.

Paper presented at the Western General Professional Meeting, of The Engineering Institute of Canada, at Vancouver, B.C., June 7th to 9th, 1928

In a province such as British Columbia, with its wide areas and diversified topography, where even preliminary surveys are far from complete, and where topographic, geological, soil, and climatic surveying is yet in its infancy, an accurate statement of the forest resources is impossible. The forest resources of British Columbia not only include those bodies of mature timber now ready for the axe and the saw of the logger, but also the young growth and the qualities of site, soil, and climate which will repeat time and time again the mature forest crop, and which determine whether our annual increment shall be five or two hundred cubic feet per acre per year; and our topography, transportation, and markets, which determine how much of that crop can be used to serve a human need and how much will return a dollar for each one spent thereon. Conservation is the making legitimate use of our natural resources. It is not the spending of $1.25 in the recovery of a product that will command only $1.00 on the market.

A decade ago the Commission of Conservation of Canada made an exhaustive study of the data then available, and published a comprehensive report, "The Forests of British Columbia." This is still the most authoritative general information on the subject.

The Forest Service, in co-operation with timberland owners, licensees, and timber cruisers, is now engaged in compiling a similar estimate based on the information secured during the past decade. This will not only record the stands ready to cut, but the area and age-classes of reproduction, and from the information secured a rough forecast can be made of areas which will be available to cut when the mature timber is exhausted.

The report of the Commission of Conservation gives an estimate of 350 billion feet as the saw-milling timber in the province, and states there is 100,000 square miles of fire-swept areas in various stages of regeneration which, if protected from fire, will be able to produce 6 to 7 billion feet per year.

Present investigations have gone far enough to show

Figure No. 1.—Typical Scene of a Forest Fire.

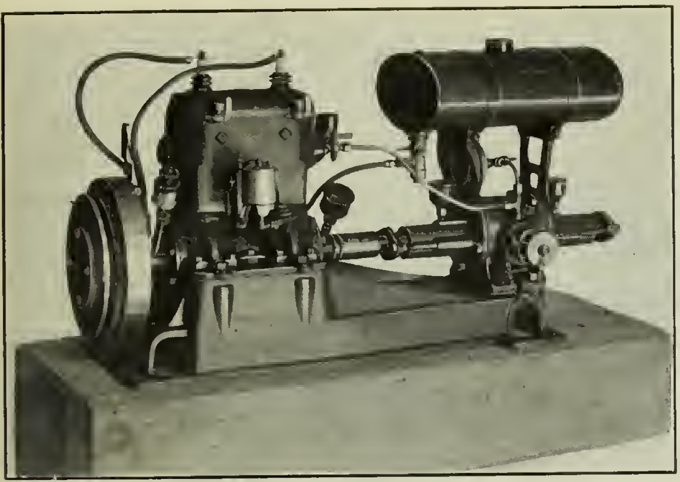

Figure No. 2.—One Type of Portable Gasoline Pump Used in Forest Fire Control.

that in some areas this estimate is excessive and in others very low. On considerable areas young stands forty, sixty, eighty years of age exist, which will produce merchantable material in forty to sixty years. The work has not yet proceeded far enough to state how the total will check with that report.

Forest Protection

H. S. Reynolds, of the Massachusetts Forestry Association, aptly says: "What will it profit us to know how to grow timber if it is to be destroyed by fire?" The forest-fire phase of conservation work was early recognized by the British Columbia Forest Service. It received the earliest attention of the Service and has always occupied a premier place in the working programme. The area now under patrol is approximately 125,000,000 acres in extent, or about 60 per cent of the area of the province, one-half of the area being productive forest land or land capable of producing commercial stands. The expenditure for protection work averages about $600,000 per year, or about one cent per acre.

Forest fires are not new phenomenon on the Pacific coast. The forest-fire menace, however, has unquestionably increased since the advent of the white race, with its land clearing, its machine logging, and other industrial activities in the forest, and it is still increasing. The automobile has opened up a new world—"the forest"—to the city dweller, a world which he thoroughly enjoys, but as yet he does not appreciate the damage his neglected camp-fire, discarded cigarette, or dropped match may do.

The objective of the Forest Protection Division is to counteract this increasing hazard through educating the public and developing in them a forest conscience, and to control fire outbreaks with a minimum of loss and expense.

Forest-fire protection is not the simple problem of a decade or two ago, when a patrolman was sent out on horseback with a shovel and a bucket to patrol and control any forest-fire outbreaks. The saddle-horse and the shovel still have their place in the organization, but portable gasoline pumps with one or two lines of hose delivering water to heights of 250 feet; tank pumps filled with a mixture of water and "no-burno" for mopping up; motor cars; fast gasoline launches with radio equipment in order to speed up communication and transportation; the use of the hygro-thermograph and the forecasting of humidity as an element in fire control; the construction of the mountain lookout, the "eyes" of the Service; and special aeroplane patrols, are developments of the last decade. Some idea of the size of these operations can be gained from the following figures for the British Columbia Forest Service per year:

Distance covered by gasoline transportation	750,000 miles
Hose required for pumps	25 miles
Messages received and sent by radio	9,800
Fires handled (ten-year average)	1,688

In organizing for fire control it is necessary to foresee as far as possible emergencies and to plan in advance for sudden and disastrous outbreaks. In addition to the regular staff of rangers and assistant rangers, patrolmen, lookouts, and smoke-chasers, through co-operation the Service attempts to organize the countryside into a reserve. Honorary fire wardens to the number of 635 have been enrolled and have undertaken to take the first steps to control any outbreak in their vicinity. The man-power of the community is canvassed and assigned, in the organization plans, to their particular jobs,—foremen, strawbosses, shovel men, snag fellers, packers, pump operators, cooks, etc. Tool caches are established, and points where further supplies may be secured are recorded. It is often necessary to expand the organization in a locality from a few men to several hundreds or even thousands, with all machinery for their effective supervision, subsistence and work, and these organization plans are then invaluable.

Figure No. 3.—Second Growth Stand 100 Years Old at Vancouver Island, Now Ready to be Cut.

Figure No. 4.—Douglas Fir Reproduction Amid Debris of Old Logging.

"Does organized forest protection pay?" is a pertinent question and, at the same time, a difficult one to answer. The destruction which has occurred in spite of the best efforts of the Service is known, and it can only be conjectured what it would have been without effort. The chief forester of the United States Forest Service points out, however, that in the United States in 1926, 91,000 fires occurred, burning over 24,000,000 acres, that 63 per cent of the fires and 80 per cent of the area were in states having no organized forest protection. On an average, fire burned 16½ acres out of each thousand acres of forest land in those states having patrols, but 106 acres in the areas without patrol. In British Columbia the area burned out of each thousand acres of timber land was 10 acres in 1926 and 2 acres in 1927. In three years an average of 78 per cent of all fires were controlled under 10 acres and 85 per cent under $100 in damage.

The railways are subject to a natural operating hazard and, in British Columbia, are required to maintain a patrol along their rights-of-way. While the percentage of fires originating from railways remains relatively high, 13 to 17 per cent, the damage from these fires has been reduced to 2.26 per cent in 1926 and 0.93 per cent in 1927.

Again the closer organization for fire control by the British Columbia logging operators, following the disastrous losses in 1923, has brought about a marked reduction in industrial fires as shown by the following percentages:

Year	Fires due to Industry
1923	11.11 per cent.
1924	6.1 " "
1925	5.5 " "
1926	4.84 " "
1927	3.89 " "

In spite of the severe years of 1925 and 1926 this work showed direct results. The question can, therefore, be answered with an emphatic "Yes." Today, there is being spent for protection one cent per acre of productive area. It has been estimated that 3½ cents are required for adequate protection in the Douglas fir belt, and 4 to 8 cents in the mountainous sections of Idaho and Montana. In British Columbia the season is somewhat shorter, and there is little hazard on the north coast. The author believes that 2 cents per acre would, however, be a figure comparable with the above estimate for that area now under patrol. More lookouts, more patrolmen, and especially more roads and trails to permit getting to fires and starting control work while they are still small, are required.

Forest Reserves

It is obvious that if forest crops are to be produced, crops which require seventy-five to one hundred and fifty years to mature, the first step is to select the site and dedicate it to forest production. It is useless to spend money in securing regeneration on areas which will in five, ten or twenty-five years be pre-empted and cleared for cultivation, or used for some other purpose. The Forest Service is now engaged on an active programme of selecting and securing the dedication of Provincial Forests for the perpetual production of timber. These are the socalled "Forest Reserves." There have now been so dedicated eighteen Provincial Forests, totalling 6,500,000 acres, under the jurisdiction of the provincial government, and an additional 1,714,000 acres of national forests have been set aside in the Railway Belt. The programme calls for further dedication at the rate of 1,000,000 acres per year, and by 1950 it is hoped to have 25,000,000 acres so set aside, an area greater than the public forests of both Germany and France.

In selecting these areas an examination has to be made

Table No. 1

	Merchantable		Age Classes—Acres				Present Sustained Yield M.B.M.	Ultimate yield under crude forestry M.B.M.
	Area acres	Timber M.B.M.	80 and over	41 to 80	1 to 40	Not restocked		
Four Coast Forests (Hardwick, The Thurlows, Sonora, Redonda).	63,800	1,221,000	......	2,100	21,700	17,100	18,500	27,800
Four Okanagan Valley Forests	163,900	1,380,000	27,600	204,100	201,000	......	27,000	38,000
Babine	244,000	2,400,000	51,100	210,000	224,000	197,000	In process	of compilation
Nehalliston	101,000	1,070,000	......	61,400	32,700	30,000	In process	of compilation

to determine possible future use and to separate areas chiefly valuable for forest purposes from those capable of supporting agricultural development. A survey is then made of the existing and potential forest crop under the headings of Mature Timber and Young Growth in various age-classes. See Table No. 1.

With this information on record it is possible to determine how much and where the cut can be made without depleting the resource. A sale of 52,000 M. feet in the Little White Mountain Forest has just been completed. This sale not only provides for the re-establishment of a new crop, but it limits the cut not to exceed two million feet per year, the estimated annual growth of the forest at present. Thus, barring accidents, a permanent supply of logs for a local factory is provided, which in turn supplies boxes for the fruit industry of the valley, and the forest asset of the region is in no wise reduced. Insofar as it is possible, without confiscating private interests, all Forest Reserves or groups of Reserves will be brought under sustained yield. It may be well, here, to emphasize that the word "Reserve" does not infer a withdrawal of the timber from legitimate use, but rather an encouragement to use the area to the fullest extent for forest purposes. It is only by such use that it can be hoped to put forestry on a paying and permanent basis.

The Forest Reserve Development Fund, three per cent of the collections from stumpage and royalty, and equalling $65,000 to $70,000 a year, is available for the selection, surveying and development of the Provincial Forests.

Forest Research

This is an age of research. Through agricultural research the wheat belt has been extended hundreds of miles north; rust has been conquered; and many other changes in production brought about. The forest is an even more complex crop and its development is influenced by a multitude of factors. In Europe forest research has been going on for generations. In America, and especially on the Pacific coast, there are new species and rapidly changing environments due to the rugged topography. On every hand unanswered questions await the scientific investigator. It is known that abundant natural regeneration can be obtained in most cases, but not in all. Why? The number and quality of the seed-trees left in logging are of moment to the operator and the land-owner alike, but their interests are directly opposite. Before intelligent contracts can be drawn, providing for such seed-trees, it should be known how far successful seeding will take place, and whether or not a scrubby tree situated on a rocky knoll will make a successful parent for the future crop.

Professor Ralph S. Hosmer of Cornell University says: "It is not difficult to learn how to plant trees well. To bring to maturity a fully stocked forest of high-grade timber is not so easy. But if we are to realize the objective that we have set up as our National Forest Policy, to do just this becomes the duty of the forester. In undertaking it, he needs all the help he can get from specialists working in varied branches of science. Mother Nature uses many servants. The ways in which they do her bidding are secrets that are not easily found out." If our forest conditions are to be assisted or improved these secrets must be known.

The Forest Service is now engaged on the most pressing of our forest problems. For some years market extension work has been carried on, and closely allied to this is the work now going on in connection with the utilization of waste products. The objective of this undertaking is a more complete utilization of the present stands, since the more of the product that can be marketed at a profit, the nearer the goal where it will pay to grow a forest as a paying crop such as wheat or cotton.

More recently the Service has taken up some of the silvicultural problems, more especially those related to the securing of natural regeneration and seed-bed conditions which are responsible for success or failure in securing a crop without the heavy expense of planting. At Aleza lake a demonstration forest has been created where the theories evolved by our research men will be put into practice on a commercial scale.

Forest nurseries for the production of planting material are being developed, one for the coast and one at Aleza lake for the northern spruce areas. These will be small and experimental in nature for the present, but capable of being extended so that, if necessary, any blank spaces which may occur in the natural regeneration on our Provincial Forests can be planted. While forest fires are still taking a toll of 100,000 acres of young stands per year, planting is not only a precarious investment but the money can be spent to better advantage in solving the fire problem.

Figure No. 5.—Hemlock Reproduction Amid the Fire-seared Trunks of the Former Stand.

Figure No. 6.—The Modern Logging Engine.
This equipment not only yards the logs to the track but also loads them on to the railway cars.

The Service is now expending $15,000 to $20,000 per year on markets and waste products, and a like sum on silvicultural research It is the author's opinion that during the next decade money spent on well directed research will return a greater dividend than any other forest investment except fire protection.

Transportation

Transportation is probably the most important single factor in giving value to the forest crop. Dr. Schenck, a forester of international repute, says: "Conservative forestry is more a matter of transportation than of botany." In the intensively managed forests of central Europe, one mile of road for each 200 acres, one-half of which is hard-surfaced, is the objective. And often $1.00 to $1.50 per acre per year is spent on road construction and maintenance.

On the British Columbia coast Nature has provided, in the wonderful system of inlets and channels, the main arteries for transportation, but many of the side valleys and mountain forests are today absolutely closed areas. These areas must be opened up before conservative forestry can be practised or adequate protection given to what Nature provides.

The Public Works Department is today building a system of provincial roads, some of which will serve as arteries for future forest roads. Leading back from these the Forest Service is constructing bridle paths and trails which provide access for fire-crews, but which cannot be used for the transporting of forest material. The abandoned grades of our logging railways would, in many cases, form the basis of an excellent system of forest roads, but would need a certain amount of upkeep each year.

In closing, then, it should be emphasized that there are still, in British Columbia, large stands of mature timber and areas of young growth which will be of commercial size before the mature timber is cut. The quantity of timber that can be removed depends on markets, transportation, and engineering skill.

The policy of the Forest Service for forest conservation is:

(1) Increased forest protection until the losses in forest material, especially in young growth, are reduced to the minimum.

(2) Extension of forest surveys to determine the quantity of material now available; the age-classes, stocking, and annual growth of our young stands; and what areas are more suitable for forest production than for agriculture.

(3) The reservation of areas unsuited for farming but suitable for timber-growing, such reservation to take place at the rate of one million acres per year until some twenty-five million acres are selected and reserved.

(4) The encouragement of the opening up of our forest areas by the construction of roads and trails which will serve as a means of access in case of fire and assist in the transportation of forest material to market.

(5) The building up, through research, of scientific data for use in the administration of the Provincial Forests on the soundest and most economical lines.

(6) The development, as conditions warrant, of forest nurseries for the planting of blank areas in the Provincial Forests. Such planting at the present time will be limited and of an experimental nature, rather than on a commercial basis.

Discussion of Paper on the Lock Gates of the Welland Ship Canal by Frank E. Sterns, M.E.I.C.[1]

J. L. Weller, M.E.I.C.[2]

Mr. Weller remarked that the author had opened up the subject of single leaf versus mitering lock gates, and while this was now a dead issue as far as the Welland canal is concerned, it was important for other canals which might be built in the future; in his opinion the conclusions presented in the paper should not be broadcast without protest. Mr. Weller, after years of experience in handling wrecked mitering lock gates, endeavouring to improve them and to develop something more simple and reliable, was firmly of the opinion that the single leaf gate as originally designed for the Welland canal was the greatest advance in canal engineering that had been suggested in many years. The single leaf was as far ahead of the mitre type as the single span bascule or lift bridge was ahead of the double leaf, and no railway man would accept a double leaf where he could possibly use a single leaf span. The single leaf gate required no meticulous care in construction or fitting, as both ends rested positively on heavy wooden bearings against vertical checks in the lock walls. A single leaf gate might be destroyed by a heavy blow from a ship, but it could not be unseated like a mitre gate. Should an accident warp or twist a single gate even three or four feet out of its true plane, no delay need occur, as the gate could be closed and the water pressure would bring it to a true bearing. This method dare not be attempted with mitering gates; mitre-gate advocates lost sight of the fact that each leaf of their gates was really a complicated single leaf gate which had a precarious toe support, depending as it did upon the friendly resistance offered by its mate instead of a solid abutment, and the best of friends had been known to part. One leaf of Mr. Sterns' gates of much simpler construction would make a good single leaf gate for a lock about forty-five feet in width; one leaf of the Panama lock gates is not much smaller than the single leaf gate for the Welland canal. He presented this discussion in the hope that when other canals are built, single leaf gates would be given more consideration.

E. S. Mattice, M.E.I.C.[3]

Mr. Mattice, as the engineer responsible for the actual building of the steel gates, had been impressed with the great care taken in the preparation of the design and the accuracy of detail. Only two points in the design had seemed to him to involve unknown difficulties. The first of these, (probably caused by the special care taken to secure as much duplication as possible), was the making of all the horizontal girders a uniform depth back to back of angles. The girder angles were riveted at their ends to the continuous vertical ¾-inch angles at the quoin and mitre end post; and the sheathing plates, varying in thickness from 15/16-inch at the bottom to 7/16-inch at the top of the 82-foot girders, were riveted to the girder angles and butted against the toes of the ¾-inch vertical angles. A vertical continuous doubling plate was placed over the sheathing plates and the face of the angle, and passed under the return portion of the continuous end post plate. Sections at the top and bottom of the upstream face of an 82-foot gate for this construction were shown in figure No. 4. This assembly resulted in two series of shims being required to ensure tight rivets, one 3/16-inch thick throughout between the vertical angle and the doubling plate, and one, tapering from zero at the bottom to ¼-inch at the top, between the doubling plate and sheathing plates; an exceedingly difficult job to get together and make watertight.

Before beginning the work he had suggested to the author that all sheathing plates be kept flush outside with the end vertical angle, and that the depth of the girders be varied to enable this to be done. This assembly necessitated the crimping of the girder angles where the sheathing plates were less than ¾-inch thick, and the use of short shims at the girder ends where the sheathing plates were more, and gave good plain caulking edges.

In the final development of this assembly several girders were made of uniform depth and the difference made up by shim plates between the girder flanges and the sheathing plates.

The second point in the original design which he had questioned was the practicability of forging or pressing ¾-inch plates about 92 inches wide and 80 feet long, and weighing about ten tons each, to the form required, with the necessary degree of accuracy. The Hamilton Bridge Works Company, the sub-contractors for the fabrication of the steel work, were loath to undertake the work, and their chief engineer, Mr. Palmer, visited several of the largest steelworking plants in the United States in an effort to have it done. Only one firm would undertake to try the job and they would give no guarantee of tolerance, either for straightness or smoothness. It was, therefore, decided to try welding, with the result that end posts were being obtained which are to all intents and purposes an exact fit.

He believed that some notes on the Chicago boom used in erection might be of interest. This boom was designed for a length of 120 feet, (which was later increased to 130 feet), and was made of four 5 by 5 by 7/16-inch angles latticed 35 inches back to back through the middle lengths.

The heaviest piece in a gate was the mitre post, weighing 20 tons, which was erected near the centre line of the lock, while the quoin post, weighing 10 tons, was erected close to the far wall. The boom is, therefore, designed for a load of 20 tons on a 60-foot radius or 10 tons on an 85-foot radius. The impact was taken at 60 per cent, a wind load of 20 pounds per square foot was allowed for, and eccentric loading was carefully considered. The formula used was as follows:—

$$F = \frac{W}{A} + \frac{Wl^2}{8S_1} + \frac{PW}{P-W} \times \frac{D}{S_2}$$

where

F = Maximum fibre stress, (not to exceed 20,000 pounds per square inch).
W = Total axial load on boom.
A = Area of boom.
W = Resultant dead and wind load at right angles to axis of boom.
S_1 & S_2 = Section moduli at right angles to respective loads.
D = Deflection due to cross bending.
P = Critical load from Euler's formula.

The boom fall has seven parts of ¾-inch steel rope and the load fall eight parts.

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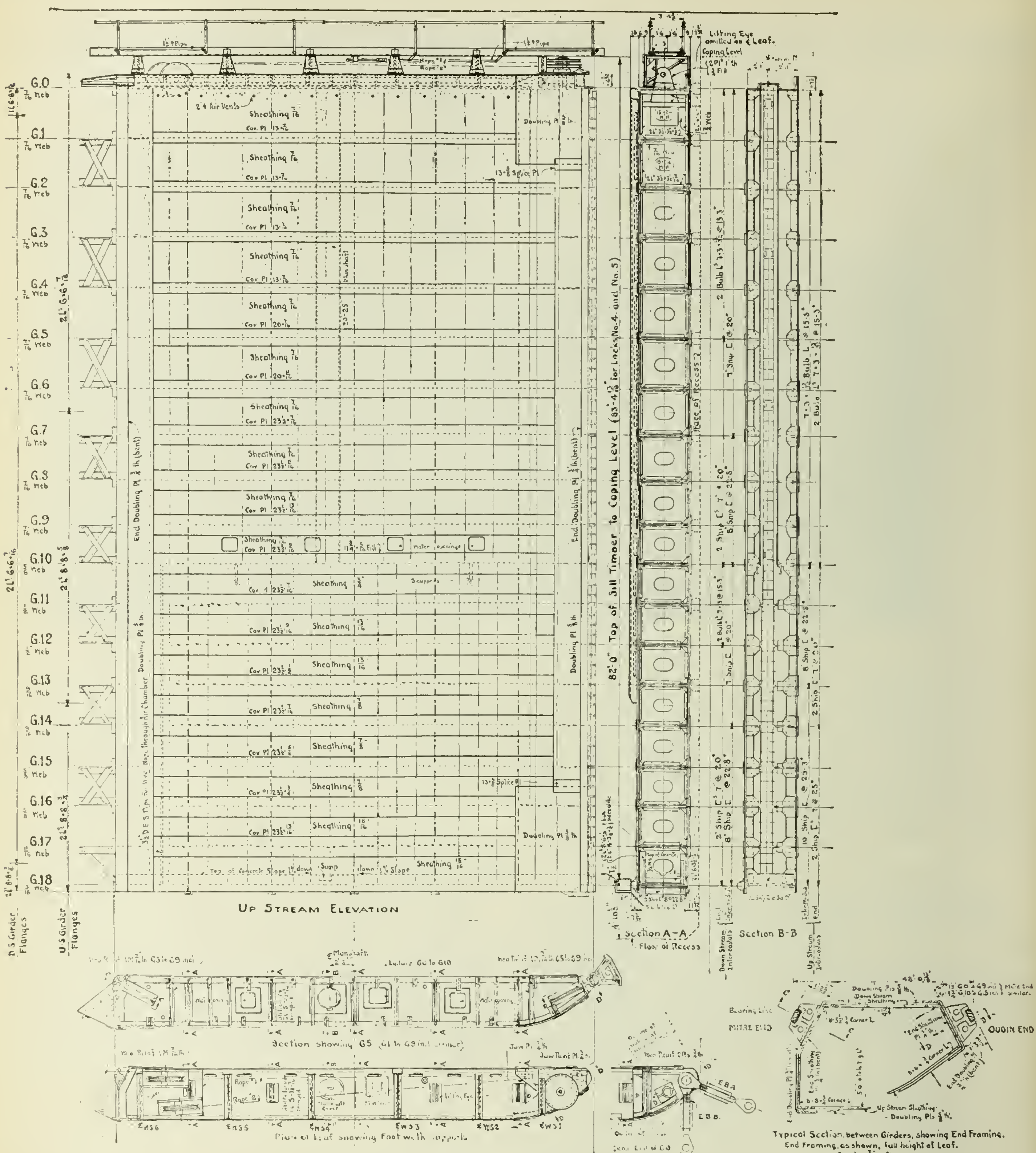
(1) This paper was presented at the Annual General Professional Meeting of The Engineering Institute of Canada, Montreal, February 15th, 1928, and published in The Engineering Journal, February 1928.

(2) Consulting Engineer, Hamilton, Ont.

(3) Manager and Chief Engineer, Steel Gates Company, Limited, Montreal.



(Figure No. 4 of original paper published in February 1928 Journal.)

Steel Gate Leaf 82 feet High.

D. W. McLachlan, M.E.I.C.[4]

Mr. McLachlan observed that the question of whether single or double leaf gates should be used for locks had been brought up by Mr. Weller, and desired to explain that the arch traitor in going back to the mitre gates from the single leaf gates had been himself.

In the early stages of the Welland ship canal, when its location was being considered, along with many features of its design, he had been engaged on the work with Mr. Alfred Noble, Mr. Bowden and Mr. Sterns in 1912, and the ques-

[4] Department of Railways and Canals, Ottawa.

tion of single leaf and mitering gates had been a subject of argument for a number of years during the different stages of the work.

One point about the single leaf gate had made it attractive to Mr. Bowden, the late chief engineer of the department. This feature was that such a gate could easily be swung to in case of accident. That is, in the event of a ship carrying away a gate so that the lockage was lost, a single leaf gate long enough to swing right across could simply be let free and would slam, and if it could be brought to rest at the free end slowly, the situation would be saved.

At the time single leaf gates were first adopted it was thought that this was quite practicable, but on looking into the details a serious objection was found; a lock gate swings around a circular quoin, and its axis of rotation is not in the centre of that circular quoin, but, in lock practice, is always put slightly to one side, so that the gate does not bring up against the circular support or quoin until it is in its closed position, when the quoin post makes a tight fit against the quoin. Thus in the case of a single leaf gate closing under a considerable head of water, there would be a tremendous leverage tending to make the gate roll out of its quoin, and break the yoke and pintle. For this reason Mr. McLachlan had advised Mr. Bowden and Mr. Grant to go back to the old mitering gate, and he was glad that they had done so.

Mr. Henry Goldmark.[5]

Mr. Goldmark begged to differ with the author of the paper as to one statement made by him on page six, in which he had stated that " gates are rarely, if ever, struck on their down-stream side." One of the most serious accidents on record occurred on the Canadian Soo lock in 1909, when a vessel approaching the lock from below struck the lower operating gate. This accident was described briefly in a paper by Mr. Goldmark read before the American Society of Civil Engineers, December 7th, 1927, which gave photographs showing the flow of water through the locks after the accident.

The author's description of the gates, the method of design, loads, stresses, and also the method of erection, was so complete that he had nothing to add in way of discussion. It was of interest to note, however, the great increase in the cost of these gates over the very similar ones erected in the locks of the Panama canal, which was completed in 1914. The bids for the Panama gates were opened in 1910, the price of the structural steel work being only 3.79 cents per pound of steel erected and painted. The Welland price for corresponding materials was 9 cents per pound.

He noted that the Welland gates were opened and closed by wire cables operated by an electrically driven winch. This form of operating machinery had been used less of late years than other kinds of mechanism, this statement applying to the United States and Europe. Even in 1908 he had been informed by the engineer in charge of the new locks at Avonmouth, near Bristol, England, that no English engineer would think of using rope-driven machinery for lock gates, and he much preferred mechanism which dispensed with ropes or chains.

Professor Peter Gillespie, m.e.i.c.[6]

Professor Gillespie remarked that for an engineer with a penchant for analytical mechanics, the design of the mitering lock gate afforded much opportunity for the exercise of his mathematical bent and for industry also. It was evident that the author had brought both in large measure to the solution of his problem. One was particularly struck with the ingenious way in which the changing lengths of the hauling cables for the lock gates had been determined, how this variation in length had been provided for by slight differences in the diameter of the winding drums and how minor residual differences had been taken care of by compensating springs. It was noted that the hauling ropes passed along the top of the leaf from the quoin to the mitre and down to the bottom along the mitre post. Presumably the designer had considered the comparative merits of this plan and the one in which the cables would pass down the leaf at the quoin, thence horizontally along the bottom of the leaf to the mitre.

(5) Consulting Engineer, New York, N. Y.

(6) Professor of Civil Engineering, University of Toronto, Toronto.

J. B. O. Saint-Laurent, a.m.e.i.c.[7]

Mr. Saint-Laurent asked what means were adopted to prevent the rapid wear of the ropes which are used to open up the gates. These ropes, he understood, passed round curved masonry at the bottom of the locks. Did they go over rollers or did they rub against the masonry?

R. A. Ross, D.Sc., m.e.i.c.[8]

Mr. Ross enquired as to the operation of the safety horns on the gates. When these horns were put together they appeared to resemble the Zip overshoes, fitting very closely together. How was such an accurate joint obtained?

W. J. Smither, m.e.i.c.[9]

Mr. Smither desired to ask the horse power required to move the gates, and the time required for their operation.

Frank E. Sterns, m.e.i.c.[10]

The author, in reply, believed that the point raised by Mr. Weller had been answered by Mr. McLachlan and by the statement as to the relative merits of the two types of gates given in the paper. With regard to Mr. Mattice's discussion, the use of girders of different thicknesses in order to make it easier to take care of shimming at the ends was a very practical detail, but he would have hesitated to put that on the plan in the first place, feeling sure that had this been done, the contractor, whoever he might be, would have wanted to have them all the same depth in order to facilitate construction.

With regard to the bent plates shown on the end posts, enquiries had been made, and assurances had been received that the proposed construction was feasible, but when the point of commercial manufacture was reached, it could not be managed.

With regard to the question by Professor Gillespie, it would be a difficult thing to have the ropes pass down the gate at the quoin, because on account of the gate moving from the open to the closed position the sheaves would move with it, and the ropes would not lead properly, or they would have to be mounted on swivels, which would bring in an objectionable detail. It would also mean that the ropes would be leading along the bottom of the gate under water, where they would be likely to be obstructed with sunken logs or any other debris in the locks. This would be a less reliable arrangement than the one adopted, whereby the ropes go along the top of the gate in the air.

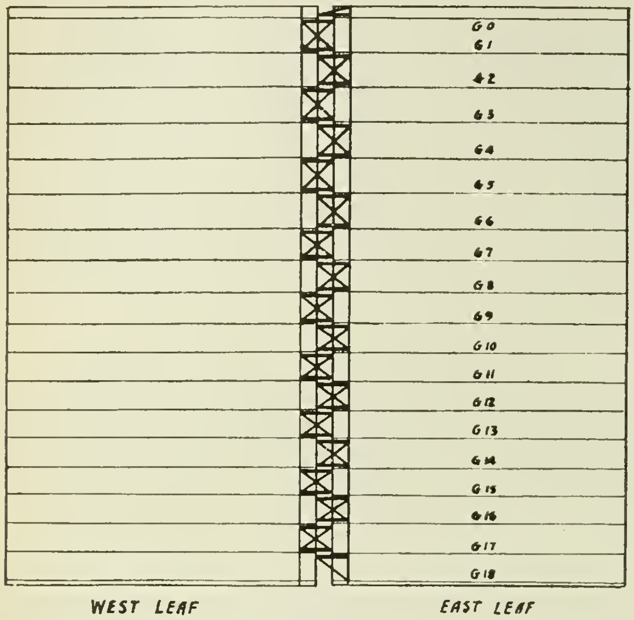
With regard to Mr. Saint-Laurent's question as to rubbing of the ropes against the circular wall, it should be noted that the ropes did not move on the wall, but simply lay against it. As the gate moved the sheave rolled along

(7) Superintendent of Lachine Canal, Department of Railways & Canals, Montreal.

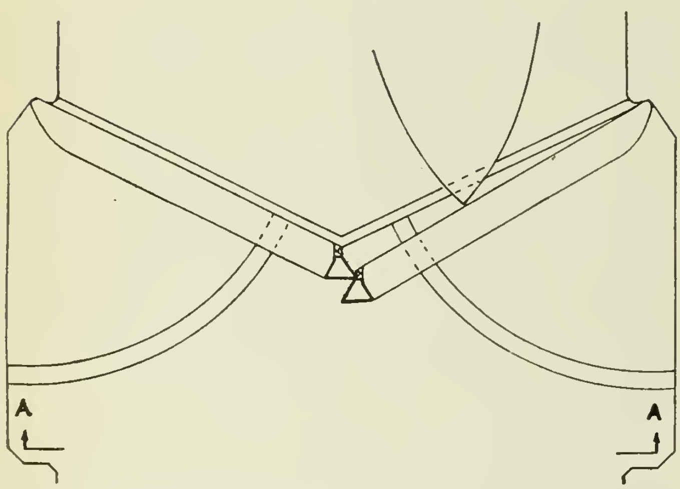
(8) Consulting Engineer, Montreal.

(9) Assistant Professor of Structural Engineering, University of Toronto, Toronto.

(10) Designing Engineer, Welland Ship Canal.



ELEVATION A-A



(*Figure No. 3 of original paper published in February 1928 Journal*)

Diagram Showing Arrangement and Action of Safety Horns.

the rope, and the rope went up through the gate behind the sheave. The rope was anchored near the end of the wall and pressed against the wall without moving along it, thus avoiding any wear at that point.

In answer to the question asked by Dr. Ross, the author believed that figure No. 3, showing two leaves in a displaced position, would be of assistance. Of course in that position there would be a great deal of leakage through between the bearing faces of the two gates, but that would not be the normal position. Ordinarily, when the leaves are closed, the smooth bearing faces of timber would bear against each other, and make a perfectly water-tight joint, and the castings would simply lie against each other in the triangular spaces left. Only when the gate was moved out of its mitered position would there be any leakage through between the leaves.

Referring to Mr. Smither's question about the horse power required and the time necessary to operate the gates, he might say that the time required to open or close a gate was approximately one and a half minutes. Under the worst conditions, against a high wind with both leaves moving together, fifty horse power was required for the 82-foot gates. For the lower gates, under average conditions, probably half that horse power would be used. However, all the operating machines were made the same and were able to deliver the maximum power.

Professor Peter Gillespie, m.e.i.c.

Professor Gillespie desired to refer again to the eccentricity of rotation of the quoin. He understood that the gates did not revolve about the centre of the quoin, in order that when a gate swung open the friction against the quoin would be relieved, that the eccentricity was about an inch and a half, and that the size of the pintle was sixteen inches. He did not quite see how the pressure would cause the leaf to unseat from a pintle 16 inches in diameter with an eccentricity so small as that.

Frank E. Sterns, m.e.i.c.

The author replied that with the eccentricity provided, the leaf while swinging was not supported on the masonry wall except at the top and the bottom, the support at the bottom being due to its sitting on a 16-inch hemisphere. When the leaf is nearly closed its quoin end comes in contact with the hollow quoin and, as a result of the eccentricity, the further movement of the leaf causes the pintle to slide slightly forward upon the base casting and transfers the horizontal component of its load to the hollow quoin.

Professor C. M. McKergow, m.e.i.c.[11]

Professor McKergow would like to ask what happened if a rope broke when the gate was being opened. Would the gate simply slam back?

Frank E. Sterns, m.e.i.c.

The author remarked that the gate could not slam unless it were moved by something, because the lower part of the gate was immersed 30 feet deep in the water, and great force would be required to move it. Unless the breaking of the rope were caused by the impact of a ship, probably the gate would stay where it was or drift very quietly one way or the other. As to the life of the ropes, they have not yet been in operation, so that no information was available. Where operating ropes were used in a slightly different way, however, they had been found to last about a year or a year and a half.

The statement in the paper, to which Mr. Goldmark had taken exception, that "these gates are rarely if ever struck upon their downstream side," referred to the lower gates of the present Welland canal and not to lock gates in general. The records showed that on the present Welland canal, forty-four accidents in which lock gates were carried away had occurred during the seventeen years 1911 to 1927 inclusive, of which not one had resulted from a lower gate being struck upon its downstream side. It was the fact, however, as Mr. Goldmark had pointed out, that the only accident at Sault Ste. Marie in which lock gates were carried away by a ship had resulted from the lower gate of the Canadian lock being struck upon its downstream side.

As regards the use of wire ropes for operating the gates, wire ropes had been used for many years in the locks at Sault Ste. Marie and had given such satisfaction that they were adopted in the new third and fourth locks of the American canal.

(11) Professor of Mechanical Engineering, McGill University, Montreal.

Discussion of Paper on the Uniflow Steam Engine by E. A. Allcut, M.E.I.C.[1]

PROFESSOR E. A. ALLCUT, M.E.I.C.[2]

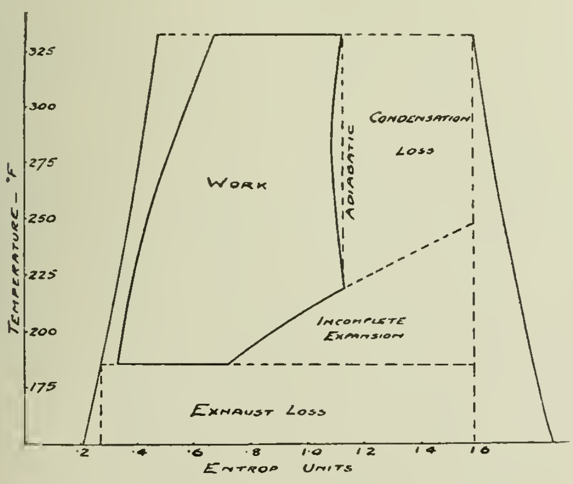
The author, in presenting the paper, remarked that there were many misconceptions regarding the history of the uniflow engine, which was by no means unusual in engineering work. An inventor occasionally worked on something about a hundred years before his time; then the subject dropped practically out of sight, and afterwards reappeared as the very latest development in that particular field, while the early work was liable to be forgotten. His apology, if any were needed, for including in the paper quite a lot about the history of the uniflow engine was this fact, and in that connection it was interesting to note that the uniflow engine had now almost reached its centenary.

The uniflow engine was first constructed by Jacob Perkins in England in 1827. He also experimented with a compound engine working on the same principle, of which the next example appeared at the Wembley Exhibition in 1924 and was regarded as the very latest word in steam practice. It was also remarkable that at the time when Boulton and Watt were using pressures of 5 and 10 pounds per square inch, Perkins actually used steam at a pressure of about 2,000 pounds per square inch.

The development of the uniflow engine was bound up with the question of cylinder condensation, and he therefore proposed to consider briefly cylinder condensation and the principal influences which affected it. In the ordinary type of engine the steam entered at a temperature of say 400 or perhaps 500°F.; it expanded in the cylinder and went out at a temperature in the neighbourhood of 100° to 150°F., depending on the conditions. That inevitably meant that there must be a considerable variation of temperature in the metal of the cylinder itself, and that the metal which was cooled or partly cooled by the exhaust steam during one part of the cycle must again be raised to a higher temperature during the admission part of the cycle. Therefore, if the steam were dry or only slightly wet at the beginning, it would inevitably be considerably wetter later on. Referring to figure No. 1 in the paper, which applied to an ordinary counterflow type of engine of about the same size as the uniflow engine of which particulars were given in the paper, it would be noticed that the dryness fraction at the point of cut-off was somewhere in the neighbourhood of 55 per cent. When that steam went into the engine it was 99 per cent dry, which meant that between 40 and 50 per cent of the steam entering the cylinder had been condensed, and after that little more condensation had taken place.

(1) This paper was presented at the Annual General Meeting of The Institute, Montreal, February 15th, 1928, and published in The Engineering Journal, January 1928.

(2) Associate Professor of Mechanical Engineering, University of Toronto.



(Figure No. 1 of original paper published in January 1928 Journal.)

Entropy Diagram from 50-h.p. Counterflow Engine.

The next factor was the ratio of surface to volume. If the portion of the cylinder exposed to the steam up to the point of cut-off were large in diameter and very thin, there would be much more chance for the steam to be condensed than if the steam space were comparatively short and thick. Thus, other things being equal, the larger the surface in comparison to the volume present at that time the greater would be the amount of cylinder condensation, and therefore in ordinary steam engine practice an early cut-off contributed greatly to cylinder condensation.

The third factor comprised the various facilities for heat interchange. Among these, of course, would be the extent to which the cool steam or comparatively cool steam from the exhaust process flowed over the surface which had been heated by the previous admission process. Thus in a counterflow engine the cold steam from the exhaust flowed back through the passages previously heated by the live steam, in which case, other things being equal, the heat loss and the mean cylinder condensation would be greater than in cylinders where this reversed movement did not take place.

He had mentioned still another factor which needed stressing rather more than was usually done, and that was the wetness of the steam. Dry steam, of course, was a very poor conductor of heat; superheated steam was poorer still, and consequently the greater the heat conductivity of the fluid actually in the cylinder the greater would be the amount of cylinder condensation, because the heat would be able to get from the interior of the cylinder to the outside with greater facility. These, he thought, were the principal factors in connection with the facilities for heat interchange.

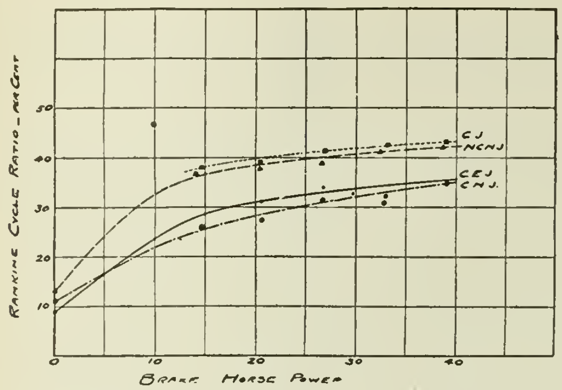
MR. W. CLINTON BROWN.[3]

Mr. Brown desired to call attention to one statement in the paper which he thought liable to be misleading; that was, the sentence reading as follows:—

> "The reduction of mean effective pressure due to the large amount of power used for compression also necessitates the use of larger cylinder diameters than are customary in counterflow engines producing the same powers."

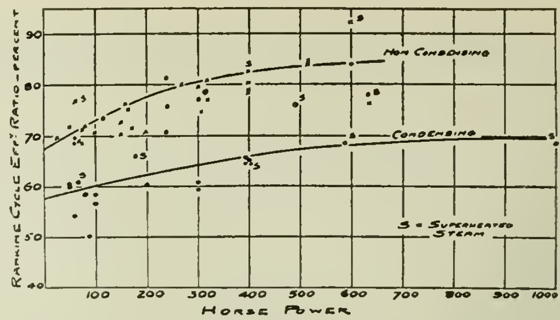
While high compression, especially in atmospheric exhaust engines without auxiliary exhaust valves, did increase the cylinder diameter needed for a given power, the great factor in reducing the mean effective pressure was really the short cut-off used in these engines. On account of the elimination of initial condensation it was possible to operate uniflow engines with very short cut-offs without loss, and get the economical benefit of low terminal pressures, and this was one of the reasons for the remarkable economy of the engine. As the steam consumption of a uniflow engine was even lower than that of a counterflow compound engine, the steam cylinder diameter should be compared to the low pressure cylinder of the compound engine, rather

(3) Managing Director, Stumpf Una-flow Engine Co., Inc., Syracuse, N.Y.



(Figure No. 8 of original paper published in January 1928 Journal.)

Rankine Cycle Ratios of 40-h.p. Engine.



(Figure No. 13 of original paper published in January 1928 Journal.)

Rankine Cycle Efficiency Ratios of Uniflow Engines.

than to the cylinder diameter of a single cylinder engine which was not in its class.

Mr. C. C. Trump.[4]

Mr. Trump believed that the chief value of the paper would be found in the rather complete history and bibliography which was presented.

The discussion of the steam jacket was of special interest. Unfortunately the author had not included a complete description of the 40-h.p. engine and other apparatus used in his tests. The engine was possibly defective to some extent, for the Rankine cycle efficiency ratios were not nearly good enough, as would appear on comparing figures Nos. 8 and 13.

In connection with the author's views about end jackets as expressed in his second paragraph on page 6 of the paper, Mr. Trump would refer him to the last paragraph of the discussion of the tests by Barrus, (A.S.M.E. Transactions, paper 1968, May 1925, on page 489, and to Chapter 8 of the Book by Professor Stumpf, 2nd Edition), where it was shown by actual temperature measurements of precision that the heat of compression in the cylinder raises the temperature inside the head as much above that of supply as it falls below. Thus head jackets would not condense steam under full load conditions, in a properly designed uniflow engine. Body jackets were most effective with saturated or wet steam supply, as shown by the author's tests, as well as those by Stumpf and others.

The description in the Appendix of the Stumpf Compound Uniflow Marine Engine showed independent means of jacket supply and drainage.

Single cylinder uniflow engines might be bled for heating steam as easily as compounds, and he was surprised that this was not more often done. Let the engineers of the smaller plants know this and it would help many of them to economies in fuel.

Prof. L. M. Arkley, M.E.I.C.[5]

Professor Arkley considered that in reviewing the development of the steam engine one could easily find certain milestones which indicated its progress.

Perhaps the most important recent step in this connection, and certainly the most important from the standpoint of increasing the efficiency of the engine, had been the development of the uniflow engine by Stumpf in the early years of this century.

The reciprocating steam engine had lately been meeting some severe competition. The steam turbine as applied to marine propulsion and central station work had practically replaced the reciprocating engine, and the development had been so rapid that plants were now being equipped with 75,000-kw. turbines, while still larger ones were being built.

The internal combustion engine, not the steam engine, supplied the millions of horse power in use in the automobile industry, and now had come the Diesel engine with its high thermal efficiency and its ability to use a cheap fuel, decreasing still further the field open to the steam engine.

In view of the above it was natural to enquire as to the necessity for spending the money and time necessary to design and perfect such a unit as the uniflow.

The answer was, that there were still many places where an efficient reciprocating steam engine had advantages over any of the prime movers mentioned above. The steam turbine, while it had many good points, was not at its best unless operating at high vacuum and in large units.

An ideal situation for a uniflow engine would be a manufacturing plant where a large quantity of low pressure steam could be used for heating purposes or in process work. The high economy of such a plant was often overlooked; for example, the highest efficiency yet achieved by condensing plants using high steam pressure and highly superheated steam is about 30 per cent, but a non-condensing plant where all the exhaust steam can be used could reach an efficiency of over 60 per cent.

As indicated in the paper, one of the most important points in the operation of the engine was the question of compression. This also affected efficiency, and while it could be proved theoretically that if compression were carried to the admission pressure of the steam no loss would result, this was not borne out by actual tests. The tests of Professors Jacobus and Carpenter to determine the effect of compression on efficiency as reported in the Transactions of the American Society of Mechanical Engineers, in each case showed a reduction in efficiency as compression increased.

As stated by the author, a series of tests, such as those in this paper, on an engine giving at the most 40 h.p. could have little bearing on the actual performance of the uniflow engine as applied to industry. In the first place it would be difficult to predict from the efficiency of a 40-h.p. engine what might be expected from one of say 400 h.p. Prof. Arkley did not think that it would even be safe to generalize in regard to the use of jackets from such a series of tests, as the size of the cylinder had so much to do with this. The interesting thing to know about the uniflow engine was whether its superiority to the old counterflow type would prove to be sufficient to keep it from being pushed aside by the prime movers mentioned above. The author in table No. 4 had given some interesting information along this line; for example, the quoted steam consumption of 8.8

(4) Merion Station, Pa.

(5) Professor of Mechanical Engineering, Queen's University.

pounds per i.h.p. per hour was quite good considering the low pressure and moderate degree of superheat used. William D. Ennis, writing in Marks and Davis's handbook, reported tests made by Lentz on a 100-h.p., uniflow condensing engine, which, operating at a pressure of 235 pounds per square inch absolute and with superheat of 528°F. had a steam consumption of 6.52 pounds per i.h.p. per hour, which represents 162 B.t.u. per i.h.p. per minute; and operating at 461 pounds per square inch absolute, and 559° superheat, the steam consumption was 5.67 pounds per i.h.p. per hour, or 144 B.t.u. per i.h.p. per minute.

These were remarkable results and showed a thermal efficiency which compared favourably with anything on the market, and would lead us to conclude that the uniflow engine had a useful future ahead.

Prof. Arkley regretted that the author had not included in his paper some of the typical indicator cards from his tests, and desired to ask if the tests were run with the engine operating as a true uniflow, or if the auxiliary exhaust valve had been used to lower compression.

H. A. Wilson, A.M.E.I.C.[6]

Mr. Wilson drew attention to the claim by a manufacturer of uniflow engines that he had designed into his valve gear something which would compensate for the expansion of the cylinder at different loads, claiming that an extremely long cylinder had an expansion that had to be taken into consideration, which would upset the balance of the engine. One side of the piston had been so arranged that it would be delivering more power than the other side, which was claimed as a superior point of his engine. Had that been shown, in the various makes of engines, as an advantageous factor?

He had also been told that unless a certain ratio of expansion was available, the uniflow engine would not show sufficient economy over the counterflow to warrant the extra investment. He would ask whether the field of the uniflow was to be confined to the higher net expansion, did back pressure throw it out of the running, and was a high initial pressure necessary before it really became an efficient engine?

Professor E. A. Allcut, M.E.I.C.

Replying to Mr. Clinton Brown, the author agreed that the diameter of the uniflow cylinder should be compared with the low pressure cylinder of the compound engine. Mr. Brown had said that in the uniflow engine it was possible to use economically an earlier cut-off, and that in itself produced " skinny " diagrams, although it made for efficiency. If on the top of that a high compression curve were superimposed the amount of work would be further reduced, and of course the mean effective pressure would be low in spite of the superior economy.

In reply to Mr. Trump's questions, as was stated in the paper, the diameter of the cylinder in this particular engine was 10 inches, with a stroke of 15 inches, and there were two piston valves. This statement answered one of Professor Arkley's questions also. One valve controlled the admission and the other valve the exhaust, so the engine was not a true uniflow engine, in that the compression was controlled by an auxiliary valve; it should perhaps be regarded as a hybrid of the uniflow and counterflow types. On the other hand, the true uniflow engine, as was pointed out in the paper, could only be used with difficulty without such valves with low vacua or non-condensing operation. The only way to get over that would be by using a larger clearance volume, the inefficiency of which had already been referred to. Earlier compressions had been experimented with but were unsatisfactory. Since the publication of the paper vacua up to 28 inches of mercury had been used but with no improvement of efficiency.

The tests mentioned by Mr. Trump were also referred to in the paper, so that due attention had been paid to the points raised by him.

With reference to the remarks of Professor Arkley, particularly regarding the steam turbine, he would point out that as far as the flow of steam was concerned the steam turbine itself was a uniflow engine, because the steam always moved in one direction. Professor Arkley's reference to non-condensing operation and process work was very timely, and had partly answered the question raised by Mr. Wilson, who asked if the uniflow engine could be used or was used in non-condensing work, and the exhaust employed for process work, or for heating. In that way a combination of exceedingly high efficiency would be obtained. The author considered that the uniflow engine would be efficient when used in that way, if it were possible to provide some device for using efficiently the exhaust heat.

Professor Arkley's remarks about the smallness of the Toronto engine were of course very true, but, unfortunately, as Professor Arkley knew only too well, the expense of a very large unit in a university laboratory would be so great that other equipment could not be obtained, and, further, a large unit could only be run very seldom, so that universities were necessarily confined to the use of small units for experimental purposes. As far as the results were concerned, the Rankine cycle efficiency was certainly lower than he had expected to get with that engine, but efficiencies obtainable with larger units were given in the paper, so that current practice could be referred to.

The value of this particular series of tests was comparative, as all the tests were made under strictly comparable conditions, and therefore reasonable deductions could be made from them.

The reason why the indicator cards were not included was that in his opinion the entropy diagram, for those who were familiar with such diagrams, gave more information from the thermal standpoint than the indicator cards could do. They were simply a means of expressing all that the indicator diagrams did, and more.

The expansion of the cylinder referred to by Mr. Wilson was an important point. In using high temperature steam this expansion, and particularly the resulting distortion, might be a serious matter. He was not aware, however, that the expansion was so great as to make any considerable difference in power between the two sides of the cylinder. Usually the valve gear had a great deal more to do with that matter than the expansion of the cylinder could have.

The 1,500-h.p. three-cylinder marine engine, to which he had referred in the paper, had exhaust ports in the centre of the cylinder which were not cut from a solid liner, but constituted the space between two liners, one inserted from each end of the cylinder. That seemed to be quite a reasonable attempt to get over some of the difficulties of expansion to which attention had been drawn.

As had been stated before, a high ratio of expansion and a low back pressure were essential for economy in the true uniflow engine unless the exhaust steam could be utilized, in which case the economy of the engine was not usually a question of paramount importance. A high steam pressure was not essential, as some of the results tabulated had been obtained with quite moderate pressures.

[6] Manager, Pump & Electrical Department, Canadian Fairbanks Morse Co., Ltd.

THE

ENGINEERING JOURNAL

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OF CANADA

VOLUME XI JUNE 1928 No. 6

Result of Ballot for Amendments to By-Laws

The report of the scrutineers appointed to canvass the recent ballot for the amendments to By-laws was presented to Council at the meeting held on Friday, May 18th. The report disclosed that all of the proposed amendments, with the exception of that to Section 29, were carried by substantial majorities. The amendment to Section 29, however, was defeated.

The proposals to amend the By-laws, it will be recalled, were made in accordance with Sections 75 and 76 of the By-laws, and adopted by Council and presented to the annual meeting in Montreal on February 14th for discussion. Subsequently, the ballot was mailed to all the corporate members and canvassed on May 12th.

As a result of these changes, which have now become effective, the age limit of the grades of Student and Junior, as provided in Sections 9 and 10, may be extended, if, in the opinion of Council, special circumstances warrant such extensions.

The wording of Section 18 is changed to conform with the deletion of Section 24, which previously provided for an Engineering Sections Committee.

Section 53 is amended by the addition of a paragraph to provide for the formation of Students' Sections in connection with the various branches.

The wording of Sections 68, 69 and 70 is changed for the purpose of clarification, as difficulty had arisen from the use of the words "Officers' Ballot" in these sections.

By the amendment of Section 76, provision is made whereby any proposed modifications or alterations which may be made to the proposed amendments at the time of the annual meeting shall be included in the letter ballot and voted on by the corporate members of The Institute.

The other amendments referred to Sections 74 and 52, and were intended to authorize the present practice in connection with the subscriptions to The Engineering Journal by Honorary Members, Life Members and Members who have compounded their fees, and in connection with the appointment of the secretaries and treasurers of the branches.

The By-laws as they now stand are being prepared for printing and will be available within a short time and will include not only the recent amendments but those which were adopted during 1927.

The Annual Meeting of 1929

The members of The Institute will be interested in the announcement that the Annual General and General Professional Meeting next year will be at Hamilton, Ont., the tentative dates being February 14th to 16th, inclusive. The preliminary work in connection with this meeting has already been commenced and announcements of arrangements will be made through the Journal from time to time.

Institute's Year Book being Revised

The Year Book of The Institute containing the list of members is at present being revised and will shortly be sent to the printers for publication.

At the end of 1927 a special card was mailed to all members requesting information for the membership list. The returns from this request were gratifying, although there are still a number of members who have not replied. In order that the Year Book may be as complete as possible, any member who has not returned his card is requested to forward, without delay, information as to his present position, the name of the firm with which he is connected, his business address and his home address.

In this connection it will not be possible to make any changes in the forthcoming issue of the Year Book after June 30th, 1928.

Institute's Employment Service

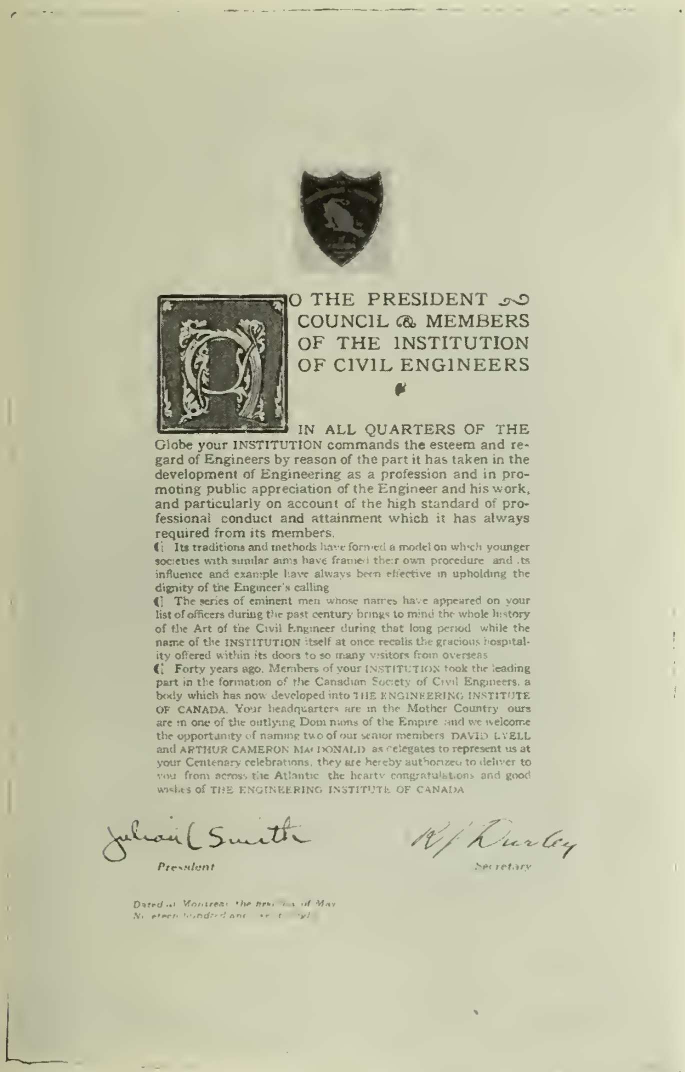
The work of The Institute's Employment Service has grown to such an extent that it has been found necessary to establish a somewhat more elaborate system for handling the applications for positions received, in order that the greatest possible service may be given to the members.

Full particulars of the proposed development of this work will be announced later, but in the meantime it will be of great assistance if all members wishing to register with the Employment Service will advise Headquarters so that the necessary forms and instructions may be forwarded to them. It is proposed that each member upon registering should forward a statement of his professional record on a prescribed form with ten extra typewritten copies of his record of qualifications and experience. He is also requested to attach a photograph of himself to each copy. This is necessary if the fullest advantage is to be taken of the Service, as it will provide material to submit to prospective employers. The provision for ten copies is made in order that a sufficient number may be available to supply various requests which may be received about the same time. The value of supplying photographs with the record is at once evident.

The record sheet with details of the Service and instructions as to requirements will be available about June 15th and every member wishing to register or to have his name retained on the list should communicate with headquarters as soon as possible.

The Centenary of The Institution of Civil Engineers

In the ninth year of the reign of King George the Fourth, or, in other words, in 1828, that monarch granted to "Thomas Telford of Abingdon Street, in our City of Westminster, Esquire, a Fellow of the Royal Societies of London and Edinburgh, and others of our loving subjects" a Charter of Incorporation for a Body Politic and Corporate by the name of The Institution of Civil Engineers. The society



TO THE PRESIDENT COUNCIL & MEMBERS OF THE INSTITUTION OF CIVIL ENGINEERS

IN ALL QUARTERS OF THE Globe your INSTITUTION commands the esteem and regard of Engineers by reason of the part it has taken in the development of Engineering as a profession and in promoting public appreciation of the Engineer and his work, and particularly on account of the high standard of professional conduct and attainment which it has always required from its members.

Its traditions and methods have formed a model on which younger societies with similar aims have framed their own procedure and its influence and example have always been effective in upholding the dignity of the Engineer's calling

The series of eminent men whose names have appeared on your list of officers during the past century brings to mind the whole history of the Art of the Civil Engineer during that long period while the name of the INSTITUTION itself at once recalls the gracious hospitality offered within its doors to so many visitors from overseas

Forty years ago. Members of your INSTITUTION took the leading part in the formation of the Canadian Society of Civil Engineers, a body which has now developed into THE ENGINEERING INSTITUTE OF CANADA. Your headquarters are in the Mother Country ours are in one of the outlying Dominions of the Empire and we welcome the opportunity of naming two of our senior members DAVID LYELL and ARTHUR CAMERON MACDONALD as delegates to represent us at your Centenary celebrations, they are hereby authorized to deliver to you from across the Atlantic the hearty congratulations and good wishes of THE ENGINEERING INSTITUTE OF CANADA

Julian C. Smith
President

R. J. Durley
Secretary

thus formed is accordingly celebrating this year, on the 3rd of June, the one hundredth anniversary of the event above mentioned, and the Council of The Engineering Institute of Canada has forwarded to the Institution an address of congratulation, a facsimile of which is reproduced above.

The occasion is memorable, for the Institution of Civil Engineers is not only recognized as the leading engineering society in the British Empire, but also holds a commanding position owing to its seniority, its high standard of professional attainment, its widespread membership, and the acknowledged eminence of the names to be found upon its lists of officers, past and present. Members of The Institute will join in the message of goodwill which their Council has transmitted to the Institution.

Meeting of Council

Meeting of May 18th, 1928

A meeting of Council was held at 8 o'clock p.m. on Friday, May 18th, 1928. President Julian C. Smith, M.E.I.C., in the Chair, and nine other members of Council being present.

The minutes of the meeting held on April 20th, 1928, were taken as read and approved.

The Financial Statement of The Institute for the period ending April 30th, 1928, was submitted and approved.

The preliminary arrangements for the Annual General Meeting 1929 received consideration, and it was noted that the dates suggested for the meeting, February 14th, 15th and 16th, 1929, met with the approval of the Hamilton Branch Executive Committee.

The programme for the Western Professional Meeting to be held in Vancouver on June 7th, 8th and 9th was approved.

The report of the scrutineers on the voting for the amendments to By-laws closing on May 12th was presented, and in accordance with this report, the amendments proposed to Sections 9, 10, 18, 24, 52, 53, 68, 69, 70, 74, and 76 of the By-laws were declared to be carried, and that proposed to Section 29 was declared to be lost.

It was decided that the question of the changes, if any, which are desirable in the present method for the election and transfer of members in The Institute should receive consideration at the Plenary Meeting of Council to be held in October. Consideration being also given at that time to the changes which are desirable in the present scale of members' annual fees.

A resolution passed by the Alumni Society of the Ecole Polytechnique opposing any change in the present policy of The Institute regarding the qualifications of its different classes of membership was presented, noted, and referred to the Committee which is at present considering the question of Grades of Membership in The Institute.

A letter was submitted from the President of the Royal Architectural Institute of Canada, regarding the proposed standard forms of contract of the Canadian Construction Association, suggesting that the Committee of The Institute at present considering this question co-operate with their own Committee, with a view of arriving at some final decision. After a short discussion the Secretary was directed to express Council's willingness for the two committees to co-operate in the manner suggested, and to notify the Chairman of The Institute Committee accordingly.

The report of the Board of Examiners was approved, showing that of three candidates for admission or transfer to the grade of Junior, who took the examination under Schedule B. on May 1st, two failed and one passed, and of three candidates who took the examinations under Schedule C. all had passed.

A memorandum was presented pointing out that in order to develop the work of the present Employment Service some means of more frequent and regular communication with the members of The Institute and with prospective employers should be available, so that positions can be brought promptly to the attention of the former, and the qualifications of those seeking positions can be placed before employers. The Journal hardly offers a satisfactory medium for this purpose, due to the lapse of time between issues, and it was therefore suggested that a weekly news bulletin, to contain lists of positions available, brief outlines of qualifications of those seeking positions, news items of proposed works, notices of meetings of The Institute and other societies, announcements from Headquarters such as elections and transfers of members, preliminary notices of applications for admission or transfer, etc., should be established.

After a short discussion, on the motion of Fraser S. Keith, M.E.I.C., seconded by Professor C. M. McKergow, M.E.I.C., it was decided to approve the issue of a bulletin, along the lines suggested, for a trial period of six months.

The membership of the Leonard Medal Committee for the current year was approved as follows: L. L. Bolton, M.E.I.C., Chairman, F. W. Gray, M.E.I.C., J. Colin Kemp, A.M.E.I.C., L. H. Cole, M.E.I.C., and J. F. Robertson, M.E.I.C.

Consideration was given to the representations made by the various branches regarding the subject to be chosen for the first competition for the Past-Presidents' Prize for the year July 1928-July 1929.

Council noted with deep regret the death of H. J. Cambie, M.E.I.C., which took place on April 23rd, 1928, and the following resolution was unanimously passed:—

> By the death of Henry John Cambie, The Engineering Institute of Canada has lost one of its oldest members, an engineer of ripe experience, and one of the few survivors of that band of pioneers whose efforts marked out the routes of our present transcontinental railways.
>
> Mr. Cambie served on Council, contributed to the Transactions and throughout his long career lost no opportunity of furthering the interests of his fellow engineers.
>
> The Council of The Engineering Institute of Canada records his death with deep regret, and desires to convey to his family the most sincere condolence and sympathy.

The list of officers of the St. John Branch for the year 1928-29 was submitted and approved.

The Secretary reported that Lt.-Col. A. C. Macdonald, D.S.O., M.E.I.C., and Col. David Lyell, C.B.E., C.M.G., D.S.O., C.deG., M.E.I.C., had consented to act as The Institute's representatives in London on the occasion of the Centenary Celebrations of the Institution of Civil Engineers in June of this year, and was directed to express to these gentlemen Council's thanks for their services. The address which is to be presented to the Institution on this occasion was submitted and approved.

A letter was presented from the American Society of Mechanical Engineers, requesting The Institute to nominate a representative to act on an Advisory Committee which is being formed in connection with a new Engineering Index Service. The Secretary was directed to communicate with the Society asking whether his services on the Committee would be acceptable.

A letter was submitted requesting Council to nominate a representative to attend the Eighth Industrial Chemical Congress which is to be held at Strasbourg on July 22nd-28th, 1928. Council regretted its inability to make arrangements for representation on this occasion.

It was noted that the President and Secretary had received invitations to attend the opening ceremonies of the new library at the University of Louvain, (Belgium), on July 4th, and the Secretary was directed to express Council's appreciation of the courtesy paid to The Institute.

Four reinstatements were effected, seven resignations accepted, and five special cases dealt with.

The following elections and transfers were effected:—

Elections.		Transfers.	
Associate Members	6	Assoc. Member to Member	4
Students	9	Junior to Assoc. Member	5
		Student to Assoc. Member	1
		Student to Junior	3

Twenty-seven applications for admission and transfer were scrutinized and classified for the ballot returnable June 15th, 1928.

The Council rose at 12.05 o'clock a.m.

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.

University of Manitoba

University Gold Medal and Joseph Doupe Gold Medal

Bain, Archie Marcus, B.Sc., (Ci.), Winnipeg, Man.

University Gold Medal

Briggs, Herbert Lee, B.Sc., (El.), Killarney, Man.

Degree of B.Sc.

Borgford, Thorsteinn Bjorgvin, B.Sc., (Ci.), Winnipeg, Man.
Cantlon, Carman Farrar, B.Sc., (El.), Winnipeg, Man.
Cheney, Wayne Putnam, B.Sc., (El.), Winnipeg, Man.
Collins, George Edward, B.Sc., (Ci.), Winnipeg, Man.
Fidler, Frank, B.Sc., (El.), Winnipeg, Man.
Kalinchuk, William, B.Sc., (El.), Valley River, Man.
Michel, Mordecia, B.Sc., (El.), Winnipeg, Man.
Nicholl, Henry Iltyd, B.Sc., (El.), Winnipeg, Man.
Petursson, Rognvaidur Franklin, B.Sc., (El.), Winnipeg, Man.
Robinson, Richard Henry, B.Sc., (Ci.), Winnipeg, Man.
Storey, Thomas Edwards, B.Sc., (El.), Winnipeg, Man.
Varcoe, Herbert Reginald, B.Sc., (El.), Winnipeg, Man.
Young, William Richard, B.Sc., (Ci.), St. James, Man.

Nova Scotia Technical College

Armstrong, Owen Fred Calder, B.Sc., (Me.), Tupperville, N.S.
Dyer, John Henry, B.Sc., (El.), Halifax, N.S.
Kent, George Edward, B.Sc., (Me.), Halifax, N.S.
Lovett, Percy Arthur, B.Sc., (El.), Halifax, N.S.
Wetmore, Ralph Eugene, B.Sc., (Me.), Halifax, N.S.

University of New Brunswick

Babbitt, Gerald Wetmore, B.Sc., (El.), St. Andrews, N.B.
Dines, Milton Emery, B.Sc., (El.), Fredericton, N.B.
Hayes, Elbert Harvey, B.Sc., (El.), Moncton, N.B.
Todd, Rolph Murray, B.Sc., (El.), Fredericton, N.B.
Vivyan, Archibald Edwin, B.Sc., (El.), Barker's Point, N.B.
Wakeham, Charles Arthur, B.Sc., (El.), St. John, N.B.

Queen's University

Degree of B Sc. (with honours)

William, Douglas Kirk, B.Sc., (Ci.), Windsor, Ont.

Degree of B Sc.

Racey, Herbert John, B.Sc., (Ci.), Westmount, Que.
Shearer, John Leabourne, B.Sc., (Ci.), Ottawa, Ont.
Thicke, James Ernest, B.Sc., (El.), New Liskeard, Ont.

Ecole Polytechnique of Montreal

Gold Medal

Boyer, Marc, B.Sc., (Ci.), Westmount, Que.

Silver Medal

Vinet, Pierre-Paul, B.Sc., (Ci.), Verdun, Que.

Degree of B.Sc.

Leblanc, Jules, B.Sc., (Ci.), Montreal, Que.
Brisset des Nos, Andre, B.Sc., (Ci.), Montreal, Que.

University of Toronto

The British Association for the Advancement of Science Medal (with honours)

Hunt, Albert Brewer, B.A.Sc., (El.), London, Ont.

Degree of B A.Sc. (with honours)

Moogk, Ernest George, B.A.Sc., (Ci.), Weston, Ont.

Degree of B.A.Sc.

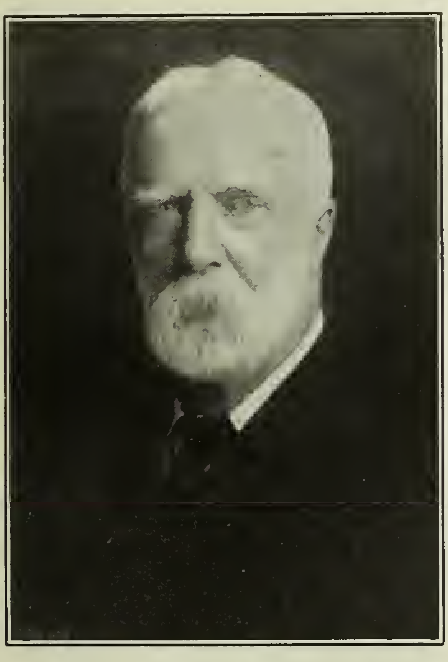
Beam, Donald Carleton, B.A.Sc., (Ci.), Toronto, Ont.
Godfrey, Morley Berry, B.A.Sc., (Ci.), Toronto, Ont.
Chvilivitsky, Jokov, B.A.Sc., (Ci.), Toronto, Ont.
Galimberti, George Michael, B.A.Sc., (Ci.), Toronto, Ont.
Sanderson, Edward Lowrey, B.A.Sc., (Ci.), Toronto, Ont.

OBITUARIES

Henry John Cambie, M.E.I.C.

Through the death of Henry John Cambie, M.E.I.C., which occurred in Vancouver on April 23rd, 1928, The Engineering Institute of Canada has lost one of its earliest members and staunchest supporters, and Canada, and Vancouver in particular, is the poorer by the loss of an engineer of ripe experience and one of the few survivors of that small group of pioneers, through whose ability, energy and resourcefulness the development of Canada's great transcontinental railway systems was made possible.

Following an illness of little more than a week, from a severe cold which developed into pneumonia, this great pioneer passed away peacefully, in the beautiful setting which he had made his home during his declining years, and with his passing there comes to a close a life of great achievement indelibly inscribed on the pages of Canadian history.



HENRY JOHN CAMBIE, M.E.I.C.

An Irishman who never quite lost a touch of the brogue, Henry John Cambie came from an old Irish family which settled at Castleton, in the county of Tipperary, in Cromwellian times. He was born in Tipperary on October 25th, 1836, and while still a lad of sixteen he emigrated to Canada with his parents and a brother.

Shortly after his arrival in this country he entered the office of the late Walter Shanly, M.E.I.C., of the Toronto and Guelph Railway as an apprentice. From 1853 to 1859 he was with Messrs. Gzowski and Company, contractors for the western part of the Grand Trunk Railway, occupying various junior positions, principally in connection with surveys. For two years after 1860 he was engaged on surveying and exploratory work with the Government of Upper Canada, and from 1863 to 1866 for the Intercolonial Railway of Quebec, New Brunswick and Nova Scotia. Before the age of thirty he was in charge of his first railway construction project, when during the years 1867 to 1868 he was engaged in locating and constructing the Windsor and Annapolis Railway. The three succeeding years found him in charge of some of the most extensive works on the Intercolonial Railway in New Brunswick and Quebec.

When British Columbia entered Confederation one of the conditions was that a transcontinental railway should be undertaken. As nothing had been done three years later the premier of the western provinces complained bitterly to the Federal government. The Hon. Alexander MacKenzie, then head of the Dominion government, dispatched James Edgar to the Pacific coast as mediator with instructions to propose the immediate construction of a railway between Esquimalt and Nanaimo and at the same time sent Mr. Cambie to the coast to take charge of the work. This proposal was not accepted by the western provinces and when the project fell through Mr. Cambie was employed by the Dominion government on explorations and surveys throughout the province of British Columbia and his work resulted in the decision that Burrard Inlet could be made into a suitable deep-water harbour and that a railway could be built through the Fraser canyons. In 1875 he explored the difficult Chilcotin country, seeking a route for a railway to Butte inlet and thence, over Seymour Narrows, to Vancouver island.

In 1876, Sanford Fleming, chief engineer for the Dominion government, began a four years leave of absence. Marcus Smith, who was in charge of surveys in British Columbia, took his place and Cambie was put in charge of surveys in British Columbia, and continued in charge until 1880. In 1876, he and Dr. G. W. Dawson retraced Sir Alexander MacKenzie's route from Bella Coola to the Fraser river.

Next year he directed the survey of the Fraser river route from Yellowhead Pass to Port Moody, and the information gathered on that survey practically determined the selection of Burrard Inlet as the terminal of the new railway.

In 1878, Mr. Cambie was sent by the Federal government to determine the feasibility of a line to the mouth of the Skena river, both by the Peace Pass and the Pine Pass. In this work he was accompanied by Dr. G. W. Dawson, Henry MacLeod and Rev. D. M. Gordon, later principal of Queen's University. On his return from this work he learned that the Fraser route had been selected for the railway and that the contract for the Pacific section had been let.

The work of construction was to be proceeded with at once and Mr. Cambie, whose record in the Eastern provinces had not been forgotten, was placed in charge of operations in the Fraser canyons. After this tremendous work was completed, Mr. Cambie was made superintendent of construction on the section from Savona to Shuswap lake, and after the opening of the line he was appointed engineer to the western division of the Canadian Pacific Railway. In 1902 he was made consulting engineer to the company and he retired from active service in 1920, although his services were retained by the company in an advisory capacity.

Throughout his long and eventful career Mr. Cambie was ever ready to assist his fellow engineers in furthering their interests. He was elected a member of The Institute on February 9th, 1888, and throughout its early days, before its name was changed from the Canadian Society of Civil Engineers, he took a very active part in its affairs, serving on its council during the years 1892, 1896, 1901, 1904 and 1910. He contributed two papers to The Institute which were published in the Transactions; one on the "Fraser River Bridge" in Volume V, 1891, and the other on "Unrecorded Property of Clay" in Volume XVI, 1902. In the fall of 1923 an interesting photograph of three of Canada's railway pioneer engineers was taken at Vancouver, and was published in the February 1924 issue of the Journal. This group consisted of Thomas Henry White, M.E.I.C., the late Henry John Cambie, M.E.I.C., and the late James Henry Kennedy, M.E.I.C.

In its editorial columns the Vancouver newspaper refers to the death of Mr. Cambie in part as follows:—

> " For of Henry J. Cambie, explorer and railway builder, it can be said more than of most men that he died full of years and honour and at the close of a long life so well rounded out that it is not possible to think of any other circumstance that would have made it more complete. Great achievement and the love and esteem of many friends were his and it is doubtful if he had an enemy in the world. What could man desire more and of how few can this be said after ' life's fitful fever ' is passed and the final call has come.
>
> " When ninety-one years ago this contemporary and friend of Strathcona, Mount Stephen and Angus—the three great organizers of the Canadian Pacific Railway—was born in a little hamlet in Tipperary, Ireland, who could have foretold such a career of strenuous endeavour and accomplishment in a country six thousand miles away? Of these four men, all of whom lived to be over ninety, the last to go has been the practical man, the actual builder. Upon three railway systems he left the mark of his constructive genius and the last of these was the greatest, for he was in charge of the mapping out, surveying and building of that stupendous piece of work through the Fraser canyons.
>
> " That was Henry J. Cambie, the practical man, the man of achievement. But there was included in his make-up another man, the man of character, of personal charm, of lovableness, of great modesty regarding his works, and that was the man whom a later generation knew and learned to esteem, and that is the man who will linger in memory. His life was an example to those who come after him. He was a man who did unto others as he would be done by and who did his duty. Can there be finer epitaph than that? "

Alexander Siemens, M.E.I.C.

In the death of Alexander Siemens, M.E.I.C., which occurred at Westover, Milford-on-Sea, Hants, England, on Thursday, February 16th, 1928, at the age of 81, there has passed an engineer whose name has been intimately linked with the development of the electrical industry, and whose name, with that of Sir Charles Siemens and Werner von Siemens, will occupy an honoured place in any history of the progress of this branch of engineering.

Born at Hanover, Germany, on January 22nd, 1847, the late Mr. Siemens received his early education at the schools in Hanover until 1866, when he entered the Polytechnic School. While still a young man of 20 he moved to England to assist his uncle, William Siemens, in the works which he had established and which are still existing at Woolwich for the production of electrical equipment. In 1868 he was called for military service but was rejected on account of bad eyesight, although he afterwards served in the Franco-German war and as a private in an infantry regiment was present at the fall of Metz and received the Iron Cross after being wounded at the battle of Beaune-la-Roland in the Orleans campaign. Prior to his active service, however, he had been engaged on the erection of the Indo-European telegraph line in Persia,* and in laying cables in the Black Sea.

In the autumn of 1871, he returned to Woolwich, and was employed for the next few years in the design and erection of those regenerative furnaces for various purposes with which the name of his uncles will always be connected. In September, 1875, he again took up telegraphy and joined the cable ship Faraday, during the time she was stationed at Halifax, N.S. He was still closely connected with furnace work, however, assisting in the erection of blast and steel furnaces, both for the Steel Company of Canada and at Pittsburgh. He was nationalized as a British subject in 1878. After his return to England in 1879, Alexander Siemens was appointed manager of that branch of the works at Woolwich, which was engaged in the manufacture of dynamos. Machines of this kind, produced under his direction, were used for lighting the Albert Hall, London, the British Museum, and the Albert Docks, while the firm also undertook the contract for lighting the streets of Godalming, in Surrey, this being the first town in which a public supply of electricity was given in this country. He was also connected with the electrification of the tramway between Portrush and the Giant's Causeway, in Ireland.

After the death of Sir William Siemens in 1883, Alexander Siemens assumed a much more important position in the firm, of which he became first a director and subsequently managing director. Soon after his appointment to the latter position, the firm secured the contract for laying the third Atlantic cable for the Commercial Cable Company, and also for a cable which extended 1,000 miles up the Amazon river. At the same time, the use of electricity for power purposes was increasing, and the firm took their full share in these activities, one of the more important contracts undertaken by them, though at a later date, being the complete electrical equipment of the Waterloo and City Railway.

ALEXANDER SIEMENS, M.E.I C.

Soon after the beginning of the century the business of the firm had increased so much that no further extensions

*An interesting historical account of this work appeared on page 209 of the February 17th, 1928, issue of Engineering.

on the Woolwich site were possible, and for this and other reasons it was determined to divide the telegraph and cable work from the manufacture of machinery, and to establish new factories at Stafford for the production of the latter. Further, the firm was divided into two, the Woolwich branch retaining the original name of Siemens Brothers and Company, while the Stafford section became known as Siemens Brothers Dynamo Works. The two, however, worked in the closest co-operation, and Alexander Siemens was the chief permanent director in England of both.

Although this important position claimed a great deal of his time, he did not neglect the technical side of engineering and was particularly interested in the work of scientific associations and was a frequent contributor to their proceedings.

He was a founder member of the Institution of Electrical Engineers and was appointed a member of its council in 1880. He was elected vice-president in 1890, and became president in 1894 and again in 1904, thus following his uncle, who had occupied the same chair in 1872 and 1878. He joined the Institution of Civil Engineers as a student in 1867, soon after his arrival in England. He was transferred to Associate and to Full Membership in 1890. In 1898 he was elected Member of the Council of The Institution and served as its President in 1910-11. He was also a member of the Institution of Mechanical Engineers, the Iron and Steel Institute, the Physical Society and the Society of Engineers. He served as president of the Junior Institute of Engineers in 1894 and was secretary of the Royal Institution from 1913 to 1915. He was a member of the Committee appointed in 1897 to enquire into the desirability of establishing the National Physical Laboratory, and later served on the executive committee of that institution. He was also connected with the formation of the London Association of Engineering and Shipbuilding Employers, and was its first president up to 1901. About the same time he was a member of the British Admiralty Committee to consider the question of utilizing electrical energy on warships, and was subsequently nominated a member of the Railway Conference, which sat during 1908-09 at the Board of Trade. He was also appointed a member of the Departmental Committee on Railway Amalgamations and Agreements which reported in 1911.

His connection with The Institute dates from the early days of the Canadian Society of Civil Engineers, when on June 11th, 1888, he was elected a Member of the Society. On November 21st, 1922, he was made a Life Member of The Institute.

Howard George Kelley, M.E.I.C.

Howard George Kelley, M.E.I.C., former president of the Grand Trunk Railway System and one of the outstanding railway engineers of Canada, died suddenly on May 15th, 1928, at San Diego, California.

At the time of his death Mr. Kelley was in his 71st year, having been born at Philadelphia, Pa., on January 12th, 1858. His engineering training was received at the Polytechnic College of Pennsylvania, following which he entered railway work in 1881. During the first four years he was engaged as assistant engineer on the location and construction of the Northern Pacific Railroad on the Western and Pacific Divisions, but in 1887 he became interested in mining work and accepted the position of mines superintendent in connection with some works in Montana. He returned, however, after three years to railroad engineering and his ability earned for him the position of resident engineer and superintendent of bridges of the St. Louis and Southwestern system.

Rising to the posts of chief engineer on the Minneapolis and St. Louis Railway and the Iowa Central Railway, he finally travelled back to the St. Louis and Southwestern system again in 1898, in the capacity of consulting engineer. By this time his qualities had made him famed throughout the railroad world of the North American continent, and in 1907 he was brought north to Canada as chief engineer of the Grand Trunk Railway system. The late Mr. Charles M. Hays was at the helm of the big Canadian road in those days. Before him, Mr. Hays saw possibilities in the extension of the steel. For location and construction work he could see nobody more qualified than Mr. Kelley and thus it was that the engineer joined the Canadian road. Under him, some ten thousand miles of track, largely in practically unexplored territory, were added to the Grand Trunk Railway mileage. Before the work had been completed the Titanic disaster came and with the huge liner went the late Mr. Hays and over a thousand more of the passengers. The presidency of the Grand Trunk Railway went to Mr. E. J. Chamberlin, and Mr. Kelley was promoted to the post of vice-president in charge of operation, maintenance and construction, one of the most onerous positions in the gift of the system. He had jurisdiction over not only the Grand Trunk lines in Canada, but also those dipping into five states in the Middle West, and traversing New England.

Upon retirement of Mr. Chamberlin the presidency of the Grand Trunk system, comprising the Grand Trunk Railway and the Grand Trunk Pacific Railway, fell to Mr. Kelley. That was in 1917, and he remained in that capacity until the Dominion government took over the consolidated Grand Trunk and Canadian Northern systems. Then he retired from office.

From time to time during his career the services of Mr. Kelley were taken advantage of by United States bankers involved in railroad financing, while his counsel also was sought by governments in several European countries.

The late Mr. Kelley joined The Institute in 1907, when he was elected a Member on December 12th of that year.

HOWARD GEORGE KELLEY, M.E.I.C.

Thomas James McMinn, M.E.I.C.

It is with regret that we record the death of Thomas James McMinn, M.E.I.C., which occurred at Philadelphia, Pa., on September 21st, 1927.

The late Mr. McMinn was born at Port Hope, Ont., on October 8th, 1854. His engineering work was commenced in June 1874 when he was on the construction of the new waterworks for the city of Toronto under the late P. A. Peterson. He remained on this work and its various subsequent extensions until 1879 when he was made assistant engineer to the late R. J. Brough. In 1880 Mr. McMinn was engaged in making surveys, plans, specifications and estimates for the construction of a 6-foot oak conduit to be built and extended for a considerable distance into Lake Ontario. In 1881 he was appointed resident engineer on this work and served in this capacity until the end of 1882.

From that date until 1889 Mr. McMinn was employed as assistant engineer of the waterworks department of the city of Toronto, during which period he made a barometric survey of the country extending to the north of Toronto in connection with the proposed gravitation water supply for the city.

On leaving the employ of the city of Toronto, Mr. McMinn moved to the United States and joined the staff of the late Rudolph Hering, M.E.I.C., who was engaged in the private practice of engineering in New York city. He remained with Mr. Hering until January 1898 when he was elected assistant secretary of the American Society of Civil Engineers, which position he retained until his retirement in 1919. Shortly after retiring he moved to Bridgeport, Conn., and then to Philadelphia, Pa., where he resided until the time of his death. During latter years Mr. McMinn was engaged in editing several technical books.

Some insight into the character and personality of Mr. McMinn may be gained from the memoir recently issued by the American Society of Civil Engineers, which reads in part:—

> "Such, in brief, is an outline record of a useful life. To most members—and Mr. McMinn was widely known in the Society—his most valuable work was comprised within his official term as Assistant Secretary. The duties of this office were varied, especially in the early days, when the smallness of the organization demanded a wide variety of service of each officer. Always, however, Mr. McMinn gave his main efforts to publications.
>
> "At one time he handled the many phases of this work—editing, attending to engraving, proofreading, and supervising the printing. Later, however, as the work expanded, he devoted his time mainly to the editing. In this he was, happily, successful. Endowed naturally with a clear perception of the fitness of expression, he was at once painstaking, well read, and widely versed in engineering methods. Many of the details of style he instituted are still standard practice, to the lasting credit and reputation of the publications. . . .
>
> "During so many years' intimate connection with the Society journals, he gained a wide and close acquaintance among the members. Endowed with a mildness of manner and a gentlemanly bearing, his relations were always pleasant. No one could exchange ideas with him anent engineering matters, especially the details of rhetorical expression, without feeling his innate grasp of such intricacies.
>
> "His qualities of person and character endeared him to his many colleagues at Society Headquarters. He had made for himself a solid place in their esteem. Apparently the feeling was mutual; the several years after his retirement were punctuated by frequent visits to New York, at which times he always made it a point to keep his many friendships in good repair.
>
> "Mr. McMinn was essentially a literary editor and an excellent one. But he was also an engineer; and, above all, a man. His lengthening years of Society work only served to ennoble his character, to bring into stronger relief the qualities of mind and of person that made him revered and loved. His place in the annals of the Society is secure."

The late Mr. McMinn was one of the few remaining original members of The Institute, and while his name does not appear on the list of chartered members it may be found among those who were responsible for its establishment, as his election to membership dates back to January 10th, 1887.

PERSONALS

C. R. Murdock, A.M.E.I.C., town engineer of Timmins, Ont., has resigned to accept the post of town engineer and townsite manager of the town of Kapuskasing, Ont.

J. K. Sexton, S.E.I.C., who graduated from the University of Saskatchewan this year, has joined the staff of the Calgary Power Company at Seebe, Alta.

M. Du Bois, J .E.I.C., formerly marine engineer with the Alex. McKay Company, Limited, Quebec, Que., has been appointed to the staff of the hydraulic department of the Dominion Engineering Works, Limited.

R. S. Baker, A.M.E.I.C., formerly mechanical research engineer for the Canadian International Paper Company at Temiskaming, Ont., is now located at Ottawa with Messrs. Alex. Fleck, Limited.

R. K. Robertson, A.M.E.I.C., factory manager of the Canadian Marconi Company, Montreal, has joined the staff of the Cooksville Shale Brick Company, at Cooksville, Ont. In 1923 Mr. Robertson was with this firm in the capacity of works manager.

William S. Orr, A.M.E.I.C., formerly on the staff of the Hydro-Electric Power Commission, Niagara Falls, Ont., has been appointed works commissioner of the city of Niagara Falls. His appointment combines the positions of city engineer and superintendent of outside construction.

D. G. Geiger, A.M.E.I.C., lecturer in electrical engineering at Queen's University, Kingston, has resigned his position to join the staff of the Bell Telephone Company of Canada at Montreal, where he is in charge of special transmission information, toll circuit testing and transmission surveys in the transmission division of the engineering department.

C. O. Whitman, A.M.E.I.C., has joined the staff of the Foundation Company of Canada and has proceeded to Lake Resignoul in Nova Scotia in connection with the company's work on the Liverpool river. Mr. Whitman is a graduate of Nova Scotia Technical College of the year 1921 and has had extensive experience in various construction works since that date.

J. E. Armstrong, A.M.E.I.C., has been appointed assistant chief engineer of the Canadian Pacific Railway, according to an announcement recently issued by the company. Mr. Armstrong is a native of Peoria, Ill., where he was born in 1886. He is a graduate of Cornell University of the class of 1908. Previous to that date he had been employed in the engineering department of the Toledo, Peoria and Western Railway for some five years.

P. L. Pratley, M.E.I.C., of the firm of Monsarrat and Pratley, consulting engineers, Montreal, has been retained by the city of Grand'Mere, Que., to represent the city and the province on the project for a highway suspension bridge over the St. Maurice river at Grand'Mere. The firm of which Mr. Pratley is a partner has been engaged as consulting engineers by the financial interests behind the project for a highway and railway over the Saguenay river at Chicoutimi, Que., and as designing engineers for the Saguenay river bridge of the Quebec and Chibougamau Railway.

J. B. Carswell, A.M.E.I.C., president of the Carswell Construction Company, Limited, Toronto, has been appointed managing director of the Burlington Steel Company, Limited. Mr. Carswell is a native of Paisley, Scotland, where he received his primary education; his technical training was obtained from the Paisley Technical School and Glasgow University. His first engineering work in Canada was in 1910 when he was on maintenance work in connection with the Grand Trunk Railway. The following year he was with Messrs. John Stewart and Company, railway contractors, and in October 1911 he joined the staff of Messrs. Ross and Macdonald, architects.

Alan H. Munro, A.M.E.I.C., of Peterborough, Ont., has accepted a position with the Alcoa Power Company, Limited, at Kenogami, in connection with the design of the company's new power development on the Saguenay river. Mr. Munro is a graduate of the University of Toronto of the year 1911 and has had extensive experience in various types of construction, his work having been connected mostly with hydro-electric power projects. Prior to his recent appointment he was engaged on a survey in connection with the proposed power development on the upper waters of the Ottawa river, and before that he was with the Ontario Paper Company, Limited, on the construction of the hydro-electric power plant at Outarde Falls, Que.

A. R. Ketterson, A.M.E.I.C., has been appointed assistant engineer of bridges of the Canadian Pacific Railway, with headquarters at Montreal, according to an announcement recently issued by the company. Mr. Ketterson is a native of Greenock, Scotland, where he was born on June 24th, 1881. Mr. Ketterson entered the Canadian Pacific Railway service as bridge inspector in the chief engineer's department, Montreal, in May 1907. In 1910 he was engaged on work as a structural draughtsman of bridges in the same department and in 1912 was appointed assistant engineer until 1916, when he went overseas, where he served with distinction and was awarded the D.S.O. In 1919 he was appointed to the chief engineer's department and is now called to the position of assistant engineer of bridges in that department.

A. J. T. Taylor, M.E.I.C., has been elected to the board of directors of the Sir W. G. Armstrong, Whitworth and Company according to an official announcement recently issued, which also contains the information that the Earl of Verulam has been added to the board. Mr. Taylor was formerly president of Combustion Engineering Corporation until the beginning of 1926, when he was transferred from Canada to England as managing director of the Underfeed Stoker Company of London, England, and as director of International Combustion, Limited. He was also chairman of Ruth Steam Accumulator Company of New York, but has resigned the chairmanship to become managing director of Ruth's Steam Accumulators, Limited, of London, England. Upon his election to the board of Messrs. Armstrong, Whitworth he also resigned from the Underfeed Stoker Company.

ELECTIONS AND TRANSFERS

At the meeting of Council held on May 18th, 1928, the following elections and transfers were effected:—

Associate Members

FRY, Albert Edward, general mechanical engrg. work with Dominion Glass Co., Montreal.

GEAR, Sydney Stuart, grad., (Univ. of Toronto), contracting engr., Horton Steel Works, Ltd., Bridgeburg, Ont.

JONES, Robert Bolton, asst. engr., C.P.R. terminal and yard design, valuations rail, etc., Montreal, Que.

MELLOR, Arthur Lees, sr. inspector, Montreal South Shore Bridge, Messrs. Milton Hersey Company, Ltd., Montreal.

SPENCE, William Archibald, B.Sc., (Queen's Univ.), engr. for Thomson & Clark Timber Co., Ltd., Vancouver, B.C.

WALTON, Clarke Gibbs, B.Sc., (Queen's Univ.), constrn. engr., Ford Motor Co. of Canada, Ltd., Sandwich, Ont.

Transferred from the class of Associate Member to that of Member

CARSWELL, John Ballantyne, B.Sc., (Glasgow Univ.), president, Carswell Constrn. Co., Ltd., Toronto, Ont.

HOLLOWAY, Edward S., B.Sc., (McGill Univ.), reporting on various pulpwood operations, wharves, loading plants, etc., i/c for Kerry & Chace, St. Hilaire, Que.

KENNEDY, Howard, B.Sc., (McGill Univ.), mgr. woodlands dept., i/c all woods operations and purchase of pulpwood and match lumber, E. B. Eddy Co., Ltd., Ottawa, Ont.

MILNE, Arthur H., B.Sc., (McGill Univ.), mgr. of mtce. for Protestant Board of School Commissioners, Montreal.

Transferred from the class of Junior to that of Associate Member

BUNTING, William Russell, B.A.Sc., (Univ. of Toronto), power apparatus specialist, Northern Electric Co., Ltd., Montreal.

LeCLAIR, William James, ch. engr. and managing partner of Lawson & LeClair, Dalbeattie, Scotland.

McKAY, Hugh Alexander, B.A.Sc., (Univ. of Toronto), mgr. London Structural Steel Co., Ltd., London, Ont.

VOGAN, George Oliver, B.Sc., (Queen's Univ.), designing engr. for the Alcoa Power Co., Ltd., Arvida, Que.

Transferred from the class of Student to that of Associate Member

DICK, George McKinstry, B.Sc., (McGill Univ.), designing engr. on mine hoists and haulage machinery, Can. Ingersoll Rand Co., Ltd., Sherbrooke, Que.

Transferred from the class of Student to that of Junior

FERRABEE, Francis Gilbert, B.Sc., (McGill Univ.), i/c selling and servicing the Ingersoll Rand Products in the lower half of the state of West Virginia, Huntington, W.Va.

HORSEY, Richard Mountstephen, B.Sc., (McGill Univ.), power cable testing and design, Northern Electric Co., Montreal.

WIGHTMAN, John, B.Sc., (McGill Univ.), mine exploration in N.S., N.B. and Nfld. for Cons. Mining and Smelting Co. of Canada, Ltd., Sydney, N.S.

The Canadian Ohio Brass Company, Limited, announces the removal of its Montreal office from 1188 Phillips Place to 708 Canada Cement Building, effective immediately. This new location provides the company with better facilities for serving the territory covered by the Montreal office.

The Canadian General Electric Company, Limited, announces the publication of their new 1928 Industrial Control Catalogue. This is a 200-page treatise on the latest Canadian General Electric practice in the control of motors. For instance, controllers embodying thermal overload protection, definite time acceleration, time delay, undervoltage protection and other modern features are described in detail. Copies may be obtained through the nearest Canadian General Electric office.

Recent Additions to the Library

Proceedings, Transactions, etc.

PRESENTED BY THE SOCIETIES:

The Institution of Engineers, Australia: Transactions, 1925; List of Members, 1927.
The Institution of Mechanical Engineers: Proceedings, 1927.
The Institution of Civil Engineers: Proceedings, 1928.
The American Society of Civil Engineers: Year Book, 1928.
The American Railway Engineering Association: Proceedings, 1924-1927; Manual, 1921.
The Mining Institute of Scotland: Transactions, 1928.
The Canadian Engineering Standards Association: Year Book, 1927.
The Canadian Institute of Mining and Metallurgy: Transactions, 1927.
The Institution of Water Engineers: Transactions, 1927.

Reports, etc.

DEPARTMENT OF TRADE AND COMMERCE, CANADA:
Bureau of Statistics: Trade of Canada with United States; Trade of Canada with United Kingdom; Canal Statistics, 1927.

DEPARTMENT OF LABOUR, CANADA:
Prices in Canada and Other Countries, 1927. Report No. 11. Wages and Hours in Labour in Canada.

NATIONAL RESEARCH COUNCIL, CANADA:
Report of the President and Financial Statement, 1926-27.

DEPARTMENT OF MINES, CANADA:
Gold Bulletin.

HYDRO-ELECTRIC SYSTEM, WINNIPEG:
Annual Report, 1927.

ELECTRIC POWER COMMISSION, NEW BRUNSWICK:
Annual Report, 1927.

POWER COMMISSION, NOVA SCOTIA:
Annual Report, 1927.

DEPARTMENT OF COMMERCE, UNITED STATES:
Bureau of Standards: Sci. Paper 570, Thermal Expansion of Alloys of the Stainless Iron Type. Tech'c Paper 359, A Superheat Meter or Differential Thermometer for Airships. Tech'c Paper 361, Deterioration of Steels in the Synthesis of Ammonia. Circular 346, Light Metals and Alloys, Aluminum, Magnesium. Handbook 3, National Electrical Safety Code.

DEPARTMENT OF THE INTERIOR, UNITED STATES:
Geological Survey: Water Supply Paper 557, Plants as Indicator of Groundwater.

MONTREAL TRAMWAYS COMMISSION, MONTREAL:
Annual Report, 1927.

PUBLIC WORKS DEPARTMENT, BOSTON:
Annual Report, 1926.

MIAMI CONSERVANCY DISTRICT, OHIO:
Technical Report: Part 3, Theory of the Hydraulic Jump and Backwater Curves. Hydraulic Jump as a Means of Dissipating Energy.

Technical Books, etc.

PRESENTED BY THE AUTHOR:
Laboratory Notes for Electrical Engineering Students, by A. R. Nissar.

PRESENTED BY CANADIAN INGERSOLL RAND COMPANY, LIMITED:
Handbook of Pneumatic Engineering Practice, by W. L. Saunders. A Handy Reference on the Subject of Hydraulics.

PRESENTED BY D. VAN NOSTRAND COMPANY, NEW YORK:
The A. C. Commutator Motor, by C. W. Olliver.
Probability and Its Engineering Uses, by Thornton C. Fry.
Matter, Electricity, Energy, by Walter Gerlach and Francis J. Fuchs.
The Disposal of Sewage, by T. H. P. Veal.

PRESENTED BY THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS:
The Engineering Index, 1927.

PRESENTED BY J. R. W. HECKMAN, M.E.I.C.:
The Engineering Institute of Canada: Transactions, 1887-1918; Journals, 1918-1927; Quebec Bridge, 1908; Charts of Canadian Pacific Railway.

PRESENTED BY MRS. C. B. SMITH:
The Engineering Institute of Canada: Transactions, 1887-1911. Royal Commission: Quebec Bridge Inquiry, 1908. Institution of Civil Engineers: Proceedings, 1905-1908, 1911; List of Members, 1908.

EMPLOYMENT BUREAU

Situations Wanted

ENGINEER AND SUPERINTENDENT

First class man, graduate engineer, is looking for a new position. Has ten years experience in big construction work. Apply to Box No. 236-W, The Engineering Journal.

MUNICIPAL AND CONSTRUCTION ENGINEER

Fully qualified engineer with experience in municipal work, paper mill construction and operation, and other industrial work, is available for a position. Experience covers a period of eight years on municipal work, during which the position of city engineer was held, two years on the construction and operation of a paper mill, and six years as engineer, superintendent, and chemist in manufacturing work. Apply Box No. 237-W, The Engineering Journal.

CIVIL ENGINEER

Age 35, A.M.E.I.C. and Regd. Professional Engineer of Ontario, seeks position as town engineer for small Ontario town, Northern Ontario preferred, but other locality considered. Apply box No. 238-W, The Engineering Journal.

Situations Vacant

STRUCTURAL STEEL DETAILERS

A company in Ontario has two openings for experienced structural steel detailers. Apply box No. 195-V, The Engineering Journal.

PULP AND PAPER MILL DESIGNER

A pulp and paper company in Northern Quebec has an opening for a competent designer. Preferably one with pulp and paper mill, or at least industrial experience. Preference will be given to an unmarried, university graduate. Apply box No. 197-V, The Engineering Journal.

INSTRUMENTMEN

Two graduate engineers with experience in survey work as instrumentmen for general survey work in connection with power projects. Apply box No. 203-V, The Engineering Journal.

ARCHITECTURAL DRAUGHTSMAN

With experience in designing, detailing and able to make specifications and estimates. Apply box No. 204-V, The Engineering Journal.

BOOK REVIEWS

The Disposal of Sewage

By T. H. P. Veal, Van Nostrand Company, New York, 1928, Cloth, 8½ x 5½ in., 170 pp., figs., plans, $4.25.

This book, written for the use of engineers, introduces the subject of sewage disposal by giving a short and interesting history of the sanitary conditions in Britain in the early nineteenth century, and traces the gradual development of the method of dealing with sewage and storm water.

Owing to the increasing density of population and the aggravated unsanitary condition of the rivers and streams, drastic measures had to be taken decades ago in an honest effort to improve affairs, and, without doubt, Britain was therefore compelled to lead in the work of sanitation. Broad irrigation of land, which its subsequent modifications, has long had its day and in many places has had to be supplanted by improved methods of treatment.

The collection of sewage and storm water, simple as it appears to many, entails considerable study to obtain the best result. The author traces these conditions and refers to the many differences between British requirements, and, say, North American. The use of water is greater in this country. The climatic conditions are more severe, and the intensity of rainfall is higher. The author also refers to the periodicity and fluctuations of the flow of sewage.

A Canadian student using the book as his text must bear in mind the differences mentioned.

The design of sewers by the Burkli-Zeigler formula is seldom done now in North America with satisfactory results. The rational method, or, more correctly, the synthetical method with the adoption of suitable factors, is largely in use here.

The author describes the various methods of sewage disposal. He deals with screens and grit chambers, also with tanks for sedimentation. If the tank is to be self-cleansing, the slopes should exceed one in ten, as stated on page 55. Interesting calculations are given to estimate the capacity of rectangular settling tanks for continuous flows.

Reference is made to contact beds similar to those built by the reviewer in 1896 and contact beds are still in use where careful supervision is possible, but many changes have taken place since then, and percolating filters have largely supplanted them. The efficient use of percolating filters depends to a great extent upon the proper performance of the operations in the sedimentation tank, for if much fine flocculent sludge is carried forward, the filter will choke. The use of percolating filters is extensive, and where it is under proper control its efficiency is high, hence the desirability of maintaining good sedimentation, the avoidance of septic action, and the adoption of reliable efficient distributors, many of which are illustrated in this book.

In the matter of bio-aeration treatment, the author gives a terse history of its development. On page 115 he states that the detention in bio-aeration tanks varies from six to eighteen hours. This much exceeds the time allowed in this country. Possibly this is due to the more dilute character of the sewage on this side. The interesting method of aeration which originated in Sheffield is described, but this method has not yet been tried on this side. The Simplex Surface aeration whieh was evolved at Bury has been tried in the United States.

The use of combined bio-aeration tanks and trickling filters as tried at Birmingham has considerable promise, for the action in the aeration tank is rapid and it is possible to minimize the time and cost of aeration by completing the purification on trickling filters.

The author mentions the subject of the creation of activated sludge, which by normal aeration is a slow process. The Director of the Engineering Division of the Provincial Board of Health of Ontario has a chemical process of starting the plant which is effective and expeditious.

The disposal of the sludge is a matter of prime importance in eonnection with sewage treatment. Mechanical methods such as centrifuging, pressing, intensive filtration, etc., are not practically efficient. Mr. Watson of Birmingham long ago suggested the process which gives promise of success, namely, by digestion. This is dealt with by the author, but not in a sufficiently comprehensive manner. The policy of reducing the sludge by proper digestion is one which will probably be largely adopted in future. This problem is under investigation today in a number of places, both in Europe and America.

The development of power by using gas generated in digestion tanks is a most interesting one, and the author might discuss this matter more fully in future editions.

The costs of works as given by the author are useful for British readers, but the proportions and expenditures involved are not comparable for use on this continent. Nevertheless, the reader will find much of value.

The disposal of sewage in rural districts is dealt with and many instructive examples are given.

Veal's volume on "Sewage Disposal" will be found useful for reference as to the methods adopted by different engineers in handling various sewage problems, and, if it is borne in mind that the book is intended primarily for British engineers, it will be found valuable by students of sanitary engineering in Canada and elsewhere.

R. O. Wynne-Roberts, M.E.I.C.
Wynne-Roberts, Son & McLean,
Toronto, Ont.

Matter, Electricity, Energy

By Walter Gerlach, translated by Dr. F. J. Fuchs. Van Nostrand, New York, 1928, Buckram, 9 x 5 in., 427 pp., figs., $6.00.

The title of this book, "Matter, Electricity, Energy," does not give as clear a conception of its contents as if the title read "Atoms, Electrons and Quanta," for this is indeed the range of subjects of which the book treats. However, one can well understand that to the author, matter and electricity are practically synonymous with atoms and electrons and that he regards energy as being more worthy of emphasis than theories concerning quanta.

This book, which has only recently been translated from the German, was originally written in 1893 and revised in 1896, and is really a mine of information on the subjects of which it treats. It is written from the experimental standpoint, contains no mathematics and is therefore fairly easy reading. Before reading the book, however, unless one is well versed in physics or physical chemistry, it might be advisable to obtain some slight knowledge of atomic physics by reading some such book as the "World of Atoms," by Haas, recently reviewed in these columns, which treats of many of the same topics but in a more elementary way and much more briefly. We are informed that the book was written for the chemist, the mineralogist and the engineer, and that it has been widely used as a seminar text book for graduate students. This information gives us a good idea of the scope of the book and to the class of reader to which its appeal is made.

To the engineer who wishes to keep abreast of the times, we recommend the book very highly, for, while it treats of many things that are regarded as pure science, we must remember that the pure science of to-day is the source out of which to-morrow's applied science must spring. Some of the pure science in this book is already receiving practical application. For instance, photo-electricity is now fundamental in the new science of television. Certain practical applications of the photo-electric effect are taken up and given considerable attention. There are also chapters on super-conductivity, crystal conduction, photo-chemistry and structure-analysis by means of X-rays. Super-conductive effects are simply marvellous, for we are informed that at very low temperatures,—within a few degrees of absolute zero,—the resistance of certain metals is 10^{12} times as low, or, in other words, one millionth of a millionth as low as at zero degrees centigrade.

The translation is well done, and we are under obligation to Dr. Fuchs for having made available to us in English this important German book.

W. B. Cartmel, M.E.I.C.,
Engineering Department,
Northern Electric Company, Limited.

Addresses Wanted

A revised list of members is being prepared for publication in the form of the Year Book, and it is desired to have this list as accurate as possible. The following is a list of names of members for whom there is no address on file at Headquarters. The Secretary would appreciate any information as to the present address of any of these members.

Members

Albertson, D. J.
Angstrom, A.
d'Abbadie, D.
Lavoie, A. J.
Longley, H.
MacKenzie, H. J.

Associate Members

Avery, C. R.
Ball, A. N.
Boese, P. R.
Bower, J. H. W.
Christopherson, W. W.
Crawley, F. A.
Edwards, T. A.
Erskine, J.
Franzen, J. L.
Fraser, A. S.
Ghysens, A. L.
Hamilton, J. B.
Hawkins, S. H.
Hobbs, B. D.
Kingston, L. B.
LeBaron, K. S.
MacNeil, Hector
McDonald, J. M.
Miller, W. M.
Mitchell, C. N.
Mitchell, R. W.
Papineau, A. J.
Pearson, F. W.
Richardson, F. L.
Roberts, W. H.
Robertson, H. H.
Schachere, B.
Stephenson, John
Szammers, C. F.
Tidy, W. E.
Tilsley, R. F.
Turnbull, Wm. J.
Watt, T. L.
Waycott, R. L.
Wilson, W. G.

Juniors

Bigras, J. A.
Dupuis, J. H.
Ellis, W. H.
Gerin, M.
McIntosh, A. K.
McLennan, G. R.
Penrose, J. A. M.
Simpson, C. N.
Trueman, J. C.

Students

Anderson, Carl L.
Balfour, M. W.
Batzold, H. A.
Benger, W. F. A.
Boismenu, Romeo
Boyd, I. W.
Bryant, G. F.
Campbell, F. R.
Chabot, A. J.
Chen, T. Y.
Climo, C.
Cornish, W. E.
Evans, W. J.
Evjen, R. W.
Fetter, R. E.
Finkle, C. S.
Fox, M.
Frid, C. H.
Gibbs, J. W. S.
Hamilton, G. J.
Henderson, W. A.
Hicks, Alva
Johansen, A. M.
Johns, C. F.
Kellett, J. E.
Kernaghan, E. B.
LeGron, R.
Lewis, C. E.
Lewis, W. J.
Lowry, W. S.
MacDonald, F. S.
Mathieu, Albert
Mauer, R. W.
McLeish, R. G. H.
McNab, A. H.
Morris, Max
Morton, R. M.
Munroe, K. A.
Oliver, J. H.
Pringle, J. B.
Roquet, Leo L.
Scovil, J. L.
Seely, H. C.
Shanly, R. C.
Smith, D. F.
Snyder, E.
Stock, S. W.
Switzer, H. R.
Weisburgh, C.
Wells, C. M.
Whatmough, F. R.
Wilson, F. E.
Wyatt, D.

BRANCH NEWS

Border Cities Branch

Orville Rolfson, A.M.E.I.C., Secretary-Treasurer.
(Reported by R. C. Leslie, A.M.E.I.C.)

This branch held its April meeting in the Prince Edward hotel, Windsor, on Friday the 20th. The meeting was well attended and a good speaker was on hand whose talk was enjoyed by all present. Mr. Herbert W. Walter, superintendent of the Port Colborne plant of the International Nickel Company, was the guest of honour, and he described for us the nickel industry.

Mr. Walter went over some of the history of nickel, telling of its early discovery in Ontario in 1854, and of the difficulties which stood in the way of refining the new metal. The discovery of a suitable process for refining brought with it a realization that there was no market for nickel after it was produced in commercial quantities. The governments of Canada and the United States were both interested in nickel and assisted the producers in developing markets. The United States navy ordered one million dollars worth of nickel steel for armour plate. Gradually other uses became known, and the production of nickel increased.

The members were shown, by means of diagrams, the Creighton mine and the system used there for removing the ore. Then the process of natural roasting takes place before the smelter is reached. The material that is shipped to Port Colborne is a nickel matte, 80 per cent copper and nickel. The Port Colborne plant uses the Orford process for refining nickel, and this was described in detail. Mr. Walter stated that with the electrolytic refining, which is being used more and more, the nickel comes out 99.95 per cent pure.

Before the World War the main use of the metal was in ordnance and armour plate, and during the war the demand increased tremendously. However, with the cessation of hostilities in 1918, followed by the Washington Conference of 1922, the market disappeared. For a time the nickel business was practically non-existent. The company then instituted a vigorous research programme with a view to discovering new uses. They were highly successful in so doing, and today the business is larger than before the war, but the major demand is for peace time purposes. An interesting comparison is to be had in the following table:—

	Uses in 1913	Uses in 1925
Armour plate	52 per cent	3 per cent
Coinage and plating	26 " "	23 " "
Nickel steel	17 " "	50 " "
General	5 " "	24 " "

How intimately nickel has been worked into the life of today was shown by tracing the daily routine of the average man, showing how nearly everything that he uses or comes in contact with during the day has nickel in its composition.

In the discussion which followed Mr. Walter's address, a visitor to the branch, Mr. Cummings, who had been connected with the Nickel Company for some years, gave some additional information that was of great interest.

Moncton Branch

V. C. Blackett, A.M.E.I.C., Secretary-Treasurer.

Sackville Meeting

On April 4th a combined meeting of Moncton branch and the Engineering Society of Mount Allison was held at Sackville, in the Science building of the university. H. J. Crudge, A.M.E.I.C., building engineer, Canadian National Railways, Moncton, N.B., gave a very instructive address on "Construction Methods." The address was illustrated with slides and motion picture films, showing construction of the immigration building, and new Canadian National Railway hotel and station at Halifax. Prof. F. L. West, M.E.I.C., presided.

Construction Methods

The term "Construction Methods" in reality had reference to handling the material of which the structure was composed. The best and cheapest methods are those which involve as little handling as possible. Strange as it may seem, the lazier the foreman or superintendent, that is, with regard to moving his building materials, the more efficient he may be. Naturally, in avoiding unnecessary physical labour, considerable foresight and planning is required. The mixing of concrete, for example, is an every-day manufacturing operation, but the efficient stacking and handling of the materials of which the concrete consists is a problem that sometimes taxes the skill of the engineer to a considerable extent.

Mr. Crudge described in detail conditions affecting the building operations at Halifax. In the construction of the hotel foundations, the sand and gravel were taken in dump trucks from a central pile, an average distance of 200 feet, and elevated to the mixer. The finished concrete was carried away by a suspended trolley, then dumped into steel buggies and wheeled by hand to the forms. The daily, (8-hour), output averaged 100 cubic yards. It was interesting to note that both dump trucks and buggies were equipped with roller bearings in order that operations should be carried on with maximum speed and minimum effort. In pouring the upper floor of the 1,250-foot immigration building, the mixer was mounted on a travelling tower. The haul away from the mixer was reduced and the daily output increased to 125 cubic yards. Very favourable circumstances existed in connection with the pouring of the lower floor, in that two parallel tracks ran alongside the building for its entire length. The mixer, in this case, was mounted on a flat car on the inner track and the material cars drawn up on the outer. The movement of material, both to and from the mixer, was in consequence reduced to a minimum and the daily output again increased, this time to 140 cubic yards.

In conclusion, Mr. Crudge described briefly the precautions that were taken to protect the concrete in freezing weather.

Following the address, the thanks of the meeting was tendered the speaker by the presiding chairman.

Forestry and Its Relation to Canadian Forests

A joint meeting of Moncton branch and the Gyro Club of Moncton was held in the Palm Room of the Brunswick hotel on April 23rd. This meeting was arranged in connection with the "Canadian Forest Week" campaign for forest protection. H. P. Webb, professor of forestry, University of New Brunswick, delivered an address on "Forestry and Its Relation to the Canadian Forests."

The forestry profession is still very young in Canada. Very little has been done along purely scientific lines of research. However, a start has been made and this phase of the profession has been receiving more attention during the past few years. The day of the old timber cruiser has passed to a great extent, and now private companies, trust companies and banks throughout the Dominion require reports of timber limits made by educated, trained men who can make a systematic survey that is not a casual guess.

The crying need of our forests to-day is protection. Not only protection from fires but protection from too heavy exploitation and protection from insect pests. All of these represent part of a forester's problem. The greatest enemy of our forests has been fire, and unless we can stop the fire fiend from licking up our green timber and young growth the pendulum, which is now swinging to a great era of development and prosperity, will swing in the other direction. Prevention is better than cure, and if every Canadian citizen could be impressed with the value of our great heritage the cure would not be quite so necessary.

The second part of the forester's duty is to prevent depletion from overcutting the annual growth increment. This phase of forestry has been given too little attention in the past. The province of Quebec has enacted legislation whereby lease-holders of Crown Lands are only permitted to cut 80 per cent of the growth increment.

Finally, a forester should have a working knowledge of entomology, especially that branch of it which is known as forest entomology, along with a knowledge of forest pathology. We have, in the past, had serious insect pests in our forests, outbreaks which have cost Canada the loss of millions of dollars.

In Canada to-day we have four forest schools which, it is believed, are adequate to supply the demand for technically trained men. These schools are the University of British Columbia, at Vancouver; the University of Toronto; the Laval Forest School, in Quebec City, and the University of New Brunswick.

The importance of the forest is second only to agriculture, and it produces more than twice the value of the products of the mines. The forests provide 20 per cent of the entire freight hauled on Canadian railways.

The area which is capable of producing timber in Canada, is estimated at about 1,200,000 square miles. Much of this area has suffered from forest fires, and in many instances is covered with young stands of timber. These areas as well as the merchantable stands must be protected from fire, since they represent a great potential value.

Montreal Branch

C. K. McLeod, A.M.E.I.C., Secretary-Treasurer.
W. McG. Gardner, A.M.E.I.C., Branch News Editor.

St. Lawrence Waterways

On March 29th, the Montreal Branch was favoured with two authentic studies bearing on the most important engineering project of the day when Vice-President Jas. H. Hunter, M.E.I.C., and Councillor O. O. Lefebvre, M.E.I.C., presented papers on the St. Lawrence Waterways.

Paper by J. H. Hunter, M.E.I.C.

In a brief historical review, the author described the discovery of the St. Lawrence river by Jacques Cartier and its subsequent exploration by Champlain, LaSalle and others. Dating from the Treaty of Paris in 1783, when the boundary between the United States and Canada was first defined, the river and Great Lakes assumed a new and international importance. Treaties in 1814, 1842, 1871 and 1909 added to the delimitation of this boundary, established other rights, obligations and interests of both countries along their common frontier and in the national sections of this waterway.

"About one hundred years ago the provinces of Canada started the present canal system, and by the year 1850 a nine-foot draught was available. Later, it was decided to deepen the Welland and St. Lawrence canals and enlarge their locks. The former was completed to a depth of 14 feet in 1887 and the latter in 1901, at a capital cost, to date, exclusive of interest, maintenance and operation, of approximately $65,000,000.

"In 1914, work on the New Welland canal was started. This work will be completed in 1930, at a cost of about $120,000,000. This canal will have eight locks instead of twenty-six and a minimum navigable depth of 25 feet. The time of passage for a boat will be reduced from an average of fifteen to an estimated eight hours. With the opening of this new canal, the largest vessels now operating on the upper lakes of about 10,000 tons will be able to navigate as far as Kingston. With improved channel depth and width throughout the Thousand Island section, these could come as far as Prescott, 110 miles west of Montreal.

"While the present tonnage passing through the St. Lawrence canals is large, the canals are not yet nearly taxed to the limit. It is true that congestion takes place at certain periods of the year, but for the major portion of the time the canals are not operated at anything like their full capacity. Government statistics show it to be less than 50 per cent. The building of the Hudson Bay railway, the ever-growing grain shipments via Vancouver, reduction in eastern railway rates and the opening of the New Welland ship canal will all have their effect on the traffic through the St. Lawrence canals.

"Agitation by the central and western states for improved navigation, combined with the demands of eastern states for a large amount of power at a low rate, culminated during 1919 in the United States government requesting the International Joint Commission which had been created by the Waterways Treaty of 1909 for an investigation of the possibilities of improving navigation and developing power on the St. Lawrence river between lake Ontario and Montreal.

"Two engineers appointed by the Commission at that time to examine the project, after having made extensive surveys and co-ordinated various reports and studies of the whole undertaking, reported in favour of the development of a combined navigation and power scheme in the international section and a navigation scheme in the Quebec national section, estimating the cost of these improvements at $250,000,000. This report was not acted upon.

"Further pressure was brought to bear upon Canada by the United States in 1924, resulting in the appointment of the St. Lawrence River Commission by the United States and the National Advisory Committee by Canada. During the same year the two governments appointed a Joint Engineering Board consisting of three engineers on each side. The Canadian representatives were Messrs. McLachlan, Lefebvre and Mitchell, all members of our Institute. This Board was instructed to investigate and report what improvements would be necessary to make the St. Lawrence river navigable for ocean steamers between Montreal and the head of the Great Lakes, together with the estimated cost of such an undertaking.

"The Joint Engineering Board has now made its final report, in which they come to the conclusion that with specific safeguards the plan is feasible. The estimated cost of the combined project of navigation and power, as recommended by them, is $620,000,000. Of this amount, which does not include the cost of the New Welland canal,—$180,000,000 is chargeable to navigation and the balance of $440,000,000 to the development of some 5,000,000 h.p.

"The proposal, as it now stands, is to dam the river at Lachine and other rapids in the Canadian and international sections; deepen and widen the channel through lakes St. Louis and St. Francis, and the connecting river portion as well as in the international part of the river between Cornwall and lake Ontario.

"The power would be developed as follows:—At the international portion of the river, 2,326,000 h.p.; Soulanges rapids, 1,980,000 h.p.; Lachine rapids, 924,000 h.p. It will be noted that 46 per cent of the power is in the international section, the United States and Canada both being entitled to 23 per cent respectively. As 54 per cent is wholly within the boundaries of the Dominion, Canada is therefore entitled to 77 per cent and the United States to 23 per cent of the total available power.

"From a navigation viewpoint, the success of the whole project depends upon the probability of obtaining return cargoes. Heretofore, owners refuse to take advantage of lower rates by reason of damage in transferring and shipping, delay occasioned in transit, and the proportionate higher rail rate for forwarding from the head of navigation due to short haul.

"From a power standpoint, there can be no question but that the development and sale of such an enormous quantity of power would more than offset the loss suffered on account of transportation. In fact, it is estimated that the sale of power would pay interest, depreciation and maintenance on the total cost and leave a considerable balance towards profit and loss.

"However, if the use of electric power in Ontario and Quebec should grow in the future as it has in the past fifteen years it would be thirty years before we could utilize our portion of the available power, possibly even forty years, taking into consideration the limitations of the specified area between Toronto and Quebec.

"In the author's opinion, there is no objection to an agreement being arrived at between the two countries for the development of power and the improvement of navigation on the international part of the river as and when Canadian requirements may demand. The upper or Morrisburg part of the project could be put through immediately, and the 300,000 h.p. which would be Canada's portion, could readily be absorbed by the Hydro-Electric Power Commission of Ontario. The second development, at the foot of the Long Sault rapids, should only be undertaken when Canada can utilize the power to which it is entitled, about 700,000 h.p. These two developments, with some dredging in the river, would improve navigation as far as Cornwall or throughout the international section of the river. At this point, the United States control of the project in any way, shape or form should terminate.

"The strictly Canadian section should not be undertaken until we are ready to absorb sufficient of the power available to pay for the cost thereof, and it should be controlled and paid for by Canada."

Paper by O. O. Lefebvre, M.E.I.C.

As a member of the Joint Board of Engineers appointed to study the development of the St. Lawrence river for navigation and for the supply of power, it was not to be expected that Mr. Lefebvre would refer to features of the project beyond the scope of the Board's report.

In opening his remarks, the author presented data relating to the Great Lakes which illustrated their ability to serve two great economic uses: as navigation routes of vital concern to the two countries and as an enormous reservoir system to equalize the flow of the St. Lawrence river.

Though the total area of the drainage basins is approximately 300,000 square miles, nearly one-third is occupied by the lake surface itself. So great is the volume of water that a draw down of only one foot on the lake system as a whole would provide the entire average flow delivered to the St. Lawrence for more than four months or a total of 1,008,500 cubic feet per second.

Loss by evaporation is very great, amounting to roughly 40 per cent of the total gross-supply. In fact, the records show months having a negative net supply. Nevertheless, the monthly mean outflow from the lakes during the past sixty-five years has ranged between the narrow limits of 318,000 and 174,000 cubic feet per second, and this minimum was due to ice retardation. The average yearly outflow is even more regular, ranging between 285,400 cubic feet per second in 1861 to 205,500 cubic feet per second in 1895. The average total outflow from 1861 to 1925 has been 246,100 cubic feet per second.

The annual fluctuation of the lake levels in absorbing the seasonal irregularities of supply is also within narrow limits, ranging from 15 to 24 inches, with extreme fluctuations rarely exceeding 36 inches.

Superimposed on the rise and fall of the level surfaces of the lakes shown by the monthly mean levels, there are occasional oscillations due to wind and barometric pressure by which the water is raised temporarily by several feet in a part of a lake and depressed by an equivalent amount in another part. Lake Erie, being shallow as well as long and narrow, is particularly subject to such disturbances. Its fluctuations reach their maximum at Buffalo where, during a western gale, the water has been known to rise eight feet above its monthly mean level, with a corresponding fall of four feet at Toledo. While the systematic recording of the levels of the lakes was not begun until 1860, old records indicate that in 1819 the lakes may have been at substantially the low levels of 1925.

The records of the several water level gauges on the Great Lakes show a gradual steady rise of the earth surface on the northerly shores of the lakes relative to that of the southerly shores. The axis of the present tilting as a whole is approximately twenty degrees north of west and the rate of titling is in the vicinity of six inches per hundred miles per hundred years. If the titling of the earth continues at the present rate, it is to be expected that the depths in the channels of the lower St. Mary's river, where the movement is worst, may be reduced by one foot in a hundred years.

The author presented a discharge formula for the St. Clair river, while ice free, as follows:—

$$Q = 100\ [(H-B) + 0.6\ (h-B)]^{1.8}\ (H-h)^{0.5}$$

Where Q = discharge in cubic feet per second.
H = elevation of Lake Huron (Harbour beach.)
h = elevation of Lake St. Clair (St. Clair flats).
B = a constant of 551.58 at present.

In referring to the diversion at Chicago, the author touched on methods of compensation that would counteract the effect and give results commensurate with their cost. Such means as a series of rock-filled submerged weirs was found to have been satisfactory at other locations.

In opening the discussion, Mr. Geo. Henderson, chairman of the Montreal Board of Trade, expressed his pleasure at being present to obtain information on the engineering problems connected with this project. Though difficult, he observed that these were not insuperable.

Mr. A. L. W. MacCallum, secretary of the Shipping Federation, believed further information was required before it was possible to say where ocean vessels could or could not go.

J. A. Jamieson, M.E.I.C., also felt that further study was required, particularly with regard to the possibility and economics of improving the present system of grain transportation.

Authentic information covering the economic features of the project was greatly needed.

Major C. F. Draper, M.E.I.C., proposed the thanks of the meeting to the speakers which was presented by F. C. Laberge, M.E.I.C., chairman of the Montreal Branch, who presided.

Niagara Peninsula Branch

Walter Jackson, M.E.I.C., Secretary-Treasurer.
C. G. Moon, A.M.E.I.C., Branch News Editor.

Under the new By-laws, the following officers for the Niagara Peninsula Branch have been elected for the coming year:—

E. G. Cameron, A.M.E.I.C., *Chairman.*
Walter Jackson, M.E.I.C., *Vice-Chairman.*
R. W. Downie, A.M.E.I.C., *Secretary-Treasurer.*

H. M. King, M.E.I.C. C. G. Moon, A.M.E.I.C. N. Bates, A.M.E.I.C.
E. S. Turner, A.M.E.I.C. J. E. Sears, A.M.E.I.C. W. R. Manock, A.M.E.I.C.
R. L. Peek, M.E.I.C. E. P. Murphy, A.M.E.I.C.

Ex-officio

A. J. Grant, M.E.I.C., Vice-President of The Institute.
C. H. Scheman, M.E.I.C., Past-Chairman.
M. B. Atkinson, M.E.I.C., Councillor.

The results of the balloting were made known at a special luncheon meeting, called the "Electoral Meeting," which was held in Thorold on May 4th. Fifty-four ballots were returned out of a total of one hundred and thirteen issued, which is probably as high a percentage as most of the municipal, provincial or federal election returns.

With that spirit of modesty which characterizes the true engineer, a few of the newly-elected officials failed to put in an appearance at this meeting, and in consequence the naming of chairman, vice-chairman and the appointing of a secretary-treasurer was held over until the following Monday.

Therefore, at noon on Monday the newly-elected executive met at the residence of Mr. Grant and prepared to transact this most important business for the branch, and there was very little time wasted. After an excellent meal, prepared under the skilled supervision of a Scottish-Canadian epicure, a motion was tentatively put forward suggesting E. G. Cameron, A.M.E.I.C., as chairman, Walter Jackson, M.E.I.C., as vice-chairman, and R. W. Downie, A.M.E.I.C., as secretary-treasurer.

Much to the surprise of these gentlemen, no question was raised as to this and the motion was then and there adopted unanimously.

The annual meeting was to be held that same Monday evening with Sir Henry Thornton, M.E.I.C., as the principal speaker.

Sir Henry, Lady Thornton and their party, consisting of A. E. Warren, R. H. Fish, T. T. Irving, A.M.E.I.C., E. G. Hewson, M.E.I.C., W. H. Hobbs and H. C. Rochester, arrived in St. Catharines at 2.30 p.m. Members of the executive met them at the station and showed them some of the interesting engineering works in the peninsula, including the lock and harbour of the ship canal at Port Weller and the hydro-electric power plant near Queenston.

Ninth Annual Meeting

Following a policy which had proved successful last year, the executive decided to again invite ladies to be present at this meeting. Lady Thornton had kindly consented to attend and bring Sir Henry, who was to do all the speaking. The combined result was an overflow meeting, with table space at a premium and a severe tax put upon the hotel staff. Some three hundred people, of whom about forty per cent were ladies, attended this meeting, which was held at Niagara Falls on May 7th. Mayor Stevens, of Niagara Falls, welcomed the members of The Institute to his city, and was responded to by Mr. Hewson, who explained that his engineering duties with the National Railways did not always include speech-making, but that he was willing to try anything once and hoped that, if he were successful, it might lead to other invitations and possibly a permanent sinecure as a substitute for Sir Henry.

Alex. J. Grant, M.E.I.C., introduced Sir Henry Thornton, M.E.I.C., as a brother engineer who had also devoted his life to the study of transportation by land instead of by water, and the growth of any large continent such as Canada was insolubly related to the growth of transportation.

Address by Sir Henry Thornton, M.E.I.C.

"This vicinity, which is known as a peninsula, and which probably could be better described as the Garden of Eden, especially in blossom time, has provoked more engineering effort than any other section of Canada. In 1824, the first canal was started, and as the decades passed by that canal, which provided an artery between the Great Lakes and the Atlantic ocean, was increased in size and altered several times until to-day the new Welland canal represents one of the greatest canal works in any quarter of the globe. The locks, I am told, even exceed in some respects those of Panama.

"Not only in the construction of canals has this been a prolific field for engineers, but from Detroit to the Niagara river various lines of railway connect various parts of the United States by a short route to the eastern part. There, too, is a great artery of commerce. To-day there flows across this peninsula and southern Ontario an enormous traffic, not only of the Dominion of Canada, but international. Last year across the Canadian National bridge at Niagara Falls there passed 650,000 loaded and 500,000 empty freight cars, which gives some indication of the importance of this part of Canada. It is singularly appropriate that this branch of The Institute should take pride in the achievements which have and are taking place in the southern part of Ontario and in the Niagara peninsula in particular.

"Engineering is probably one of the most ancient of all professions. There are two distinct features of the work of our ancestors as compared with the modern engineer. The ancient engineer was chiefly concerned with moving masses in two planes, and he had unlimited manual labour. All the great works of antiquity con-

Sir Henry Thornton's Visit to Niagara Peninsula Branch.

sisted solely of hewing blocks of stone and moving them either horizontally or vertically. The accomplishments were extraordinary, not only in the magnitude of the work, but also in the precision. All was carried out and brought to completion by the sacrifice of an enormous number of lives. They went to war to acquire slaves —manual labour. The great works of antiquity were founded on sacrifice of numerous lives.

"After what we saw this afternoon in the inspection of the plant of the Hydro-Electric Commission, I can say that there is a task which vastly exceeds in skill and ingenuity all the accumulated engineering efforts of the ages; and more significant is the fact that this great work was not brought on through the sacrifice of innumerable lives,—was not erected to do honour to some strange god or to protect some great monarch,—but for the development of electrical energy usefully employed in the service of mankind. There we have the difference between the engineers of antiquity and the modern engineers. We, as engineers, should direct our efforts and brain power to the construction of useful works and bring to bear all the science placed at our disposal. However much we may admire the grandeur or with what amazement regard the ruins of ancient days and say that modern engineers could not reproduce the work, I would say that the modern engineer not only exceeds in the monumental character of the work but in the use to which it is put."

Sir Henry then pointed out the opportunities for the engineers to assist in the great national objective to bring into harmonious relations all sections of our country and all our resources, and, after referring to the various resources of the country, concluded his remarks by saying:—

"Certainly the future of Canada is assured,—it only remains for us, as good engineers, to bring into harmonious relationship all the different elements found in this country, both material and social, and if we dedicate ourselves to that purpose and adopt the policy one for all and all for one there would be no country of greater prosperity than the Dominion of Canada, and as the ages roll by our country will become richer and richer and achieve the destiny for which it has been marked by Providence."

At the conclusion of Sir Henry's remarks, C. H. Scheman, who presided, gave out the names of the newly-elected executive and then the meeting adjourned.

Too much credit cannot be given to Messrs. Scheman, Grant and Cameron, and particularly Mr. Jackson, for their hard work and untiring effords towards making this meeting such a success. Owing to the constant demands upon Sir Henry's time, he was unable to give more than one week's advance notice. Dinner arrangements, entertainment, programmes, notices, etc., were prepared in exactly seven days.

MEETING IN HONOUR OF PRESIDENT JULIAN C. SMITH, M.E.I.C.

Another hastily-prepared meeting was responded to in a noble manner by the branch. On a day's notice, some thirty-five members met at luncheon and welcomed the president of The Institute and Mr. Durley.

The luncheon was held at the Lincoln hotel, St. Catharines, on May 17th, and quite a number accompanied Mr. Smith and Mr. Durley to Hamilton afterwards to attend the annual meeting of that branch.

Mr. Cameron introduced Mr. Smith, who spoke briefly and to the point about the affairs of The Institute.

Engineers, said Mr. Smith, were not as highly organized as some of the other professions, and one of the principal objectives of The Institute is to work towards some such organization as exists in the medical profession. To do this, however, it was necessary that engineers should pull together and give of their best towards aiding The Institute.

Ever since branches and provincial organizations had come into being, The Institute had taken on a new lease of life, but he wished to convey a warning that branch affairs might prove to be so absorbing that the parent body would suffer from neglected interest.

There should be some closer amalgamation and understanding; some sort of affiliation with the provincial bodies which would tend to do away with overlapping of effort and bring all engineers upon a uniform basis and working together, but in their respective spheres, towards a common end.

The Engineering Institute of Canada, Mr. Smith pointed out, was the oldest and best-known organization, and as such was logically the nucleus wherein improvements should have their origin. It was governed by a president, vice-presidents and councillors, many of whom gave a great deal of their time and took a lot of trouble with Institute affairs. The old idea that Council at Headquarters ran things for the benefit of a clique in Montreal is exploded.

He and others had sat many evenings from eight until ten going into business details and then from ten to twelve passing on applications for admission. Most councillors, although highly appreciative of the honour, quite willingly step aside when some worthy successor is appointed to take their place.

In conclusion, Mr. Smith pleaded that the greatest latitude be given to Council. Councillors were in touch with the needs of The Institute and could be trusted to judge fairly in the handling of its affairs. The one weakness of our democratic system of government was that men were elected to look after the welfare of the country as a whole, and yet had so little freedom that they thought provincially.

Ottawa Branch

F. C. C. Lynch, A.M.E.I.C., Secretary-Treasurer.

The Ottawa Branch was honoured in having as its guest at luncheon at the Chateau Laurier on April 23rd, Mr. F. Handley Page, C.B.E., designer of Handley Page aircraft, who was paying a short visit to Ottawa. Members of the Canadian Club were also invited to attend, with the result that the main dining room of the Chateau was well filled when Chairman Dr. Chas. Camsell, M.E.I.C., rose to introduce the speaker, whom, he stated, it was very gratifying to have as our guest, especially when the attention of the whole world was focussed upon two notable events in aviation,—the crossing of the Atlantic by the Bremen and of the polar regions by Wilkins.

RECENT DEVELOPMENTS IN AVIATION

Choosing as his subject "Recent Developments in Aviation," Mr. Handley Page first spoke of the phases through which aviation has passed in Europe. After the war, he stated, it was thought that every aircraft manufacturer must look to civil development in order to make progress, and some of them started without government subsidies to run aviation lines in Europe. Very soon it was found that in the short distances in Europe such services could not pay, and in the countries where services had been run without subsidy, subsidies were given, and in other countries that had started out with subsidies, the subsidies were increased. As time went on, these subsidies formed a very large proportion of civil aviation companies' receipts, 70 per cent in 1926 in the case of Lufthansa, the big German commercial aviation association, 54 per cent for Imperial Airways in Great Britain, 52 per cent for the Air Union in France and 80 per cent for another French company, the Franco Romaine. In effect, stated Mr. Page, the government of these countries in providing subsidies was virtually running such aviation transport, though under auspices of a civil authority.

This situation led to consolidation of transport interests, so that monopolies were created having the sole subsidy given by the state, such as Imperial Airways in Great Britain and Lufthansa in Germany. In Belgium, there is a single national company which runs services in Belgium and the Belgian Congo; in Holland, a single company; and, in France, more than one company but each assigned one definite route.

Owing to the disparity between what the public is willing to pay for services and the cost of civil aviation, there sprang into being national companies which are in effect nothing more or less than government departments, only conducted under civil auspices. The speaker contended that if such were to continue it would be a very hopeless outlook for aviation for any other purpose than military or naval ends.

The first essential for development of aviation should be a demand for civil air transport and that the people should be willing to pay a price adequate to the cost of the service rendered. The only place where such demands exist are in countries where enormous distances have to be traversed, and in this the speaker believed that no continent offered such wonderful opportunities as North America.

There is here a big demand for quick transport and a great deal of commerce between centres widely separated. Under these conditions, Mr. Handley Page believes that business men will certainly take up flying and be willing to pay prices which in countries of smaller distances are not worth while.

We are seeing such development to-day, he said, in Canada, the United States, Australia and the Belgian Congo. In the latter country a service is run for 1,200 miles over equatorial forests and swamps, covering this distance in two days from the mouth of the Congo on the west side of Africa to Tanganyika on the east. It provides transport into the rich interior mineral area in Tanganyika.

The second essential that will make air transport more widely used, the speaker contended, would be cheaper costs. The 1,000- or 1,200-h.p. plane used enough power to pull a good-sized train and was used merely to transport some fourteen or so passengers. He believed that if sufficient attention is given civil rather than military aviation, the efficiency of aircraft will be increased to where it will be possible to halve the horse power.

The third essential is that flying must be made safe. People should get into their heads that flying is, and can be made, as safe as any other form of transport. The speaker said his own company had been engaged for seven or eight years in developing the device known as the slotted wing, so that safety and security might be given to an aeroplane when it had lost its flying speed and would normally go into a spin and nose-dive into the ground. To make a plane safe it must lift under all conditions, and the slotted wing enables a machine so equipped to continue lifting when the ordinary aeroplane having lost its flying speed would crash to the ground. He believed that with this device a machine could be made absolutely immune from a tail spin or a dive, which are the most fruitful causes of aeroplane disasters.

Along these three lines of greater demand, cheapening of the cost of transport and safety in the air, Mr. Page considered that development would take place. With these requirements satisfied, he believed commercial aviation would go ahead at an enormous rate and would be one of the biggest forms of transportation that the world has yet seen,—a development that would be more important than any other in linking the British Empire together. The greatest need for quick transport was between the Old Country and the new, a route all the way along portions of the British Empire,—Canada, Ireland and Great Britain.

This service Mr. Page commended to the authorities here and in Great Britain. He thought study should be directed toward the development of a flying boat service via Ireland. It will have to be possible to fly for a longer number of hours than is possible to-day. The world's duration record of fifty hours will have to be pushed up to between sixty and seventy, and the corresponding distance that can be flown non-stop increased by a corresponding amount. When this is done and a multi-engine flying boat is capable of doing it, then the day will have arrived when we can see a service between this country and the other side. A greater possibility of demand and a much greater possibility of development, the speaker believed, existed for this great Imperial Airway than exists almost anywhere else. In Ireland and in Canada are the terminal ports through which all transport between the old and the new hemispheres must pass, whether to the United States or Canada.

On this continent, the speaker was glad to see commercial aviation starting to occupy the predominant position, in contrast to Europe, where every country is spending on military aviation more than before the war. He was glad to see on this continent developments taking place which were sure to bring aviation into its real field of usefulness for transport and the general purposes of mankind.

Reclassification of the United States Civil Service

On Friday, May 18th, the Ottawa Branch had as its guest and speaker Colonel E. Lester Jones, director of the United States Coast Geodetic Survey and United States International Boundary Commissioner. Col. Jones selected as his theme, "Reclassification of the United States Civil Service."

"I feel strongly that men who are devoting their lives to the government service and have spent a great number of hard years in college and in research and other preparational works should be well cared for when active and when retired," stated Col. Jones in his opening remarks.

Introduced by Dr. Charles Camsell, M.E.I.C., who presided, the speaker went very fully into the reclassification of the United States Civil Service, which became effective in 1925. Prior to that time, he pointed out, all government employees were underpaid under the system that pertained, of statutory salaries. The type of men who should be sought and retained couldn't afford to stay, and as a result undesirables were hired, there being no others to choose from.

Since the passing of the Reclassification Act, however, the demand for positions was greater and partisanship has disappeared. The act affected 40,000 in the District of Columbia, and a lump sum of $9,000,000 was allocated to deal with cases that were finally passed on by a Reclassification Board after recommendations made by the head of a bureau and the secretary of the department concerned. Whatever action the Board took, in the opinion of Colonel Jones, reflected, as a rule, what the department thought was best. The personnel of the Board was composed of the head of the Civil Service Commission as president, the chief of the Budget and the chief of the Efficiency Bureau. One weakness of the commission, it was pointed out, was its flexibility. Appointments for life, with salaries commensurate with the duties performed by the commissioners, were thought to be desirable by Colonel Jones, who stated that the tasks involved were tremendous, taking literally years to master.

As a result of the 1925 act, statutory salaries were eliminated, and one of the outstanding results was that an average increase of $100 followed, the people who benefitted most being the professional and administrative classes. Chiefs of bureaux who received from $3,500 to $6,000 were increased to $7,500.

Colonel Jones stressed the necessity of giving a man a living wage, which relieved him of worry with a resultant increase in the standard of efficiency. The standard of employees would moreover be raised, because they could all be hand-picked. He did not see why the government couldn't get as much from an employee as a corporation.

Attention was drawn by Colonel Jones to the fact that Congress has just passed another Reclassification Bill, as a result of further study, which aimed to give $2,000 as the lowest professional salary of an entrant in that class; the maximum of a bureau head was likewise raised from $7,500 to $9,000. The latest act affected 135,000 officials, of whom 45,000 were in the District of Columbia and 90,000 in the field.

Carrying the act into effect on July 1st would mean a total expenditure of $20,000,000, or $150 per person. It was aimed to adjust inequalities. Colonel Jones stated that the act had passed both Houses, but it had not as yet received the necessary presidential assent.

D. Roy Cameron, M.E.I.C., president of the Professional Institute of the Civil Service, in a brief and adequate manner, voiced the thanks of The Engineering Institute and the Professional Institute for the illuminating and timely nature of Colonel Jones' interesting talk.

Saint John Branch

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

The annual meeting of the Saint John branch was held amid festive surroundings in the Admiral Beatty hotel on the evening of May 3rd, 1928. Supper was served at 6.30 p.m. with twenty-eight persons in attendance and S. R. Weston, M.E.I.C., presiding.

The toast list included "The King," proposed by the chairman and observed in silence; "Our Guests" was proposed by J. L. Feeney, A.M.E.I.C., and responded to by O. J. Fraser, general manager of the New Brunswick Telephone Company, and by F. W. Johnson, of Halifax, Maritime manager for the Northern Electric Company; "The Press," proposed by J. L. Holman, Jr.E.I.C., and responded to by a representative of "The Saint John Telegraph-Journal"; "Other Professions" was introduced by E. A. Thomas, A.M.E.I.C., and replied to by C. F. Inches, K.C.; "The Engineering Institute of Canada" proposed by J. N. Flood, A.M.E.I.C., and replied to by C. C. Kirby, M.E.I.C.

In responding to the toast of The Institute, Mr. Kirby spoke in a reminiscent mood of the early days of his membership in The Canadian Society of Civil Engineers; of the formation of The Engineering Institute of Canada, and the decision to form branches in various centres throughout Canada. Mention was made of steps taken for the formation of the Saint John branch at a luncheon meeting attended by Fraser S. Keith, M.E.I.C., just ten years ago and of the growth of the local branch since then, with its benefits both to members and the community.

Following the toasts, the business meeting was conducted. The report of the auditors was given by J. M. Lamb, Jr.E.I.C., and of the executive by the secretary. The reports from the chairman of various committees were submitted as follows:—Programmes and Meetings, J. N. Flood, A.M.E.I.C.; Entertainment, E. J. Owens, A.M.E.I.C.; Employment, J. A. W. Waring, A.M.E.I.C.; Salaries, A. A. Turnbull, A.M.E.I.C.; Publicity, J. L. Holman, Jr.E.I.C.; Natural Resources and Engineering Industries, Geoffrey Stead, M.E.I.C.; Town Planning, A. R. Crookshank, M.E.I.C.

The excutive report showed that the branch had met ten times during the year and had heard nine addresses delivered before it. Events held in Saint John during that period included four regular meetings for presentation of papers; a joint dinner with the Association of Professional Engineers of New Brunswick; a complimentary dinner for R. J. Durley, M.E.I.C., general secretary of The Institute; a farewell dinner to W. R. Pearce, past chairman of the branch; a joint meeting with the Engineering Society of the University of New Brunswick at Fredericton, and a motor trip to Grand Falls,—distant 200 miles from Saint John. It was also stated that ten members of the branch had attended the annual meeting of The Institute held in Montreal, February 14th to 16th, 1928. Fitting references of regret were expressed regarding the deaths of the late A. W. Wilbur and D. L. Hutchinson during the year.

The total membership at April 30th, 1928, was 78, while the financial statement was satisfactory by showing a surplus.

The report of the scrutineers, F. M. Barnes, A.M.E.I.C., and J. P. Mooney, A.M.E.I.C., showed the following branch officers were elected: Chairman, Geoffrey Stead, M.E.I.C.; Vice-Chairman, W. J. Johnston, A.M.E.I.C.; Secretary-Treasurer, E. J. Owens, A.M.E.I.C.; Member of Executive, J. N. Flood, A.M.E.I.C.

S. R. Weston, M.E.I.C., gave an address thanking the branch officers and members of committees during the past year and escorted Geoffrey Stead, M.E.I.C., to the chair. Short speeches were given by the newly-elected officers expressing appreciation for their election.

A vote of thanks was tendered to the New Brunswick Telephone Company for use of their assembly hall for holding of branch meetings, and to the press for publicity given branch activities.

Sault Ste. Marie Branch

A. H. Russell, A.M.E.I.C., Secretary-Treasurer.

River Regulation in Northern Ontario

The regular meeting was held on Friday, April 27th, in the Y.W.C.A. rooms. Following a dinner, W. S. Wilson, A.M.E.I.C., chairman, called upon G. W. Holder, Jr.E.I.C., of the hydraulic department of the Spanish River Pulp and Paper Mills, Ltd., who gave a most interesting talk on "River Regulations Pertaining to Northern Ontario."

River regulation, according to the speaker, might be defined as the science of controlling and regulating the flow of streams so that the most economic use of water may be had for power, irrigation or other purposes or that floods and consequent property losses may be avoided. It consists of levelling off the peaks and filling up the valleys of flow by means of properly located regulating works such as dams and weirs or, as in the case of some rivers in the south, confining the flow to channels where no damage is done.

In order to make an intelligent study of a river to determine its possibilities for regulation, certain records and information must be available, and an outline of the various steps necessary to consummate a storage proposition which is the most common form of river regulation is here given.

1. The study of maps to obtain drainage areas and locate probable reservoirs, etc.
2. The study of existing rainfall and run-off records either for the given drainage area or for one nearby for which there are records. This latter requires good judgment and considerable experience in modifying these records in accordance with good practice.
3. Reconnaissance surveys to get preliminary information on ground as to probable capacity, existence of dam sites, lands which may be flooded, location of roads for construction purposes, etc.
4. Ontario land surveys to locate flood contours; these are required to be filed with the government.
5. Acquisition of storage rights.
6. Topography at dam sites.
7. The design, estimates, specifications of the work. Plans showing the proposed work must be filed with the Minister of Lands and Forests in accordance with "Streams Act 1927" and approved by Lieut.-Governor in Council before construction can start.
8. Location and construction of roads to haul equipment and construction materials to the sites and the construction of the dams themselves.
9. Last and not least is the operation of these dams intelligently to the best advantage of all the interested parties, but with the idea of getting the most economical use of the water, in this case for the mills at Espanola and Sturgeon Falls.

A map of the area covered by Mr. Holder in his work showed clearly the general progress of the development; the location of the precipitation stations and the current metering stations were given, also the location of the various dams that had been constructed during this work. The field work, the design and specifications were handled by Mr. Holder, while Lang and Ross, surveyors and contractors of the Sault, did the contour surveys and the construction of the dams.

The speaker by the use of charts and tables showed how it was possible to calculate the runoff from the data collected at the various stations above mentioned. He said, "We have found the precipitation on these drainage areas to vary from 20 to 33 inches, but the weighted average has been close to 27 inches. The average runoff is about 13.5 inches, of which 8 inches occurs in the average year during the months of April, May and June. This is the refilling period for our storage reservoirs, as about 60 per cent of the runoff occurs then, and it is on this basis that the desired capacity is calculated, providing, of course, that the lake area and surrounding country will admit of impounding all the runoff during these three months. The annual river flow or runoff has been found to be about 45 per cent of the annual precipitation for the Spanish river and 53 per cent for the Sturgeon river.

The monthly average daily flow varies from 5.5 c.f.s. to as low as 0.25 c.f.s. per square mile on the Spanish. Average daily flows as high as 7 c.f.s. per square mile have been experienced in the Sturgeon river, and close to 8 c.f.s. on the Vermillion river. On the Sturgeon river they have some 810 mile-feet of storage and on the Spanish there is about 1,200 mile-feet of storage, of which 20 per cent is controlled by the Spanish River Pulp and Paper Company.

Mr. Holder pointed out that no matter how large an area was used for storage purposes, unless it was properly controlled the efficiency was lost. At each mill there is a water regulation foreman who is responsible for the operation and maintenance of these dams. In general the reservoirs are empty by the middle of March and are ready for the spring refilling. As far as possible, enough storage is carried over to improve flow conditions during January, February and the first half of March.

A very lively discussion followed Mr. Holder's interesting talk and Messrs. Wilson and Speer tendered him a hearty vote of thanks.

Hamilton Branch

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

Executive Meeting, April 12th

A meeting of the executive committee of the Hamilton Branch was held in the Royal Connaught hotel at 5.15 p.m. on April 12th, 1928. L. W. Gill, M.E.I.C., was in the chair. Those present included R. J. Durley, M.E.I.C., general secretary of The Institute, and nine corporate members of the Hamilton Branch.

Some routine business was transacted and discussion took place with Mr. Durley regarding general Institute affairs. Letters from Mr. Durley regarding the nominations for the Sir John Kennedy medal and subjects for the Past President's prize were considered. The nomination of candidates for the Sir John Kennedy medal was postponed until the next meeting.

After considerable discussion, several subjects were recommended to Council for the Past President's prize.

The meeting then adjourned for dinner in the same room.

Branch Meeting, April 12th

A meeting of the Hamilton Branch was held in the cafeteria of the Technical Institute on April 12th, 1928, with an attendance of approximately thirty. R. J. Durley, M.E.I.C., general secretary of The Engineering Institute of Canada, was present and addressed the meeting, outlining the functions of Council and explaining some of the difficulties encountered.

The speakers were H. S. Philips, M.E.I.C., who spoke on "Sewage Disposal," and J. R. Dunbar, A.M.E.I.C., who spoke on "A.C. Generators." Both papers were illustrated by lantern slides.

Joint Meeting with A.I.E.E.

The annual joiut meeting of the Toronto section of the American Institute of Electrical Engineers and the Hamilton Branch of The Engineering Institute of Canada was held in the Westinghouse auditorium on April 27th, 1928. L. W. Gill, M.E.I.C., principal of the Technical School aud chairman of the Hamilton Branch, called the meeting to order and spoke a few words of greeting to the Toronto engineers. He announced that word had been received from the general secretary in Montreal that the annual convention of The Engineering Institute would be held in Hamilton next year. The dates would probably be early in February.

C. E. Sisson, M.E.I.C., of the Canadian General Electric Company, chairman of the Toronto section, then took the chair and introduced Mr. G. E. Stolz, manager of industrial engineering for the Westinghouse Electric and Manufacturing Company at East Pittsburgh. His lecture was illustrated by lantern slides and dealt with industrial applications of electricity.

Industrial Applications of Electricity

According to Mr. Stoltz, the manufacturer who was alert and utilized new developments had a great advantage over the manufacturer who continued manufacturing along lines which might have been considered progressive some years ago. He further pointed out that, in general, those who were successful were the ones who were quick to take advantage of new facilities.

During the war, the steel industry responded to the great demand for increased output. After the war, the keen competition which prevailed was met by the introduction of electrical apparatus and rearrangement of machinery to take every advantage of the possibilities of electrification, he said. Mr. Stoltz was well acquainted with electrical conditions in the steel industry, which was his field of concentration with the Westinghouse since 1911.

After the paper, some discussion took place. Mr. E. S. Jefferies, of the Steel Company of Canada, and Mr. C. F. Publo, of the Hydro-Electric Power Commission, contributed to this.

On behalf of the meeting, Mr. Sisson tendered a vote of thanks to the speaker which was heartily applauded. Mr. Gill then took the chair and extended to the Canadian Westinghouse Company a hearty vote of thanks for the use of the auditorium. H. U. Hart, M.E.I.C., general manager of the Canadian Westinghouse Company, replied and announced that the company had supplied refreshments to which all were welcome. The attendance at the meeting was approximately two hundred and fifty; this included about fifty who had motored over from Toronto, several engineers from St. Catharines and neighbouring towns and twenty pupils of the London Technical School under the supervision of J. R. Simpson.

Executive Meeting, May 3rd, 1928

A meeting of the executive committee of the Hamilton Branch was held in Mr. McFaul's office in the City Hall on May 3rd, 1928. Mr. Gill was in the chair and four other members of the executive were present.

Details of the annual business meeting of the branch, to be held about the middle of May, were discussed.

After some discussion, the name of a prominent engineer was submitted to Council for the Sir John Kennedy medal.

A letter from Mr. Durley announcing that Council had accepted Hamilton's invitation to hold the annual meeting here in February 1929 was read. Names of several prominent gentlemen were recommended as speakers for the annual dinner. The dates proposed by Council, namely, February 14th, 15th and 16th, were accepted, subject to later developments which might require the dates to be changed.

D. W. Callander, A.M.E.I.C., and E. M. Coles, A.M.E.I.C., were appointed scrutineers for the election of officers.

Annual Meeting, May 17th, 1928

The annual meeting of the branch for the year 1928 took the form of a dinner-meeting which was held in the Royal Connaught hotel on May 17th. The guests included Julian C. Smith, M.E.I.C., president of The Institute; A. J. Grant, M.E.I.C., vice-president of The Institute; R. J. Durley, M.E.I.C., general secretary of The Institute, and representatives of the Toronto and Niagara Peninsula Branches. Mr. Gill occupied the chair at the opening of the meeting and about forty sat down to dinner.

After dinner, H. U. Hart, M.E.I.C., introduced President Julian C. Smith to the meeting and sketched, briefly, Mr. Smith's career as an engineer. Mr. Smith gave a very inspiring address, which will be more fully reported in next month's Branch News.

Following Mr. Smith's address, E. G. Cameron, A.M.E.I.C., of St. Catharines, introduced A. J. Grant, M.E.I.C., to the meeting. Mr. Gill took the opportunity of thanking the members of The Institute, resident in Ontario, through the Hamilton Branch, for the honour they have done him in electing him vice-president of The Institute. Mr. Grant's address dealt with the Welland ship canal and will be more fully reported in next month's Branch News. R. B. Young, M.E.I.C., spoke briefly on behalf of the Toronto Branch, and expressed the pleasure of the branch at being requested to send a representative to the annual meeting of the Hamilton Branch.

The business portion of the meeting was then proceeded with. W. F. McLaren, M.E.I.C., secretary, presented the secretary-treasurer's report, which is reproduced below.

Report of Secretary-Treasurer, May 17th, 1928

The branch held eight meetings, as follows:—

Sept. 19, 21, 22.—"**The Design and Control of Concrete Mixtures,**" by Rufus S. Phillips, Lewis Institute, Chicago. Attendance, 50.

Oct. 28.—Trip to Welland Canal. Dinner Guests of Niagara Branch. Attendance, 35.

Dec. 12.—"**The Air League of Canada,**" by Maj.-Gen. J. H. MacBrien. Attendance, 50.

Jan. 31.—"**The St. Lawrence Development,**" by F. I. Ker, A.M.E.I.C. Attendance, 120.

Feb. 17.—"**Ontario Highways,**" by R. M. Smith, A.M.E.I.C. Attendance, 20.

Apr. 12.—"**A.C. Generators,**" by J. R. Dunbar, A.M.E.I.C.; "**Sewage Disposal,**" by H. S. Philips, M.E.I.C. Attendance, 30.

Apr. 27.—"**Electric Power in Industry,**" by G. E. Stoltz. Attendance, 220.

May 17.—Final dinner-meeting. Julian C. Smith, M.E.I.C., A. J. Grant, M.E.I.C.

The average attendance was about 70 and the average cost about $25.00.

Membership

Class	Resident	Non-resident	Total
Members	18	6	24
Associate Members	46	13	59
Juniors	7	4	11
Students	34	11	45
Branch Affiliates	28	..	28
Totals	133	34	167

One very carefully-prepared paper has been submitted for Student prize and two papers for Senior prize, but no action has been taken as yet.

The executive held eight meetings, with an average attendance of six out of a possible ten.

At the meeting of January 6th, the first discussion took place regarding the invitation to hold the annual meeting of The Institute in Hamilton. This was finally approved at the branch meeting of January 31st, and presented by our delegates, Messrs. Gill and Darling, at the Montreal meeting in February. The Council accepted our invitation unanimously on April 20th, proposing the dates of February 14th to 16th, 1929.

Financial Statement

Receipts		*Expenses*	
Brought forward	$627.15	Printing	$ 66.24
Branch Affiliates, 26 at $3.00	78.00	Postage and stationery	26.85
Journal subscriptions 1928, 7 at $2.00	14.00	Cafeteria and halls	50.10
Journal subscription 1927, 1 at $2.00	2.00	Telegrams	1.19
Rebates on members fees	56.70	Expenses of speakers	5.00
Branch news	11.71	Delegates to Montreal	62.60
		Journal subscriptions	14.30
		Total	$226.28
		Balance	563.28
	$789.56		$789.56

No rebates or branch news payments received since November 1927.

Expenses of dinner and allowance for stenographer still to be paid.

Election of Officers

The results of the election of officers for the next branch year were then announced. The following will form the Branch Executive for the coming year:—

Chairman	W. L. McFaul, M.E.I.C.
Vice-Chairman	J. A. McFarlane, M.E.I.C.
Secy.-Treas.	W. F. McLaren, M.E.I.C.
Executive	H. A. Lumsden, M.E.I.C.
	G. R. Marston, M.E.I.C.
	F. P. Adams, A.M.E.I.C.
	W. D. Black, A.M.E.I.C.
(Ex-officio)	L. W. Gill, M.E.I.C.

Mr. Gill, before relinquishing the chair to Mr. McFaul, the incoming chairman, remarked that, during the past year, the Hamilton Branch of The Engineering Institute of Canada had proposed to the Hamilton Chamber of Commerce that an engineering committee be formed which would handle matters on which the Chamber of Commerce desired information. He stated that an important matter has been reported to this committee and is, at the present time, under consideration.

Mr. McFaul then took the chair and thanked the branch for the honour in electing him chairman. He requested J. A. MacFarlane, F. P. Adams, A.M.E.I.C., and W. D. Black, A.M.E.I.C., the newly elected members of the Executive Committee, to come forward so that all the members might know them.

On the motion of L. W. Gill, M.E.I.C., seconded by A. H. Munson, A.M.E.I.C., W. D. Black, A.M.E.I.C., was appointed chairman of the main committee to take charge for the Annual General and General Professional Meeting of The Engineering Institute of Canada to be held in Hamilton in February 1929. The appointment of the chairmen of the various committees who will have charge of the detailed arrangements for the meeting will be left to Mr. Black.

Throughout the dinner Kalani's orchestra supplied music. Police Constable Clark interrupted the dinner to bring Mr. Marston to task for certain alleged infringements of the Statutes of the province of Ontario. After a heated discussion, in which Mr. Marston managed to clear his good name, the charge was withdrawn, but the chairman demanded some form of reparation. Mr. Gill first requested a dance, but the constable could not supply this and offered to fight any member present. As a compromise, Police Constable Clark rendered a few of the old favourite songs which were received with applause by the meeting. He repeated the entertainment shortly afterwards.

Preliminary Notice

of Applications for Admission and for Transfer

May 18th, 1928.

The By-laws now 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 election 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 1928.

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 or 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.

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.

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

ARNOLD—GUY WALKER, of Hamilton, Ont., Born at Sussex, N.B., July 20th, 1890; Educ., B.Sc., Univ. of N.B., 1912; 1911 (summer), in transformer assembly dept. of C.G.E. Co., Peterborough; 1912-14, apptce. in elec. test dept. of Can. Westinghouse Co.; 1920 (Jan. to Sept.), instructor in elect'l engrg., Dept. of Soldiers' Civil Re-establishment, Fredericton, N.B.; 1921-22, asst. to dist. engr., Can. Westinghouse Co., Montreal; June 1922 to date, with Can. Westinghouse Co., Hamilton, as follows: June to Dec. 1922, designer of induction motors; Dec. 1922 to Sept. 1925, designer of d.c. motors, generators, exciters, railway motors, etc.; Sept. 1925 to date, i/c all elect'l design of d.c. motors, railway motors, d.c. generators and exciters, synchronons, converters and their accessories.

References: H. U. Hart, W. F. McLaren, J. C. Nash, D. W. Callander, J. R. Dunbar, E. M. Coles.

BROWN—HENRY DICKSON PARK, of The Pas, Man., Born at Yoker, Scotland, Apl. 4th, 1903; Educ., public and high school, classes in Naval architecture, Clydebank Technical, 1918-22, classes in surveying and levelling, railways and roads, Glasgow Tech. College, 1924-25; 1918-23, apptce. dftsman, shipbuilding and engrg., including 2½ yrs. in experimental dept., John Brown & Co., Ltd., Clydebank; 1923-25, journeyman dftsman. with same company; 1925-26, dftsman. on railroad location with C.N.R.; 1926 to date, dftsman. on constrn., Hudson Bay Railway.

References: J. V. Dillabough, J. G. MacLachlan, A. J. Sill, J. A. H. Christie, J. L. Charles, W. Burns, H. P. Fuller.

COOPER—ROSS HERBERT, of Windsor, Ont, Born at Springhill, N.S., Mch. 19th, 1885; Educ., B.Sc., Queen's Univ., 1909; 1906-07, instrumentman on C.P.R.; 1908-18, asst. engr. with Dept. of Pub. Works of Canada; 1918-23, contractor in N.S.; 1923-28, res. engr. and general foreman with Stone and Webster Co. on steam-electric plant constrn. and hydro-electric developments; at present, with Detroit River Constrn. Co., Ltd., Windsor.

References: H. McL. Peppard, J. E. St. Laurent, F. S. Lazier, F. Y. Harcourt.

FLEMING—ALEXANDER GREIG, of Montreal, Que., Born at Craigleith, Ont., Mch. 13th, 1882; Educ., B.A., Queen's Univ., 1904; 1905-06, mining engrg. course, Queen's Univ., B.Sc. degree not completed; 1907-12, operating chemist of Int. Cement Co. plant, later Can. Cement Co. plant, at Hull, Que.; 1913 to date, chief chemist, Can. Cement Co., directing work of all the Canada Cement Co.'s laboratories.

References: A. C. Tagge, H. S. Van Scoyoc, C. R. Coutlee, F. S. Keith, W. P. Wilgar, E. Viens, C. K. McLeod.

MIESCHER—WILLIAM ALBERT, of Arvida, Que., Born at Basle, Switzerland, Apl. 11th, 1899; Educ., C.E., Polytechnic Institute, Zurich, 1922, commission as officer of the Swiss Army, Dec. 31st, 1921; 1922-23, member of experts' committee to expropriation court in a case of damage to water supply of city of Grenchen, Switzerland, investigations concerning the actual and former state of the water supply system, reporting to committee; 1923-25, asst. engr. to board of Rhine river constrn. at Freiburg, Germany, as representative of Swiss Government; 1925-26, asst. engr. with Oscar Bosshardt at Basle, designing of concrete bridges for harbour developments at Basle, investigations and report on flood protection of Emme river; May to Nov. 1926, dftsman and designer with the Foundation Co., New York; Nov. 1926 to Apl. 1927, dftsman. and designer with Stone & Webster, Boston; June to Dec. 1927, asst. engr. with A. Surveyer & Co.; Jan. 1928 to date, asst. engr. with the Alcoa Power Co., Ltd., Arvida, Que.

References: A. Surveyer, J. B. Challies, J. A. Knight, R. Morham, R. D. Carmichael.

MUMFORD—PATRICK FOSTER, of Hamilton, Ont., Born at St. Mary's, Scilly Isles, Eng., Nov. 15th, 1896; Educ., A.B., 1924, M.E., 1925, Stanford Univ.; 1924 (July to Sept.), apptce. with Yarrows Ltd., Esquimalt, B.C.; Nov. 1925 to Mar. 1926, apptce. with Pacific Diesel Engine Co., Oakland, Cal.; March 1926 to date, student with Can. Westinghouse Co., Hamilton, Ont.

References: W. F. McLaren, H. U. Hart, J. R. Dunbar, J. C. Nash, G. M. Bayne.

REES—DAVID BRINLEY, of Edmonton, Alta., Born at Llandelo, S. Wales, Aug. 6th, 1895; Educ., Llandelo Grammar School and Peterhead Academy, private professional tutors, 3 yrs. articled apptce., Wm. Jones, Lampeter, S. Wales; served in Royal Navy 3½ yrs., tsfrd. in 1918 to commission in Royal Artillery; 1919-20, efficiency engr. at Metals Recovery Factory, War Office; 1923 to date, main highways, Dept. Public Works, Prov. of Alta., as follows: 1923-25, instrumentman and assistant; 1925 to date, res. engr.; 1928, relief lecturer in engrg. dfting, Edmonton Technical School.

References: J. D. Robertson, H. P. Keith, F. T. Ames, J. W. S. Chappelle, N. H. Bradley, J. M. Anderson.

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

DAY—JOSEPH CHARLES, of Montreal, Born at London, Eng, Oct. 26th, 1890; Educ., B.Sc., McGill Univ., 1914; 1914-16, gen'l design and dfting new cable plant, Northern Electric Co., Montreal; 1916-18, designing & dfting, C.N.R.; 1918-19, designer and res. engr., gen'l bldg., hydro-electric and factory constrn., T. Pringle & Son; 1919-20, ch. designer & ch. dftsman, i/c general bldg. design, specifications and plans, Lockwood Greene, Ltd.; 1920-25, bldg. engr., i/c new building design, changes to existing plant, Northern Electric Co.; 1925-26, designer on Gatineau hydro developments, Fraser Brace Engrg. Co.; 1926-27, in complete charge design, plan, specifications, erection and equipping soda pulp mill, Cornwall, Ont., for Howard Smith Paper Mills; Apl. to Dec. 1927, general designer on newsprint mill at Dolbeau,, Lake St. John Power & Paper Co.; 1927 to date, designing engr. i/c all engrg. design, plans and specifications for paper mill extensions and hydro-electric development on Mistassini river for Lake St. John Power & Paper Co., Montreal.

References: J. J. Macdonald, J. Stadler, S. J. Fisher, J. S. Cameron, H. M. MacKay, R. P. Raynsford, D. C. Tennant, J. B. D'Aeth.

FOR TRANSFER FROM THE CLASS OF JUNIOR TO A HIGHER GRADE

BOURGET—PAUL BLAGDON, of Thurso, Que., Born at Regina, Sask., Jan. 9, 1895; Educ., private tuition and I.C.S. course in surveying; 1911, chainman, Govt. surveys; 1912, rodman, C.P.R. maintenance; 1914 (6 mos.), acting instrumentman; 1914-15, asst. to res. engr., C.P.R., Colborne, Ont.; 1915, mech'l dftsman and design, P.W.D., Victoria shipyards, Ottawa; 1916, i/c constrn. cribwork dock, Middle St. wharf, Ottawa; 1916-19, lieut. with 1st Bat., Can. Engrs. in Canada, England and France; 1919, interviewing officer, Dept. S.C.R., examination of men applying for industrial education; 1920-23, i/c loans for purchase of machinery and equipment for re-trained graduates, Dept. S.C.R., Ottawa; 1923, supervising engr., topographical survey, Quebec Land Surveys; 1924 to date, with Singer Mfg. Co., as follows: constrn. of ry., sawmill, veneer plant, cabinet plant and power house, etc.; Jan. 1927 to date, works mgr., Thurso works, the Singer Mfg. Co.

References: D. Hillman, W. A. McGaan, C. F. X. Chaloner, N. Cauchon, W. C. MacDonald.

GAUTHIER—PAUL GILLIES, of Kenogami, Que., Born at Montreal, Mch. 31st, 1900; Educ., B.Sc., McGill Univ., 1921; 1918 and 19 (summers), rodman on water power survey for Que. Streams Comm.; 1920 (summer), engr. on constrn. small R.C. and rock fill dam for Riordon Co.; winters 1921-22 and fall 1922 to Jan. 1923, demonstrator in engrg. at McGill Univ.; 1921 and 22 (summers), engr. on location and estimates, colonization roads and bridges, for Min. of Colonization, Que. Govt. 1923-25. engr. with Que. Devel. Co., i/c party on installation of constrn. plant and constrn. of spillway, power house bulkhead, etc.; June to Oct. 1925, i/c party taking topography for location of aluminum plant and city of Arvida; 1925-26, i/c field engrg. for constrn. of roads, water lines and sewers and houses for city of Arvida; 1926-27, i/c field location of 35-mile transmission line from Isle Maligne to Mistassini; 1927 to Jan. 1928, i/c engrg. field work for erection of constrn. plant and excavation of bypass channel for hydro-electric development at Chute a Caron for Alcoa Power Co.; at present, employed by Alcoa Power Co. on constrn. of above development.

References: F. H. Cothran, R. de L. French, W. S. Lee, D. F. Noyes, H. M. MacKay, H. R. Wake.

OUTRAM—ALFRED ALLAN, of Toronto, Born at Port Hope, Ont., Sept. 13th, 1895; Educ., Port Hope High School, 3 yrs., short post-grad. course, Michigan Univ., highway engr., 1921; 1915, rodman, Smith & Smith, Lindsay; 1915-19, C.E.F., Belgium, France, Russia; 1919-20, chainman, rodman, topographer, ry. location, H.E.P.C.; 1920 (summer), rodman, H.E.P.C., Queenston-Chippawa power canal; 1920 (fall), inspector concrete, Dept. of Pub. Highways of Ont.; 1920-24, asst. to res. engr., Dept. of Pub. Highways of Ont., at Port Hope and Cornwall, Ont.; 1924-25, contracting under own name, carried out grading and culvert contract for Dept. of Pub. Highways, bridge for twp. of Clarke, Ont., sewer contract for town of Port Hope, etc.; 1925-26, i/c survey party subdividing real estate for N.Y. and Fla. Investment Corp., St. Petersburg, Fla.; 1926 (summer), engr. for Dept. of Pub. Highways of Ont.; 1926 to date, engr. for Lumsden Engrg. and Transport Co., Ltd.

References: D. W. Bews, J. B. Wilkinson, A. B. Crealock, A. A. Smith, W. E. Bonn.

FOR TRANSFER FROM THE CLASS OF STUDENT TO A HIGHER GRADE

ANTLIFF—JAMES COOPER, of Westmount, Que., Born at Ottawa, July 3rd, 1900; Educ., B.Sc., McGill Univ., 1923; operating experience as wheelman, 6 mos.; asst. operator and operator in transformer house, 6 mos.; helper on mech'l and elect'l gangs, 18 mos.; engrg. office, dfting, etc., 18 mos.; all at Cedars, Que.; 1925-26, asst. inspector and engr. on constrn. of Vallee substation in Montreal; asst. to gen. supt. elect. dept., Montreal Light, Heat & Power Company. Oct. 1926 to date.

References: H. B. Pope, L. A. Kenyon, G. P. Hawley, H. Milliken, S. Cunha, L. O'Sullivan.

CARTEN—FRANCIS TRACEY, of Fredericton, N.B., Born at Fredericton, Feb. 4th, 1901; Educ., B.Sc., Univ. of N.B., 1926; 1926-27, asst. ch. of party on surveys for Gatineau Power Company; 1927 to date, instrument work, dfting, estimating, etc., with H. G. Acres Co., Grand Falls, N.B.

References: J. J. Gorman, T. W. Webb, A. C. D. Blanchard, G. H. Lowry, T. V. McCarthy.

CREIGHTON—THOMAS WHITELOCK, of Kenora, Ont., Born at Sydney, N.S., Dec. 9th, 1900; Educ., diploma, R.M.C., 1921; 1918-19-20 (summers), chainman, rodman with Water Power Br. and T. H. Dunn, D.L.S., on reservation surveys, metering, etc.; 1921 to date, with C.P.R., as follows: 1921-22, rodman, transitman on mtce.; 1923-25, res. engr., constrn. dept.; 1926, transitman and roadmaster, Kenora and Fort William; Jan. to Mch. 1927, dftsman on location, C.N.R.; at present, transitman, Kenora div., C.P.R.

References: S. C. Wilcox, J. C. Holden, W. A. James, E. A. Kelly, D. A. Livingston, C. H. Fox, J. V. Dillabough.

LAWTON—FREDERIC LEWIS, of Isle Maligne, Que., Born at London, Eng., Dec. 14th, 1900; Educ., B.A.Sc., Univ. of Toronto, 1923; 1923-24, test dept., General Electric Co., Schenectady; 1924-25, engr. i/c tests on power system stability investigations with same company; 1925-26, asst. elect'l engr. in field, Que. Devel. Co., Isle Maligne; 1926 to date, with Duke-Price Power Co., i/c dfting hydro-electric survey, and, 1927 to date, asst. to supt. of operation.

References: F. H. Cothran, D. F. Noyes, W. S. Lee, H. G. Cochrane, N. D. Paine.

McCLURE—LINDLEY WILBERFORCE, of Verdun, Que., Born at Somerville, Mass., Apl. 29th, 1901; Educ., B.Sc., McGill Univ., 1927; telephone circuits and, at present, cable engrg. research, Northern Electric Co., Montreal.

References: N. L. Dann, W. C. Adams, N. L. Morgan, C. V. Christie, G. A. Wallace, W. G. Tyler.

McGILLIS—LESTER, of Rio de Janeiro, Brazil, Born at Lancaster, Ont., Apl. 27th, 1899; Educ., B.Sc., McGill Univ., 1924; 1923 (summer), transmission line constrn., Shawinigan Water & Power Co.; 1924-25, substation and power house constrn. and small motor mtce., Hollinger Cons. Gold Mines, Ltd.; 1925-26, Rio de Janeiro Tramway, Light & Power Co., Ltd., mtce. of transforming and converting stations; Dec. 1926 to date, res. operating engr., Brazilian Hydro-Electric Company, Parahyba development.

References: C. V. Christie, J. M. Silliman, E. Brown, C. M. McKergow, H. M. MacKay.

RUTHERFORD—ANDREW SCOTT, of Westmount, Que., Born at Westmount, Oct. 7th, 1900; Educ., B.Sc., McGill, 1922, graduated from R.M.C., 1920; 1920 (summer), testing lab., Brunner Mond Co. of Canada; 1921 (summer), lines, levels, etc., on constrn., W. E. Bishop Co., Ltd.; May to Oct. 1922, engr. on constrn. with Church Ross Co., Ltd.; 1922-23, architect's inspector on constrn., R. E. Bostrom; Jan. to Mch. 1923, dfting and minor steel & reinforced concrete design, John S. Metcalf Co.; 1923 to date, with Church Ross Co., as follows: 1923-25, layout engr. and asst. supt., checking reinforced concrete, steel, etc.; 1925 to date, supt. of constrn., estimating and general supervision of constrn.

References: D. W. Ross, S. F. Rutherford, B. R. Perry, J. H. Hunter, C. G. Porter.

TAMES—JOHN ALEXANDER, of Vancouver, B.C., Born at Kearney, Ont., Sept. 11, 1900; Educ., B.Sc., Univ. of Alta., 1925; 1917-18, rodman, G.T.P Railways, Edmonton; 1924 and 25 (summers), instrumentman, Dom. Topographical Surveys; 1925-27, Can. Westinghouse apptce. course, as follows: Jan. to Oct. 1926, designer on induction motors; 1926-27, sales dept., Hamilton, on western correspondence; May to Oct. 1927, Vancouver office on correspondence; Oct. 1927 to date, salesman on power apparatus & service.

References: R. W. Ross, C. A. Robb, R. S. L. Wilson, W. F. McLaren, R. W. Boyle.

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The Cariboo Road

Its Origin, History and Re-construction

Patrick Philip, M.E.I.C.

Deputy Minister and Public Works Engineer, Provincial Government of British Columbia.

Paper presented at the Western General Professional Meeting of The Engineering Institute of Canada, at Vancouver, B.C., June 8th, 1928

Introductory and Historical

On the North American continent there are several highways of outstanding merit and importance, but chiefly because of its historic interest, the Cariboo road occupies a foremost place. The "Lincoln highway" or the "Dixie highway" are longer and traverse a more populous and diversified country, but the Cariboo road with its romanceful history occupies a unique position in highway annals. Mere mention of the name "Cariboo" conjures up stirring tales, reminiscent of the enterprise and endurance of the earliest explorers and pioneers of the province of British Columbia. In fact so insistent was the demand for the retention of the designation "Cariboo road" that the subject was brought up at the 1925 session of the provincial legislature and the following resolution unanimously passed:

> "Whereas it is proposed to change the name of the old Cariboo Road to Fraser Canyon Highway:
>
> "And whereas the name for this old road was derived from the discovery of gold on Williams Creek as far back as the year 1857, and the miners, merchants and also pioneer settlers paid a large amount of tolls towards the building of this road:
>
> "Therefore be it resolved that in respect to the old pioneers of this Province and our native sons especially of Cariboo, and in the interest of the history of British Columbia, this old historic road shall continue to be known as the *Cariboo Road*."

To commemorate the work and worth of the pioneers associated with the conception and construction of the old Cariboo road a huge granite boulder monument was erected in 1925 by the Historic Sites and Monuments Board of Canada, at Yale, on the site of the starting point of the original wagon trail.

Officially, the Cariboo road commences at Hope and is virtually a continuation of the old Yale road, (sometimes known as the Transprovincial highway), which traverses the Fraser valley eastward from New Westminster. Reference to the key map, (see figure No. 1), will show that the Cariboo road proper extends from Hope to Prince George, 432 miles, or a total distance of 536 miles inland from the Pacific coast. With the exception of the portion between Lytton and Clinton, (87 miles), which traverses the Thompson and Bonaparte valleys, this highway approximately parallels the Fraser river throughout its entire length.

This great highway so rich in romance has recently been reconstructed, partly to satisfy the demands of modern traffic conditions and partly to provide transprovincial connection with the Dominion highway system.

To engineers the original opening of the Cariboo road is the story of the first major engineering project in the West. How fortunate the Colony was in having a Colonial Governor possessed with such vision that in the settlement of the Colony his first concern was that the wagon roads should be carefully planned and supervised by competent engineers. Historically the following facts should be of comparative interest:

In 1808, Simon Fraser, the noted explorer, came overland to the Pacific by way of the river which subsequently perpetuated his name. According to his own journals that portion of the journey through the canyon filled him with a deep gloom,—"This country is a series of cascades intercepted with rocks and bounded by precipices and mountains that seem to have no end. I scarcely ever saw anything so dreary and so dangerous. Whatever way I turn my eyes, mountains upon mountains, whose summits are capped with eternal snow, close the gloomy scene. As for the road by land we could scarcely make our way with even our guns, we had to pass where no human being should venture." This is our first introduction to the famous Fraser canyon through which the original Cariboo road was built in the Sixties and later two transcontinental railways running parallel along the gorges of the mighty Fraser and Thompson rivers. The engineering profession may be justly proud of the skill and daring of the engineers who surveyed the routes of the above projects, the Cariboo road in 1858, the Canadian Pacific Railway in 1882 and the Canadian Northern Railway in 1910.

When gold was discovered in the bars of the Fraser in 1857-58, the first route into the Cariboo gold fields was by way of the lower Fraser, (see figure No. 1), up the Harrison river into Harrison lake, thence to the head of the lake over the trail built in 1857, to Little Lillooet lake. From Lillooet lake to Anderson lake, a distance of approximately 24 miles by road, the route continued three-quarters of a mile across a tramway from Anderson lake to Seaton lake, finally reaching the road to Parsonstown on the banks of the Fraser, near to what is now called Lillooet. From this point the road was built on the left bank of the Fraser through to Clinton via Pavilion mountain, and from Clinton through to the Cariboo country.

As will be seen from the map, (figure No. 1), this route was indirect and inconvenient, requiring many portages which added greatly to the cost of hauling supplies. Representations were therefore made to Governor Douglas to construct a road by the Fraser canyon route. Sometimes we are inclined to doubt the wisdom of the present generation of road enthusiasts when they present petitions for roads through seemingly impossible country. What then shall we say of those early pioneers who submitted to their Governor a request for such a vast undertaking? Truly " your young men shall see visions."

Prior to the construction of the wagon road two mule trails were built through the Fraser canyon, but the grades were prohibitive and the trails unsafe for ordinary travel. The trails, however, served to demonstrate the feasibility of this route and the possibility for improvements thereto. In 1862 a party of Royal Engineers built the first six miles of the road north from Yale, (then the head of navigation). Contracts were awarded in sections for the remaining portions of the work as far as Spuzzum or Alexandra bridge, (named in honour of the late Queen Alexandra), and built by Thomas Spence. The section from the bridge to Boston Bar, (16 miles), was built by Joseph W. Trutch; that from Boston Bar to Lytton, (30 miles), by Thomas Spence, and that from Lytton to Cooks Ferry, (24 miles), by Walter Moberley, (the eminent engineer who was later connected with the construction of the Canadian Pacific Railway, and to whom belongs the credit for the most difficult engineering work on that railway through the Selkirk mountains). All the above road construction was undertaken in 1862. Considering the disadvantages and dangers under which these pioneer road builders laboured and the magnitude of the work involved, one can truly affirm that they were real " Empire Builders," men of vision and courage earnestly devoted to their tasks.

From the map, (see figure No. 1), it will be noted that a link remained to be built between Cooks Ferry and the road originally built to the Cariboo via Harrison lake. This section was completed in 1863, a substantial bridge being built across the Thompson river in 1864 by Thomas Spence at Cook's Ferry, subsequently known as Spences Bridge.

Writing in his excellent " History of British Columbia," Judge Howay thus describes early scenes:—

> " The Great Cariboo wagon road—the Appian Way of British Columbia—reaching from Yale to the heart of the mining region, amidst the tumultuous mountain masses of the Cariboo, had not yet, (1860), been dreamed of. The boldest financier might well hesitate and draw back when from the mule trail or the Upper or Lower canyon trails, he surveyed the Little canyon and the Big or Black canyon of the Fraser and estimated the cost of a passable wagon road where a goat could scarce have gained a foothold. We now approach the commencement of that eighth wonder of the world."

Continuing, he further graphically describes the original road thus:—

> " Reaching from Yale, the head of navigation, to the mines of the Cariboo, a distance of nearly 400 miles, and solidly and substantially constructed by our infant Colony in less than three years, this road was the pride of British Columbia and a source of wonder and admiration to its visitors, who were loud in their expressions of surprise at the daring conception and skilful execution of the work. Here the road was supported by piling, there built upon immense masonry ' fills,' sometimes on gigantic crib work, the ruins of which yet remain, sometimes cut through a sheer rock bluff, now almost at the water level, and anon raised to giddy elevations whence the river seemed but a silver ribbon."

Such then is a clear and concise description of the old road, built under careful and competent engineering supervision over sixty years ago. What a tribute to the skill of the engineers and the labours of the pioneers. As engineers we are particularly gratified that the local branches of The Engineering Institute collaborated with the Association of Professional Engineers of British Columbia in the erection of a cairn at the site of the old Alexandra bridge, commemorating the work of the Royal Engineers engaged in the construction of this great road. The following is inscribed on the cairn:—

1858 — 1927

IN COMMEMORATION

of the work of

HER MAJESTY'S ROYAL ENGINEERS

and in respectful admiration of the
skill and energy displayed by them
from 1858 to 1861 in the construction of

THE ORIGINAL CARIBOO HIGHWAY
THROUGH THE FRASER CANYON

This Tablet is Erected and Dedicated
by
The Engineering Institute of Canada
and
The Association of Professional Engineers
of British Columbia

ANNO DOMINI MCMXXVII

With such a description before us we have a standard of excellence which the modern engineer could well emulate.

Considering the prevailing modes of transportation set amidst such scenic splendor, one can visualize the panoramic scenes of the Sixties.

The stage coaches with their adventurous passengers, the gold escorts with their scarlet trappings, the prairie schooners with their varied freight—all such motley conveyances traversed this grand highway. Someone has said the Cariboo road was the " Symbol of Liberty, Equality and Fraternity." Evidently its construction at comparatively high expenditure in the early life of the Colony was subsequently justified. Over $30,000,000 in gold was transported safely to the coast from the rich placer mines of the Cariboo.

With the advent of the " Iron Horse," the destruction of this highway seemed inevitable, particularly as there was little room for both road and railway in the canyon. The construction of the Canadian Pacific Railway in the early Eighties under the terms of the British North America Act witnessed the " beginning of the end " of the old Cariboo road. After the construction of the railway there was still the semblance of a wagon trail on some portions of the road diverted in terms of the contract. However, as the railway virtually destroyed the road as a continuous highway, and, moreover, offered a quicker and cheaper method of transportation, the highway, through lack of maintenance, lapsed into disuse.

The Alexandra bridge over the Fraser at Spuzzum, (demolished several years ago), suffered through the ravages of the flood of '94, and to complete the destruction of the road, the provincial government, wisely or unwisely, permitted the remainder of the old Cariboo road between Chapman and Cisco to be practically disrupted by the Canadian Northern Railway in 1912,—exactly half a century after the road was built.

Who cared, in 1886, about the cumbersome and costly means of transportation over the highway when a modern railway was built for the express purpose of carrying freight and passengers from the Atlantic to the Pacific. A lethargic public had so little vision in 1912 that it could not foresee the immense potentiality of the old road as the nucleus of a modern motor highway. Although the automobile age had then arrived, the cry was for more railways, and as the Fraser river canyon could not, as in the case of the Canadian Pacific Railway, accommodate within reasonable limits both highway and railways, the former was sacrificed. But in the case of the construction of the Canadian Northern Railway no provision was made for highway diversions, and consequently the Cariboo road, through the Fraser and Thompson canyons, was practically eliminated. Nevertheless the increasing popularity of the automobile emphasized the demand for more motor highways. As an illustration: in 1912 there were 4,289 motor vehicles registered in this province, in 1916 this number had doubled, and rapidly increased to 28,136 in 1920. (In 1927 the figures had reached to over 75,000.) Thereafter travel by road developed to such an extent that representations were made to the provincial government to build a highway from the coast to the interior, and also to provide a direct route through the Dominion for the Trans-Canada highway. Until the reconstruction of the Cariboo road all through highway traffic had perforce to detour at length via the state of Washington.

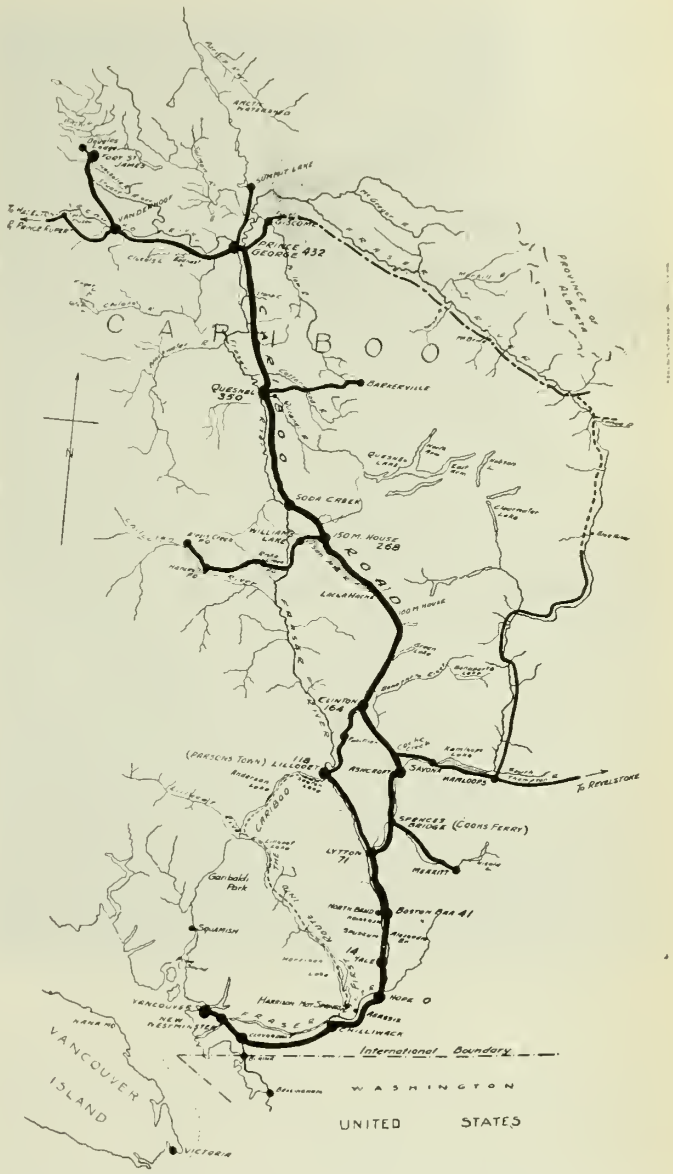


Figure No. 1.—Map showing the Location of the Cariboo Road.

Location

Those familiar with the topography of British Columbia will appreciate the fact that in the selection of a route for a highway from the coast to the interior many economic and engineering factors had to be taken into consideration. While important, initial cost is by no means the only factor in the final analysis. Annual maintenance costs, length of time the road will be open for traffic throughout the year, elevations, grades, alignment, proximity to road surfacing material along the route—all such elements have an important bearing in the choice of a transprovincial highway. Consequently careful preliminary surveys were made of three important routes: (a) the location of the old Cariboo road; (b) the Hope-Princeton route via Allison pass, (elevation approximately 4,450 feet); (c) by Harrison lake to Lillooet, (the first route adopted in 1857 and later abandoned by the pioneers after the Cariboo road was built).

With the foregoing economic and engineering factors prominently in view, publicly supported by sentimental regards for the old Cariboo road, location of the old highway via the Fraser canyon was finally selected.

Following the practice adopted on railway construction, previous to the letting of the contract, the preliminary line was extensively revised, the most important revision being in the vicinity of " Hell's Gate " in the Fraser canyon. Here the old road was " galleried " in the cliff close to high water line. When the Canadian Northern Railway tunnelled through this cliff at the west portal a huge slip occurred during railway construction. Many thousands of yards of rock fell into the Fraser river, causing a blockade, (later removed at great cost), in one of the narrowest channels, in consequence of which it is alleged that the salmon run on the river was adversely affected, causing a serious loss to the fishing industry, which, according to experts, is still suffering from the effects of this blockade. With this catastrophe still fresh in mind, and realizing the possibility of a repetition thereof should extensive blasting be done in the vicinity of the tunnel, careful inspections were made in cooperation with railway officials, which investigation confirmed the decision of the Department's engineers, viz., to locate the road in such a position as to avoid any interference with this section. Hence, following reconnaissance surveys a route was finally located at an elevation of about 650 feet above the Canadian Northern Railway at Hell's Gate. This established a new control point, and necessitated the revision of a considerable portion of the prelimi-

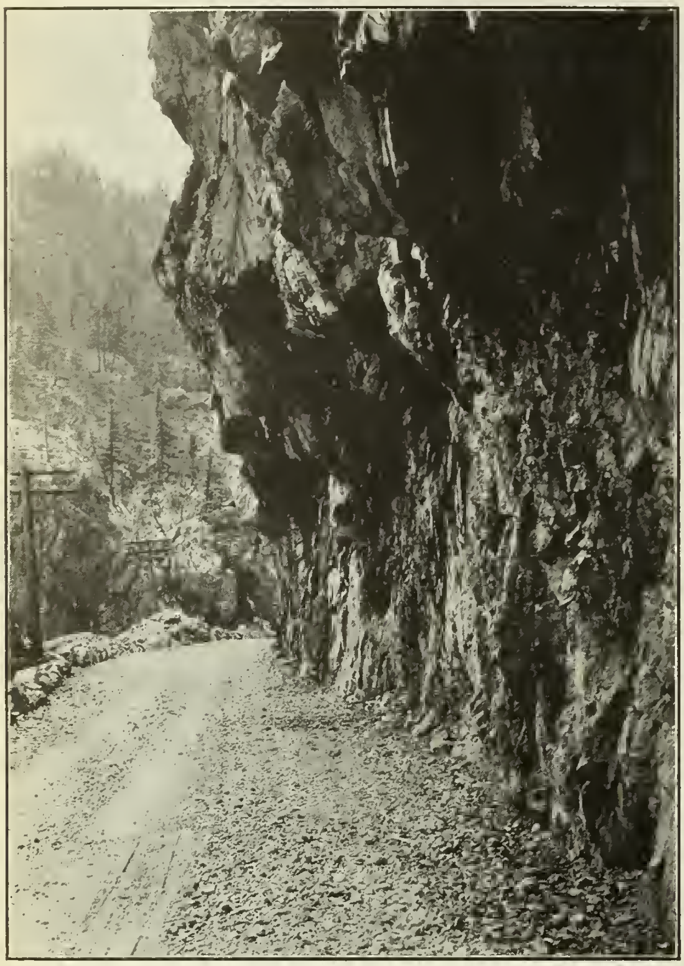


Figure No. 2.—Rock Gallery, one mile East of Yale.

nary location, excellent though it was. By adopting the revised location the engineers were able, (with the exception of one crossing near the east end of the Alexandra bridge), to avoid all level and overhead crossings of the railway through the entire length of the Fraser canyon, a distance of about twenty miles. When it is remembered that there were ten crossings of the old road by the Canadian Northern Railway the merits of the new location will be better appreciated.

As if linking in a bond of sympathy the new with the old, here and there the new road is in close contact with the old one. In fact the massive retaining walls built of random rubble sixty years ago still stand, a fitting tribute to the skill of these early roadbuilders. To the writer it is inspiring to contemplate the old roadbed and reflect on the efficient work of the master builders of 1863.

From an engineering standpoint the following facts concerning the location should here be of considerable interest and instruction:—

Grades:

Except at Jackass mountain, on the old road, where 10 per cent was imperative, the maximum grade was 8 per cent, reduced when possible on curves. At all abrupt changes of grade, vertical curves were introduced.

Curvature:

"Exterior" curves round a rock bluff, minimum radius 100 feet. "Interior" curves round a ravine, minimum radius 60 feet. Wherever feasible, however, 100 feet has been considered a minimum for all curves. A 300-foot clear view was always aimed at.

Super-elevation:

Emphasis was placed on the proper super-elevation, where necessary, of all curves,—a feature which has added both to the safety and comfort in negotiating the numerous curves.

Roadbed:

Minimum width on tangents, 16 feet clear of ditches. Minimum width on curves, 20 feet. In many places, the roadbed is 24 feet wide.

A minimum width of 14 feet 8 inches has been provided for on the timber bridges, the average estimated life of which is fifteen years,—galvanized sheeting having been freely used to protect all chord timbers, etc., from wet weather and overhead drippings. It is not found either necessary or economical to paint timber structures.

Construction

In the winter of 1924 contracts were called for the construction of portions of the road in three sections—(1) Yale to Alexandra bridge, (13½ miles); (2) Alexandra bridge to Boothroyd, (21 2/3 miles); (3) Lytton to Spence's bridge, (24 miles). The sections from Hope to Yale, (14 miles), and Boothroyd to Lytton, (22 miles), were carried out by the provincial government day labour forces under the direction of the district officials. Since in the Hope to Yale section the existing road, built in 1875, was both badly located, having no fewer than nine grade crossings of the Canadian Pacific Railway, and indifferently constructed, it was practically rebuilt. In the relocation of this 14-mile section only one of these crossings was perforce retained, (and even then on an improved location), thus demonstrating the commendable desire of the engineers to make the new highway as safe as possible even at considerably greater initial expenditure. With the "safety first" idea always prominently in view, no fewer than twenty-six Canadian Pacific Railway and ten Canadian Northern Railway crossings were eliminated, and of those remaining, two crossings are overhead, one is a subway and four are protected by automatic safety signalling devices. In constructing this section by day labour the department employed efficient foremen and workmen, chiefly local residents, together with the most modern plant, such as gasoline shovels, compressors, jack hammers, caterpillar tractors, etc.

Section No. 1, between Yale and Alexandra bridge, was built by contract in 1925-26 by W. P. Tierney and Company, Vancouver, on a unit price basis. The excavation was classified under solid rock, loose rock, hardpan and earth, (or common excavation). The following items were also covered by unit prices: dry masonry, retaining walls, timber cribbing, metal pipe culverts, round log curbing and timber trestles. The specification stipulated that the excavation prices included the loosening, removal and disposal of the various materials comprised in the different classifications, together with excavation for cribs, walls, rip-rap, culverts, bridge abutments, trestle bents and galleries. The grading of this section was carried out more substantially than originally intended, timber trestles, (previously planned for economy sake), being subsequently replaced by substantial fills. Careful revision of the preliminary survey of this line added over one mile to the length but with compensating advantages in alignment and grades. Being located adjacent to the Canadian Pacific Railway extreme care had to be exercised, one dollar per minute being the penalty for all delays or holdup of railway traffic. Fifteen trains passed daily over the railway, to safeguard the operation of which the telegraph wires were laid in duplex cables at all hazardous points. For the safety of all trains linemen and watchmen patrolled the track throughout the undertaking. A typical view of the rock gallery excavation on this road is shown in figure No. 2.

An outstanding example of grade separation can be seen

Figure No. 3.—View of River, Road and Rail, between Yale and Alexandra Bridge.

1½ miles east of Yale, where the highway is carried overhead across the railway at the east portal of the tunnel.

Travellers by the Canadian Pacific Railway will notice that as this section continues westerly:—

> " *Where the mountain pass is narrow*
> *And the torrent white and strong,*"

the canyon gradually contracts, thereby leaving little room for a road alongside the railway. Consequently careful location was necessary to obviate encroachment on the railway roadbed. Figure No. 3 shows an interesting and instructive view illustrating this unique feature of construction, viz., river, road and rail approximately paralleling each other. Attention should also be directed to the substantial dry stone wall constructed as a curb at the more dangerous points on the outside of the roadbed.

Practically all of this section was undertaken by station men, one gang doing 3 miles thereof. The excavation was handled partly with light cars and trucks, and partly by wheelbarrows. Around the first two Canadian Pacific Railway tunnels galleries were cut in the rock, (see typical gallery—figure No. 4), and in rock slides care was taken not to disturb " key " rocks. Some of the old retaining walls were used and short stretches of the old road are just as originally constructed, with stones, etc., cleared off the roadbed. Trestles were built between the tunnels at Yale and an unusually long one at Saddle Rock. For surfacing purposes the department was fortunate in procuring excellent limestone gravel adjacent to the right-of-way. This contract was commenced in January 1925 and completed in February 1926.

Inclusive of gravel surfacing, the cost of this 14-mile section averaged roughly $20,000 per mile, certainly not excessive, considering the comparatively large percentage of solid rock work, (about 65,000 cubic yards), or more than twice the yardage of earth work, the proximity of the operations to the railway, and the hazards thereby incurred. The following is the range of unit prices paid on all the contracts for the Cariboo road:—

Clearing	$100.00 per acre
Grubbing	$200.00 to 300.00 " "
Excavation (200 feet free haul)	
(a) Solid rock	$1.75 to $2.00 per cu yd.
(b) Loose rock	0.65 " 0.85 " " "
(c) Hard pan	0.50 " 0.85 " " "
(d) Earth	0.30 " 0.35 " " "
Overhaul	
Per cubic yard per 100 feet	0.04 per cu. yd.
Retaining Walls	
Dry masonry	$4.75 to $5.00 per cu. yd.
Cribbing	
Square timber	$40.00 to $50.00 M. feet B.M.
Metal Pipe Culvert	
12 to 36 inches diameter	$2.25 to $7.55 per lin. ft.
Trestle Bridges	
Square and hewn timber	$55.00 M. feet B.M.
Curbing	
Round logs	$0.20 to $0.35 per lin. ft.
Tunnelling	$100 per lin. ft.

Alexandra Suspension Bridge

About 1.5 miles north of Spuzzum the highway crosses to the east bank of the Fraser river on the Alexandra suspension bridge. This bridge was built practically on the same site as the old bridge but 10 feet higher, and, therefore, beyond possibility of damage by extraordinary floods. This structure was designed with a view to preserving, as far as practicable, the historic features of the former suspension bridge, but at the same time to provide for modern traffic requirements. The piers and wing walls are of 1:2½:5 mass concrete, (aggregating 1,066 cubic yards), faced with random rubble masonry to harmonize with the scenic setting of this structure. The towers, the tops of which are 35 feet above the bridge floor, are of reinforced concrete, (1:2:4), containing 202 cubic yards. The anchor blocks, rendered necessary owing to absence of stable solid rock anchorage, are of mass concrete, (1:2½:5), containing 638 cubic yards.

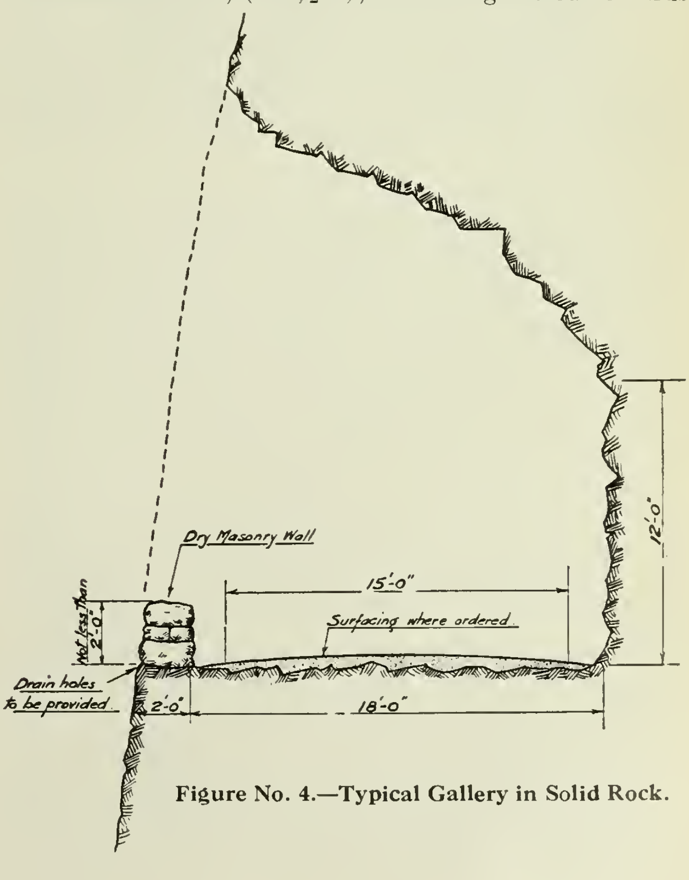


Figure No. 4.—Typical Gallery in Solid Rock.

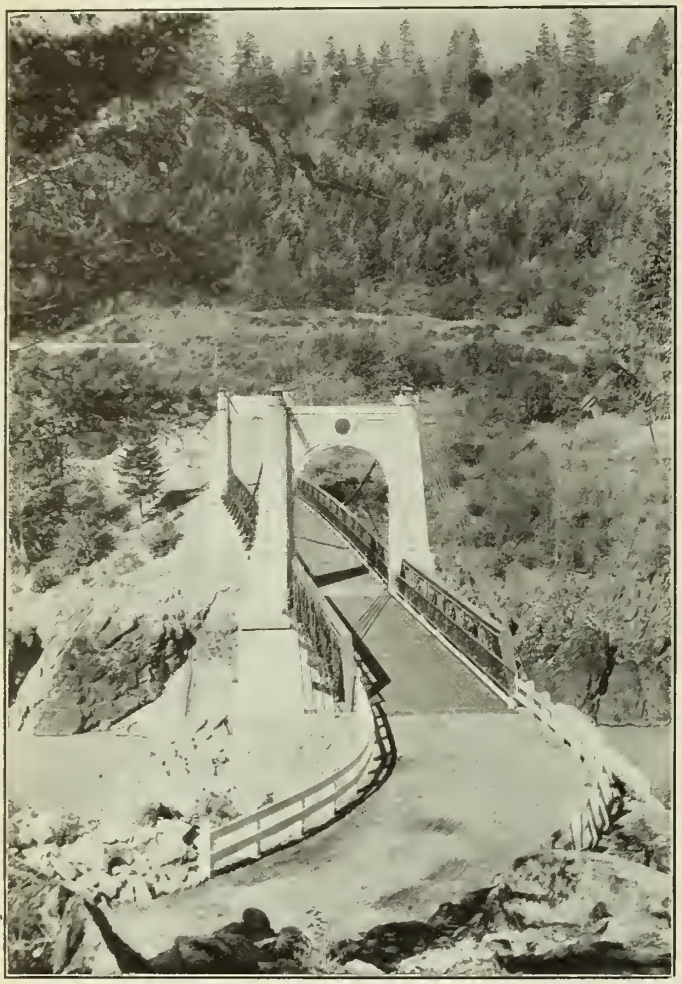


Figure No. 5.—Alexandra Bridge, Yale District.

On Cariboo highway, crossing Fraser river on same site as old Alexandra bridge built by Governor Trutch in 1863-64. One 277-foot steel suspension span and 90-foot steel truss span on concrete towers and piers, with footings faced with stone masonry. Concrete work and steel fabrication done by contract. Erection of all steel done by day labour.

The main suspension span is 270 feet long and is supported by eight 2½-inch diameter steel wire cables. The saddles for carrying the main cables on the towers are of the roller bearing type. The span is a steel stiffening truss with a timber deck having a 16-foot clear roadway. The east approach to the suspension span consists of a 90-foot steel pony truss, containing 124 tons of steel. The timber deck is finished with a bituminous surface and the timber guard rails are painted white in contrast with the black paint of the steel.

The concrete work was satisfactorily carried out by the The A. B. Palmer Company, Vancouver. The Canada Wire and Cable Company furnished the cables and hangers. The steel was fabricated by Coughlan Steel Works, Vancouver, and erected by the provincial day labour forces under competent supervision. The preparatory work in connection with test pits and foundations was commenced in the middle of August, 1925, and the entire structure satisfactorily completed the following August. On completion of the stiffening truss, the bridge was satisfactorily tested at different panel points with six loaded gravel trucks of 4 cubic yards capacity, (aggregate load 72 tons). As a result of measurements taken during construction of the 270-foot span, it was possible to determine the total amount of stretch, (viz., 16⅝ inches), in the main cables. The following summary of tests on concrete work which was undertaken by a "Little Wonder" mixer should prove instructive:—

Cement

Cement used in 1:2:4 mix.... 6.50 sacks per cubic yard
" " " 1:2½:5 ".... 4.80 " " " "

According to laboratory tests, initial set took place in 2½ hours; final set took place in 5 hours; average tensile strength sand briquettes at 28 days, 400 pounds per square inch.

Aggregate

The imported fine aggregate showed a fineness modulus of 2.71; the coarse aggregate 7.22.

Water

The quantity of mixing water used varied somewhat, according to the amount of moisture carried by the aggregates, but it was kept down to a maximum of 4 gallons per sack of cement. After having been analyzed and found suitable, Fraser river water was used.

Results of Tests

Average compressive strength of 1:2:4 mix at 28 days.......... 3,240 pounds per square inch
Average compressive strength of 1:2½:5 mix at 28 days........ 2,308 " " " "

The total cost of this structure was $101,793.58, an analysis of which, together with classified distribution, is shown in table No. 1.

The section of the Cariboo road from Alexandra bridge to Boothroyd, (21 2/3 miles), was undertaken by the A. B. Palmer Company, Vancouver. From the east end of the bridge the road loops up to cross the Canadian National Railway, (meantime for economic reasons on a grade crossing which later may be replaced by a subway), and continues above the railway on an entirely new location except for a short stretch at Chapman's station where the old road is followed.

The road climbs gradually to the summit of this section, (approximately 1,100 feet above sea level), where such was the topography that it was imperative to tunnel the gigantic granite rock bluffs with two tunnels, the first 260 feet, and the succeeding one 90 feet in length, both on tangents. The longer tunnel was made 27 feet wide and 17 feet in height, and since both tunnels were bored through hard rock devoid of seepage, it was unnecessary to line them.

Since the tunnels are the only ones forming part of a highway in the Dominion, they are unique in highway con-

Figure No. 6.—Tunnels 19 miles North of Yale.

Tunnel at right side of picture in background is 260 feet in length.

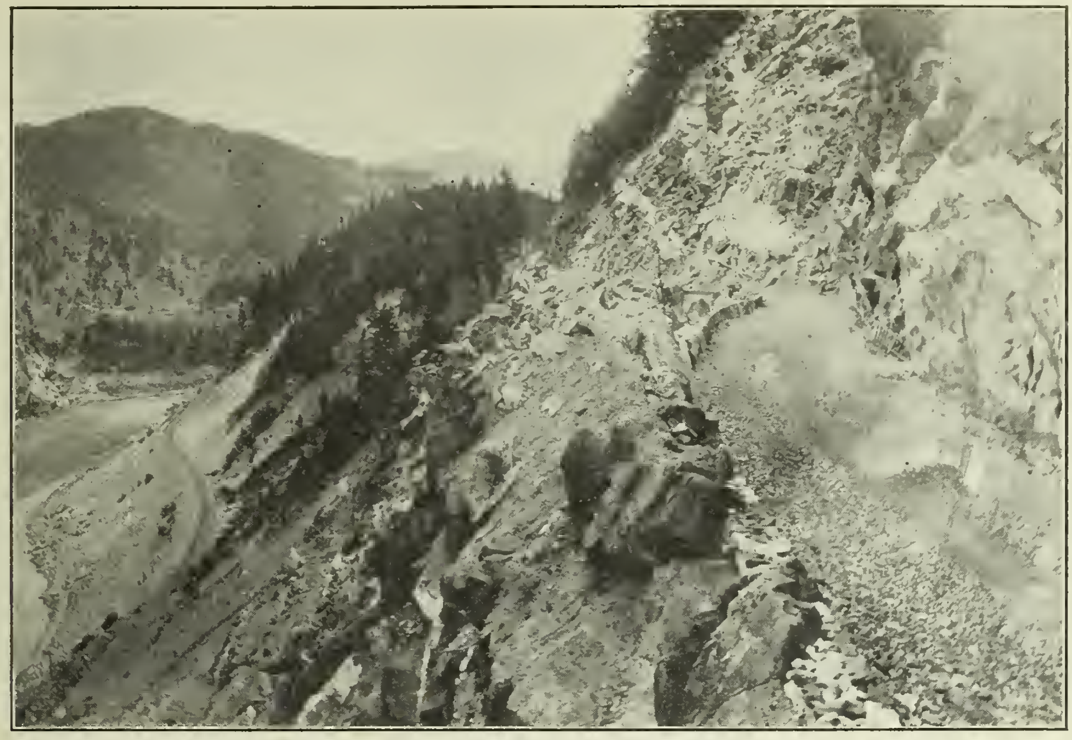


Figure No. 7.—View of Road at China Bar Bluffs—with Railway shown on the Lower Level.

struction. Pioneer bores were commenced simultaneously at each end, air compressors and pneumatic rock drills being the only labour-saving devices utilized throughout the operations, which occupied about four months. Much of the rock excavation was hauled to nearby dumps in cars on light rails, but it was possible to use the larger blocks for the dry rock protection walling which formed a special feature of the construction along the rock bluffs in this vicinity. As will be noted from the unit prices previously referred to, the tunnelling was undertaken at a unit price of $100 per lineal foot of cross-section.

After leaving the tunnels the highway continues, in easy and graceful curves, to wind round the rock bluffs, towering over the Canadian National Railway, which at this point is about 600 feet below the road. Despite the difficult and expensive construction in rock work, the highway was built of ample proportions, the roadbed being everywhere wide enough for two motor vehicles to pass safely, and all curves being widened out and super-elevated. As an added precautionary measure substantial walling, (see figure No. 6), about 2 feet in height and 18 inches wide, was constructed on solid foundations at the outer edge of the roadway, wherever this was deemed necessary. With so much rock conveniently available it was possible to construct dry rock retaining walls of massive blocks, and it is interesting to note that in many places the foundations of such walls were laid directly on the old roadbed and even in some instances on top of old retaining walls, so substantially had they been built in the Sixties. Where rock was not available heavy log protection railing was laid on cradles at the outer edge of the road. Such precautionary measures are illustrative of the care and consideration exercised to add to the comfort and protection of travellers in overcoming hazards, mental or actual.

At difficult points on this section some splendid specimens of peeled log cribwork can be seen, suitable timber being found nearby. The portion known as China Bar bluffs proved exceedingly hazardous,—certainly the most difficult piece of rock work the writer ever experienced in either railway or road construction. These bluffs overhang the Canadian National Railway tracks some 300 feet below, while above are menacing precipices. Hence every yard of rock had not only to be laboriously moved by manual methods, (exclusive of rock drilling and small shots), but also had to be loaded in cars and hauled to safe dumps away from the railway. The engineering problem was not so much to excavate a roadway round the rock bluffs, but to prevent, or rather hinder, material from the overhanging bluffs from damaging either roadway or railway.

Considerable underpinning of the rock above and construction of overhead retaining walls had to be carried out under most dangerous, and, of course, expensive conditions. But, fortunately, this section, unique in highway construction, was successfully and safely negotiated without loss of life or limb, greatly to the credit of the contractors, who had not only to shoulder tremendous responsibility, (on one occasion an eleven-hour delay of trains due to accidental discharge of rock excavation on the Canadian National Railway involved the contractors in a $2,500 renewal and repair bill in addition to the cost of clearing the tracks), but also the expense bill. The fact that an enormous yardage of rock was laboriously handled in this section, which cost the contractors no less than $76,000 for a distance of 2,260 feet, viz., over $33 per lineal foot, should best demonstrate the difficulties and disabilities under which the work was undertaken over a period of fourteen months.

The view in figure No. 7 illustrates the rugged and diversified nature of the country which this highway traverses, at the same time emphasizing the extreme engineering difficulties to be contended with.

To afford a more definite conception of the magnitude of the operations on this contract, (2A), the following is the percentage of classification of excavation:—

Solid rock	35 per cent
Loose rock	18 " "
Hard pan	28 " "
Earth	19 " "

Another outstanding feature of the location of this section of the Cariboo road was the diversion round Nine Mile creek, north of Boston Bar. While this added over one mile

Figure No. 8.—Bridge over Anderson River—160-foot Howe Deck Timber Truss.

to the length of the road it resulted in eliminating an expensive high level crossing, about 500 feet in length, paralleling the Canadian National Railway. This diversion further commended itself in the additional scenic features and auto camp sites it rendered available to the motoring public. Nowadays scenic highways are not fundamentally located on the shortest possible distance consistent with negotiable grades.

The contractors having their organization available, the gravel surfacing between a point 4 miles west of Yale and Boothroyd, (36 miles), was carried out by them on the following unit basis:—

(a) Approved material spread upon the roadbed, as directed by and to the satisfaction of the engineer; free haul three miles; volume of each load to be measured in vehicle of transport at point of loading; cubic yards, more or less. 50,000 at $1.20.....	$60,000
(b) Additional payment for each mile or part of a mile over which each cubic yard is hauled beyond the limit of three miles' free haul; cubic yard-miles, more or less. 10,000 at 35 cents..................	3,500
Total (estimated)	$63,500

So close was the engineer's estimate that the amount paid the contractors was actually $29 less than this estimated total. Exclusive of bridges, the cost of gravelling worked out at, roughly, $1,800 per mile of 14 feet width, road centre depth of 4 to 6 inches unconsolidated gravel. Several splendid gravel and shale deposits either in the larger cuts or in pits adjacent to the road reservation were available, but nevertheless the contractor was obliged to haul materials considerable distances.

In several instances it was necessary to screen the gravel through a "grizzly" erected on the roadway, but generally most of the surfacing material was of such a character as to permit of its being deposited directly on the road. By means of power shovels and 4-yard truck units it was possible to undertake a considerable yardage daily. The contractors were not required to roll the gravel, but motor graders were employed to grade and shape the roadbed to an even and uniform contour. Since the major portion of the road is built of excellent materials with a large percentage of rock, the nucleus of a splendid gravel surface was thereby procured. Subsequently the surface has been materially improved by the sustained efforts of a special day labour patrol gang equipped with mechanical labour saving outfits.

Here it may be mentioned that immediately after the opening of this highway special maintenance gangs were organized, and outfitted with the necessary equipment to deal with the rock slides, "cave-ins," subsidences and other works contingent to a newly constructed mountain highway. Hence, in the course of maintenance operations the roadbed is being widened, surfaced and otherwise materially improved. On this highway, as on other main highways built out of capital funds, the department has continued its policy of conserving, by careful and continuous maintenance, the original type of construction,—an all-important measure so frequently neglected by highway engineers with detriment to the highway and subsequent greater expense to the treasury.

As has been previously mentioned, the original road contracts did not include gravel surfacing, as it was deemed advisable to provide for such work in extended contracts after the bridges had been built. Obviously a mountain road of this description necessitated numerous bridges to negotiate the yawning chasms and span the turbulent creeks emptying into the Fraser river with comparatively wide mouths. While the ordinary bridges were undertaken by the A. B. Palmer Company, being built in systematic succession after the completion of the grading, two larger bridges, namely, those at Anderson creek and Stoyama creek, were constructed by separate contract. The photograph, (figure No. 8), shows that they were Howe deck timber bridges, that type proving most economical in design and æsthetic in appearance. Spans of 160 feet, having a clear roadway of 14 feet 8 inches, were necessary. Since they crossed rocky canyons at an average height of 160 feet from the creek bed, naturally their erection demanded an abnormal amount of falsework. The cost of the two bridges in one contract was about $46,000. Coast fir cost $85.00 per M. in place, and trestle approaches and timber piers $22 per M. in place. All the timber bridges are built to withstand a 15-ton concentrated load and have an estimated life of from fifteen to twenty years.

It is a pleasure to record the generally excellent work undertaken by the contractors, who continuously co-operated with the department's engineers in an earnest endeavour to carry out all work in an efficient and expeditious manner. In the distribution and administration of the necessary construction camps the contractors showed considerable initiative and enterprise, visitors expressing surprise and pleasure at such splendid organization and commissariat. Obviously in mountainous territory with no access roads available the assembling and distribution of plant and material called for considerable labour and ingenuity. On rocky mountain slopes the primitive mode of packing of heavy loads on men's backs had perforce to be resorted to.

Owing to the topography of the country, the ordinary methods of construction of such major highway works, namely, by excavation and other power equipment, had to be dispensed with along rocky mountain slopes. In handling the numerous large boulders and enormous excavated rock work, improvised tripods and hand cranes were used. Air compressors and pneumatic rock drills were also freely utilized to advantage in the abnormally heavy rock work.

So precipitous were the rocky slopes in some sections that the drilling and other work had to be undertaken by men suspended by ropes. Altogether the operations were of an unusual character, calling for resourcefulness and eternal vigilance on the part of the contractors. Consequently it is a fitting testimony to the excellence of their organization and the worth of their superintendents that in a contract of such magnitude involving about a million dollars, there was no loss of life, and even accidents were of minor proportions.

Boothroyd-Lytton Section

Partly because this 24-mile section involved considerable reconstruction of the old Cariboo road, and partly due to the department's desire to utilize its own extensive up-to-date equipment, it was efficiently and economically carried out by provincial day labour under the supervision of District Engineer Major Taylor, thoroughly conversant with such construction work. A half mile diversion involving heavy cuts and fills at Tilton creek was carried out by contract at a cost of approximately $32,000. Other important diversions, to improve both alignment and grades, were carried out by day labour at Kanaka, Falls creek and Cisco. The material handled in those diversions consisted largely of gravel with large round boulders, solid rock and slide rock. On account of the large percentage of rock boulders ploughing was not practicable and some of the hand-moved material cost on an average 50 cents per cubic yard.

However, the bulk of this grading on this section was carried out by the department's gasoline shovels at from 10 to 14 cents per cubic yard for earth. Particularly on the side hills, where slide rock predominated, such excavators were found most practicable, economical and expeditious in the widening out of the former narrow roadbed.

In this 24-mile section, which generally traverses, in a winding and undulating manner, the east bank of the Fraser river alternately above the Canadian National Railway and Canadian Pacific Railway, the strategic point is at Jackass mountain, where, after climbing a considerable distance on a 10 per cent grade, (the greatest on the whole of the Cariboo road), the highest summit, (1,180 feet), is reached.

Since the work at this point was directly over the Canadian National Railway track, heavy blasting was precluded, and practically every yard of rock had to be hauled away, rendering the cost of solid rock excavation about $2.75 per cubic yard.

Some splendid specimens of peeled log timber crib work can be seen at the Jackass mountain summit, where such was the perpendicular nature of the rock that retaining cribs had to be undertaken to permit of the standard width of roadbed, (sixteen feet).

At the east end of Lytton Townsite, where the old road crossed the Canadian Pacific Railway on a dangerous grade crossing, " grade separation " was resorted to. In the entire 24-mile portion there is not a single grade crossing, whereas the old location crossed and recrossed the Canadian Pacific Railway several times. With willing co-operation of the Canadian Pacific Railway Company it was possible thus to eliminate all grade crossings, with resultant improved alignment and grades to the highway generally. Hence it will be observed, and it is hoped, appreciated, that the department concentrated every effort towards obtaining a safe and serviceable location, even at greatly increased expenditure, the vision of heavy motor travel being ever prominently in view.

To permit of a necessary revision of the old Cariboo road at Cisco, Cisco creek had to be bridged over a rocky gorge with precipitous walls. From road level to creek bed is 180 feet, (see figure No. 9). Despite the extremely difficult and dangerous nature of this work and the great expense involved in falsework, the structure was successfully constructed by provincial day labour at reasonable cost, ($18,570). The structure consists of one 150-foot deck Howe truss span and 80 feet of trestle approaches, all on concrete piers and with a concrete retaining wall abutment at the east end.

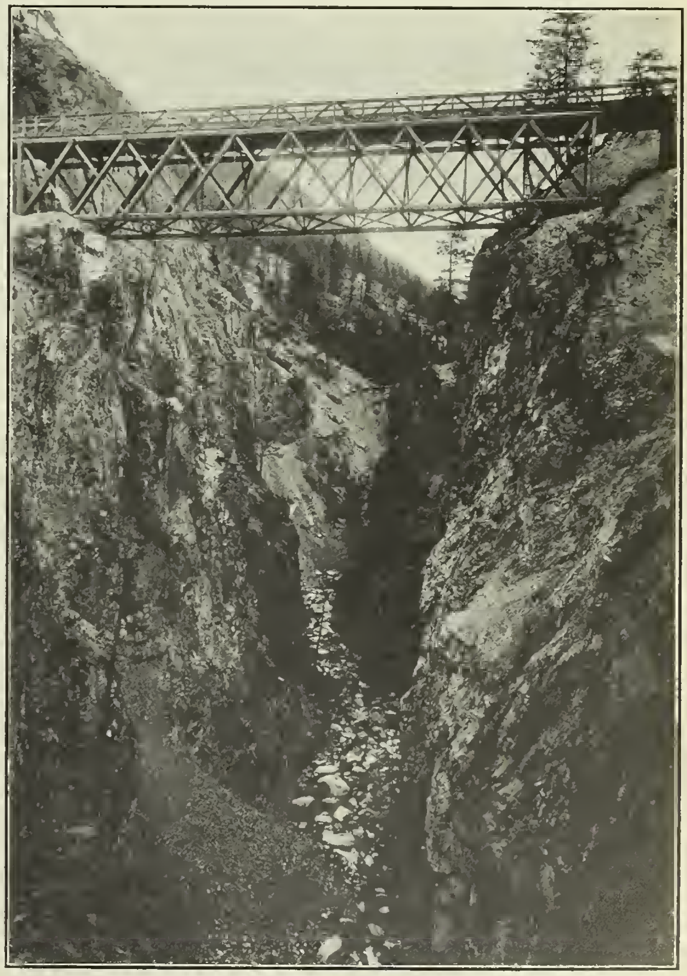


Figure No. 9.—Cisco Bridge—180 feet above bed of Creek—Built by Day Labour.

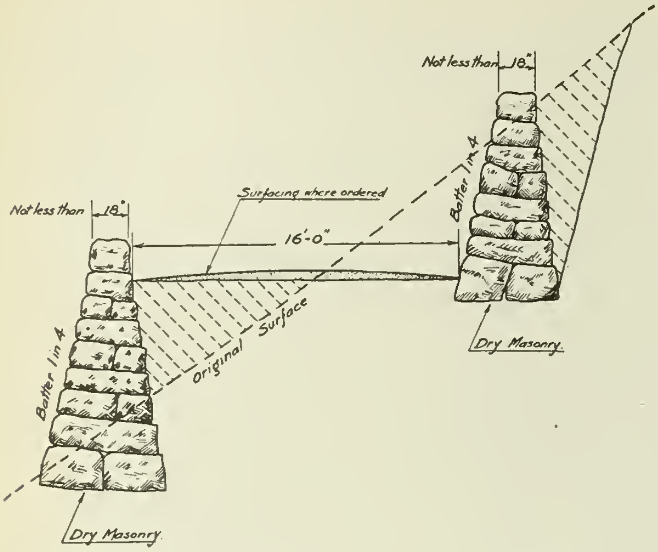


Figure No. 10.—Typical Section with Retaining Walls in Loose Rock or Earth.

Lytton-Spences Bridge

This is the last section of the Cariboo road with which the present article deals. Traversing this territory eastward, particularly for the first time, one is strongly, and even strangely, impressed by the sudden change in the nature of the landscape. Hitherto frowning precipices, the swift flowing Fraser swirling through rock gorges, and sundry cultivated areas, have in succession met the enchanted eye. But after leaving the quaint town of Lytton, situated sentinel-like at the confluence of the Fraser and Thompson rivers, the scenery displays a totally different aspect. Now we are in the " Dry Belt " with sparse timber, (chiefly bull pine), and scant vegetation subsisting on the wide sand benches which chiefly characterize this country, but nevertheless with an attraction and charm peculiarly its own.

Throughout its entire length this section of the highway is located on the left bank of the Thompson river, approximately paralleling the Canadian Pacific Railway for the greater part of the distance. For three-quarters of the length the highway route is located well above the railway, but owing to the precipitous gravel slopes, (points being designated with the weird names " Indictment Hole " and " The Jaws of Death "), it was imperative to locate the line with extreme care. To do so it was necessary to construct retaining walls adjacent to the railway and heavy rock fills into the river. In loose rock or earth, retaining walls, (see figure No. 10 for typical section), had in many places to be constructed. Here also it was possible, by careful revision, to eliminate grade railway crossings so that in the whole of this 24-mile stretch there are only two level crossings.

The country between Lytton and Spence's bridge is very rough, and consists alternately of solid rock, gravel and hard pan bluffs with short stretches of flats intervening. The old Cariboo road followed the left bank of the river and at various points round the bluffs was cut out of the solid rock or hard pan. The construction of the Canadian Pacific Railway completely destroyed the old road at many points, but particularly where the bluffs come down to the river. On account of the destruction of the old road at these points, in the construction of the new road it was necessary to go over the tops of bluffs, or in cases where that was impossible, to adopt costly and difficult means of construction. Following is a general description of the route:—

Leaving Lytton the road crosses the railway on a level crossing and climbs up a hard-pan and gravel side hill through broken country to the flat at Lytton race course, thence the grade generally falls to the two mile slide. The old road at this slide crossed the railway, ran along the bottom of the railway banks close to the river, and after passing the slide climbed up to the railway again and recrossed. The new road does not cross the railway, but comes down to a level of about eight feet above the rail and is taken along past the slide on a bulkhead consisting of round cedar posts anchored back to cedar logs with round iron tie rods, planked up behind the posts and filled with rocks. After leaving the two-mile slide the road rises to clear the tops of long gravel slides, which reach to the railway, and after reaching the summit, about two miles east of the slide, the grade drops through easier country to the flat at Gladwin.

From Gladwin flat the road climbs on solid rock and gravel side hill to get over a summit above the " Jaws of Death," and at this summit it strikes the old road which it follows to a point near Tank creek where the road drops on a steady 8 per cent grade to a level crossing. Thence the road drops on a 6 per cent grade on trestle and then follows practically a water grade between the railway and the Thompson river to Thompson Siding. At Thompson Siding there was an old railway crib approximately 1,400 feet long. This crib has been replaced with a heavy rock fill. The road now passes under the Canadian Pacific Railway Barrack Creek bridge at the west end, and distance is developed in the basin of the creek, so that the grade reaches a point about eight feet above the railway at the east end of Barrack bridge. From this point for a distance of 4,000 feet the road will be constructed parallel to the railway and about eight feet above rail level. The construction will consist of a concrete mass retaining wall.

At the end of this wall the road rises on a steady 8 per cent grade to cross the " Indictment Hole " and from this point follows a rocky side hill for a distance of two miles to an overhead crossing of the Canadian Pacific Railway. The route is then between the railway and the river to Spence's bridge. The construction consists of long cribs where the ground between the railway and the river is limited. There are several good flats where construction costs were light.

At Drynoch slide the road is well clear of the railway, but it is anticipated that trouble will always be experienced in this slide, as the railway, passing through similar ground, has always had trouble at this place. One mile east of Drynoch it was necessary to straighten out the railway to allow room for the highway above steep cut banks to the river.

The construction from this diversion to Spence's bridge consists of side hill, flats, cribs and rock cuts, and is generally of a fairly costly nature.

Owing to the many difficult construction features and the limitations placed on location of the highway by the Canadian Pacific Railway and the Thompson river the whole stretch of approximately 24 miles is costly road construction.

Signing and Patrolling of Highway

Despite the fact that extreme care was exercised both in the location and the construction of this mountain highway so as to render it as safe as possible from a traffic standpoint, careless and indifferent motorists have always to be reckoned with. Consequently, after co-operation with the Automobile Association of British Columbia, an adequate number of warning and directing signs have been placed where considered essential. At the few grade crossings automatic signals have been installed. The following press report should allay any apprehension as to the safety of this highway:

> "One of the outstanding features of the new Cariboo highway, according to the motorists who have reported their impressions of the road to the Automobile Club of British Columbia, is the safety and freedom from mental hazard provided in the Fraser Canyon stretch. Sufficiently wide at all places for two cars to pass, and entirely free from steep grades, the road is also provided, wherever necessary, with outside protection consisting of stone wall construction two feet thick. In addition to these precautions and despite the engineering difficulties presented, practically all level railway crossings have been eliminated, while ample warning signs have been provided at strategic points. These features, together with the splendid scenic offerings and excellent roadbed, have contributed much to the present popularity of the route."

In co-operation with the Department of the Interior, under whom is the control of this Railway Belt, the department is making an earnest effort to prevent the spoilation of this scenic highway by placarding it with commercial signs and alluring advertisements. No permits are being issued for any signs, however apparently attractive. During the motoring season, lasting from May to October, (although the highway will likely be open for through traffic every normal winter), an official of the provincial police, mounted on a motorcycle, will patrol it for the protection and safeguarding of the interests of the travelling public.

Conclusion

Inclusive of the Alexandra suspension bridge, the gravel surfacing, and the engineering costs, (the latter about 6 per cent of the aggregate), the reconstruction of the 100 miles of the Cariboo road, when completed in the fall of 1928, will have cost in the neighbourhood of $2,500,000. Considering the enormous difficulties contended with, the abnormal quantity of solid rock work, and the excellence of the road work done, an average of $25,000 per mile is quite reasonable.

In conclusion, due credit should be given to those engineers who closely co-operated with the writer in the following work, thereby contributing largely to the success of this undertaking, one of the most important in the highway annals of the province:—

Preliminary Surveys: W. K. Gwyer, M.E.I.C., and F. J. Dawson, A.M.E.I.C.

Final Surveys: H. C. Whitaker and R. M. Corning.

Construction Work: Major R. M. Taylor, M.E.I.C. (district engineer at Kamloops), H. C. Whitaker and D. McMillan, M.E.I.C.

Resident Engineers: F. J. Clarke, T. E. Clarke and G. P. Hayman (*deceased*).

Construction Work: Major R. M. Taylor, M.E.I.C., and E. H. Verner, M.E.I.C., district engineers; H. C. Anderson, A.M.E.I.C., and G. N. Stowe, A.M.E.I.C., assistant district engineers.

Bridges: G. M. Duncan, chief draughtsman; A. L. Carruthers, M.E.I.C., bridge engineer; H. L. Swan, A.M.E.I.C., and O. W. Smith, M.E.I.C., resident engineers.

Particularly in the debatable points of location and in the more difficult construction details, great credit is due to G. P. Napier, M.E.I.C., assistant public works engineer, for valuable advice and assistance.

Reference already has been made to the excellent work of the contractors, but special mention should be made of the willing co-operation of Mr. John Boyd of the General Construction Company, (late the A. B. Palmer Company), and also to that fine veteran contractor, Wm. P. Tierney, who carried out the western section of the canyon work so expeditiously and creditably.

Table No. 1.—Analysis of Cost and Classified Distribution of Alexandra Bridge.

:ALEXANDRA BRIDGE:
·COST ANALYSIS·

Item	Quantity	Unit Cost	Cost			
270' Suspension Span — Sub-Structure — Excavation.						
Anchors	1710 cy	$1.59	2721.37			
Piers	608 cy	$2.24	1359.34			
Total Excavation	2318 cy	$1.76	......	$4080.71		
Concrete						
Anchors 1:2½:5 (with large stone)	628 cy	$18.31	11499.31			
Piers 1:2½:5 (without large stone)	820 cy	$21.14	17334.66			
Total 1:2½:5	1448 cy	$19.91	......	$28833.97		
Towers 1:2:4 (Reinforced)	202 cy	$38.41	7774.45	7774.45		
Masonry Piers	77 cy	$56.31	4335.74	4335.74		
TOTAL: SUB-STRUCTURE:			......	......	$45024.87	
Super Structure — Anchors & Saddles	33,622#	15.2¢	5116.87	5118.87		
Cables & Hangers	451' Anc. to Anc.	$31.31	14197.24	14197.24		
Stiffening Truss	175,521# / 270'	12.3¢ / $79.74	21522.48	21522.48		
TOTAL: SUPER STRUCTURE:			......	......	$40838.59	
TOTAL COST: 270 SPAN:	316.3'	$271.46	......			$85863.46
90' Truss Span — Sub-Structure	256 cy	$19.74	5052.79		5052.79	
Super Structure	72,467# / 90'	12.6¢ / $101.77	9159.35		9159.35	
TOTAL: 90 SPAN:	115.2'	$123.37	......			$14212.14
Fencing:	167'	$7.25	1210.84		1210.84	
Back Fill & Clean-up:	431.5'	$1.17	507.14		507.14	
TOTAL APPROACHES:						1717.98
TOTAL COST	431.5'	$235.91				$101,793.58

:Classified Distribution:

Item	Percentage of Total			Amount			Remarks
Engineering. Concrete Insp.	1.3			1287.63			
" Field Work	1.9			1987.21			
" Steel Insp.	1.3			1324.77			
" Miscellaneous	0.1			115.40			
" TOTAL:			4.6%			$4715.01	
Advertising. TOTAL:			0.4%			$403.27	
Demolition, Excav. & Test Pits			1.9%			$1945.03	
A. B. Palmer - Contract	40.5			41293.35			
" Masonry	3.9			3929.31			
" Extras	1.4			1417.02			
" Rentals, Tools & Equipment	3.2			3286.16			
" TOTAL			49.0%			$49925.84	
Dept. of P.W. — Cables: Wages	2.3			2310.00			
" Material & Equipment	14.0			14304.24			
" TOTAL:		16.3%			$16614.24		
Spans: Wages	8.3			8410.88			
" Material & Equipment	19.2			19512.03			Includes Shop labor on Steel spans
" TOTAL		27.5%			$27922.91		
Approaches & site		0.3		267.28	267.28		
DEPT. P.W. TOTAL:			44.1			$44804.43	
:TOTAL COST:						$101,793.58	

Some Engineering Aspects of the Bridge River Project

A Description of the Hydro-Electric Power Development of the British Columbia Electric Railway Company, Limited; the Power Possibilities of the River, the Proposed Programme of the Stages of the Development and the Progress of Construction

E. E. Carpenter, M.E.I.C.
Consulting Engineer, British Columbia Electric Railway Company, Limited.

Paper presented at the Western General Professional Meeting of The Engineering Institute of Canada, at Vancouver, B.C., June 7th, 1928

It is, perhaps, somewhat unusual in technical procedure to present in a formal paper to the engineering profession, as represented by The Institute, a descriptive discussion of a project which has neither the status of a proposal nor of a consummation, but lies midway between, its actual state being that of a proposed project that is just taking on the first stages of fulfilment. In order to avoid any confusion the construction features of the project will, throughout the paper, be spoken of in the future tense, even though some of them may have been carried out to some degree.

It is, perhaps, equally extraordinary to present for review and discussion, plans and details of structures yet unconstructed, in fact, in many cases plans that partake of the nature of studies leading up to the best solution of the problems and the determination of the final plan. This latter point is brought out deliberately in the belief that valuable suggestions may result from the discussions with which the paper may be favoured.

Aside from the technical problems involved, the Bridge River project possesses two features of special interest which make it stand out in comparison with other power development projects in Canada, or elsewhere for that matter. These are, first, the large quantity of water capable of diversion, and, second, the high head available for its utilization. Many plants are more favoured with respect to one of these two features, but it is believed, without positive examination of the records, that few, if any, sites can be named which possess the combination of head and water supply with which this project is endowed.

Imagine a river,—not a mountain stream,—of some 3,700 cubic feet per second average flow, meandering through the flat basins of its middle course with mountain ranges towering on either side, then plunging downward some 1,400 feet in the few miles remaining to be traversed to join it with the Fraser river. Imagine then this river bending southward, before its final plunge to the Fraser, until its

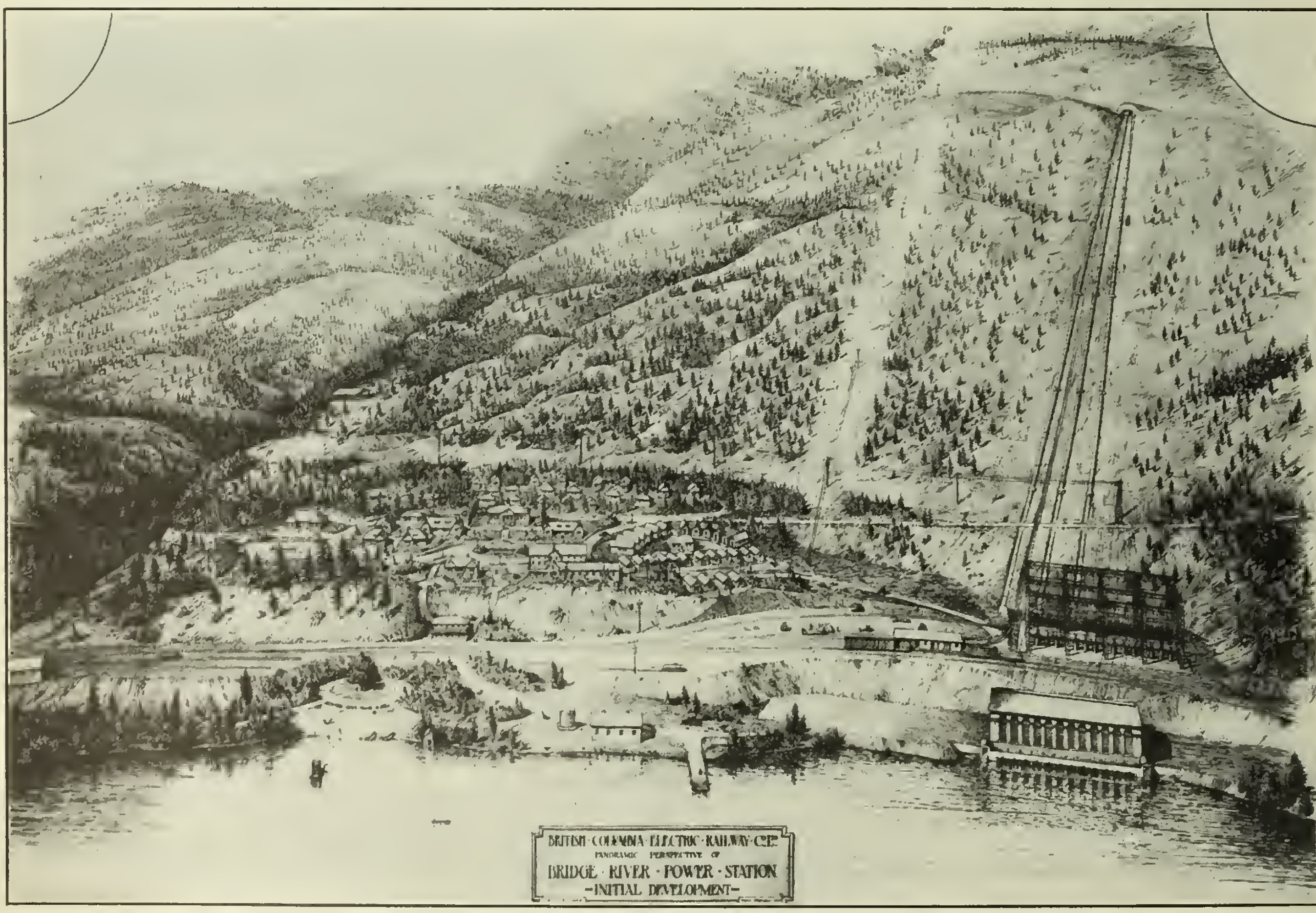


Figure No. 1.—A Sketch of Proposed Initial Development of Bridge River Power Station.

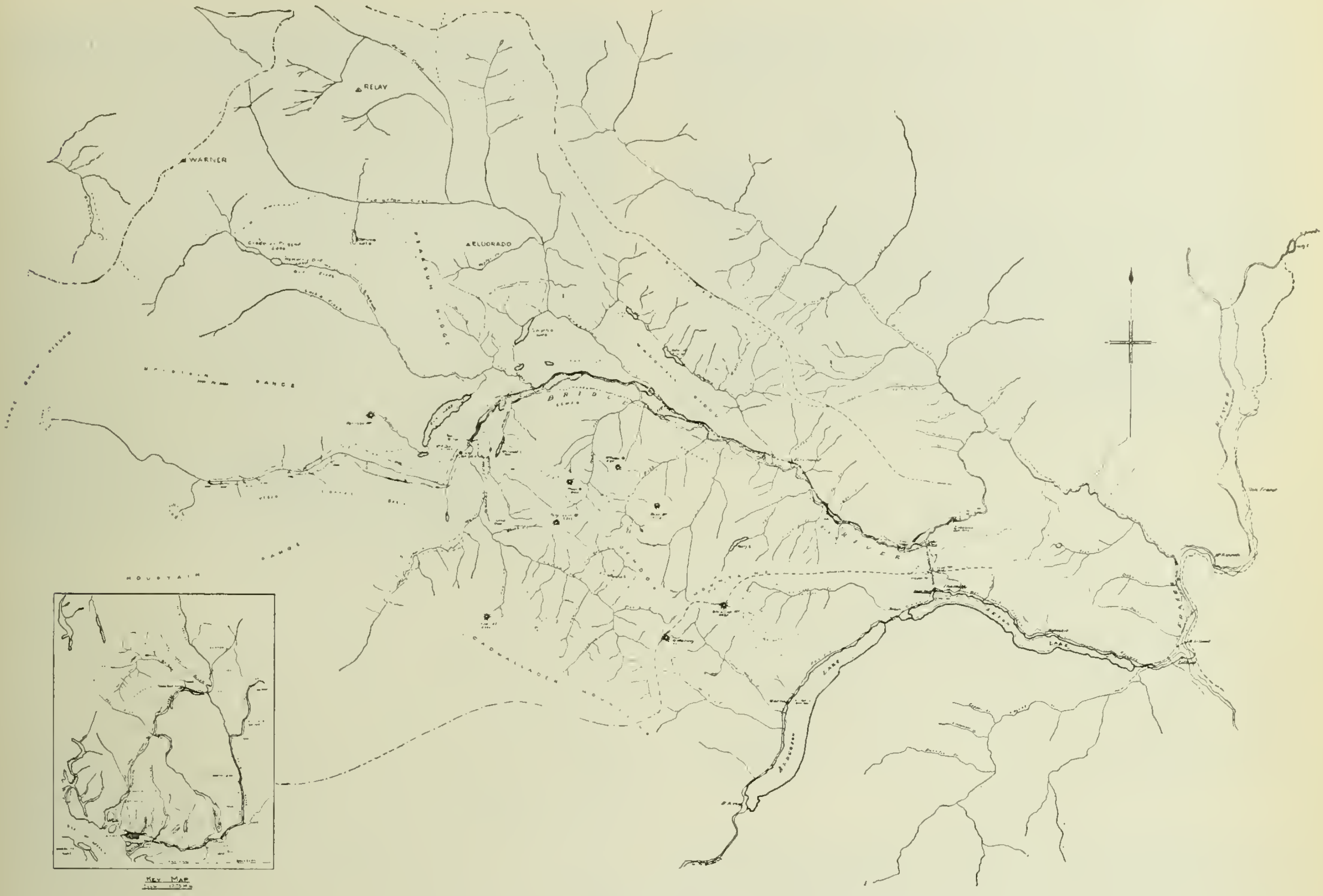


Figure No. 2.—Map of Bridge River Drainage Area.

bed is separated by less than 3 miles from a beautiful lake lying to the south in a parallel rock-bound trough of the mountain chain, but some 1,200 feet lower than the river bed; three miles of mountain mass to be tunnelled to bring the river through the mountain and discharge its mighty waters on the mountain side above the lake, there to be harnessed by the artifices of man, which will wrest from it its huge store of energy and direct it to the beneficial use of a distant community. This is a picture of Bridge river and Seton lake, the water supply and the tailwater basin respectively of the project, which will ultimately afford electric power to the extent of some 600,000 horse power, to be taken off at will, as, and when required by the expanding communities of coastal British Columbia.

History

The power possibilities of the site were first made known by Captain Downton, a land surveyor who discovered the difference in elevations of river and lake and their close proximity to each other. The first applications for appropriation of the waters for power purposes were made in 1912 by a group headed by W. R. Bonnycastle, M.E.I.C., hydro-electric engineer of Vancouver. Preliminary surveys and investigations were carried on at that time,—sufficient to establish the power capability of the project. Subsequently various schemes to promote the development to a construction stage were pursued but none of them were successful owing to a lack of a firm market for the power.

In 1925, the British Columbia Electric Railway Company took an option on the rights and properties of the Bridge River Power Company, Limited, then owners of the project, and after a close investigation of the whole project, acquired the property in September, 1926, by purchase of the stock of the old company.

Location

The site of the development lies some 130 miles transmission distance from Vancouver in a north easterly direction. The Pacific Great Eastern Railway passes the site of the generating plant at Bridge River station on the shore of Seton lake. Transportation to the site is afforded by water carriage from Vancouver to Squamish at the head of Howe sound and thence by rail to the power site. The boat trip is about 45 miles and the railway trip about 104 miles in length.

Watershed

Bridge river, one of the major tributaries feeding the Fraser river from the west, has its source in the eastern flanks of the coast mountains, which rise from 6,000 to 10,000 feet above sea level in rugged snowclad peaks and ridges whose snow fields and glaciers contribute largely to its water supply. In its upper reaches it is a turbulent, fast moving stream, highly erosive in action and carrying a heavy load of glacial detritus which is being deposited in the long flat bottomed valley basins of the meandering middle reaches. The whole picture is one of recent glacial occupation, and a youthful unorganized state of being. These valleys, or basins, two in number, with their newly deposited sand and gravel bars alternating with marshy alluvial flats overgrown with cottonwood, birch and alder,

Figure No. 3.—Gun Lake in Upper Watershed showing High Ridge beyond Bridge River.

are important to the project in that their extremely gentle gradients and flat floors afford excellent storage sites for the future regulation of the stream.

The lower reach of the river plunges downward through a deep box-like canyon, in a series of rapids and falls which dissipate some 1,400 feet of head in the 15 miles distance from the lower basin to the confluence with the Fraser. It is this plunge that makes possible the high head to be obtained by diverting the stream southward through the mountain.

The water shed is largely unmapped but is estimated at about 1,350 square miles.

Water Supply

The water supply of the river is chiefly derived from the higher levels of the watershed, where precipitation is more plentiful and falls largely in the form of snow. The lower elevations receive very limited rainfall and are semi-arid in character. Yellow pine predominates in the park-like forested slopes and benches, and sage brush is often seen on the Seton lake side of the range.

Precipitation records have not been taken continuously. Run-offs have, however, been well established by stream measurements carried on for several years. The limited records of precipitation indicate that the average at Gun lake, in the upper watershed at elevation 2,900, for the three years 1925, 1926 and 1927 was about 18 inches. At Bridge river station, the precipitation for 1927, the only year of observed record, was 20.54 inches.

With the co-operation of the Dominion Water Power and Reclamation Service, and under its supervision, the flow of Bridge river and its principal tributaries has been measured and recorded since June 1913. Thus, an excellent history of the stream is available for a fifteen-year period. The daily discharge records are published in the Water Resources Papers of the Department. A tabulation of the mean monthly and yearly flows is given in table No. 1.

The mean annual yield of the watershed of 3,736 cubic feet per second is at the rate of 2.8 cubic feet per second per square mile of drainage area. It is interesting to compare this with similar data of the company's coastal watersheds, as given in the author's paper on " The Water Power Developments of the Alouette-Stave-Ruskin Group "[1] and its subsequent discussions. The corresponding per square mile yields of the Stave, Alouette and Coquitlam watersheds are shown as 8.6, 11.2 and 8.1 cubic feet per second, respectively.

[1] The Engineering Journal, January 1927.

The stream flow is subject to wide seasonal variations. The low water stage occurs in winter. January, February and March, with minimum temperatures as low as 30° to 40° below zero, register the least discharges. April brings gradually rising waters which increase until late June or early July, when the maximum is reached, and then decrease slowly through August and September, but hold up well until the cold snaps of late December and early January. The seasonal characteristics of the Bridge river run-off differ materially from those of the lake group. This relation is, fortunately, to a degree a complementary one, in that the Bridge river run-off remains comparatively high throughout the late fall months, while the lake group is passing the critical low period of its run-off. A graphic representation of this relationship is shown in figure No. 4.

The extreme low water stages of the river are of the utmost importance in their bearing upon the first stage of the development. It has been found that following the occurrence of an extremely cold period the discharge drops sharply to approximately one-third of the normal winter minimum and remains at this lower value for three to five days, when it resumes its normal proportions, without any material rise of temperature having occurred in the meantime. Normally, this condition is most emphasized only once in a season,—at the first heavy cold snap,—although it may be subsequently repeated in a modified form. Owing to the short duration of these freeze-up discharges, their effect is not so serious and may be overcome with comparatively small forebay storage at the diversion.

This is not an unusual occurrence under similar circumstances, and it is probably largely due to the actual freezing and depositing of the running water in the form of ice in the stream and on the watershed. When this freezing progresses to a certain stage, comparative insulation is set up, and the water flow is resumed, but with the modified hydraulic characteristics imposed by the ice-covered and ice-fringed channels, which quickly settle down to their winter regimen.

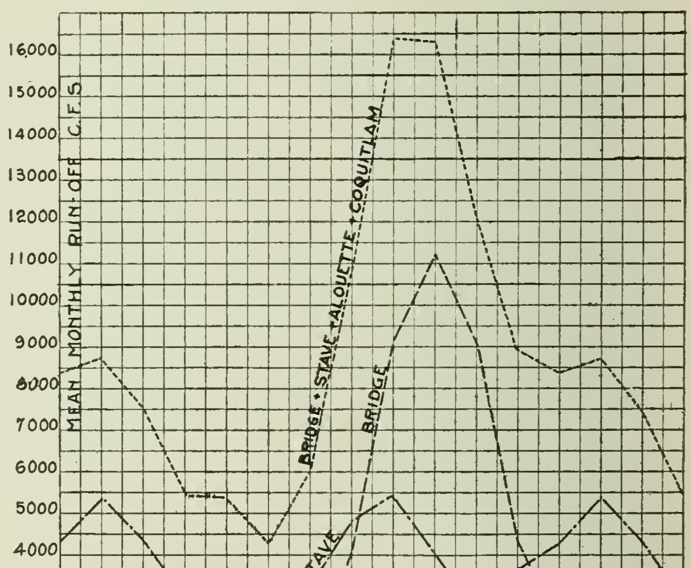


Figure No. 4.—Relation of Bridge River Run-off to that of the Lake Group of Plants.

Figure No. 5.—Testing Machine Used in Bearing Tests at Diversion Dam.

The fifteen-year observed record shows that the maximum flood occurred in June 1917, when the discharge reached 26,000 cubic feet per second, or 19.3 cubic feet per second per square mile of drainage area. The mean of the annual maximum floods for the period is 17,750 cubic feet per second, or 13.15 cubic feet per second per square mile. As a result of frequency studies, a maximum flood of 40,000 cubic feet per second, (29.6 cubic feet per second per square mile), has been set as the basis of design of spillways and other structures involving these problems.

Storage Reservoirs

The known and surveyed reservoir sites for the project are four in number, with a total capacity of 1,293,000 acre-feet, (29.7 square mile-feet). This storage, with due allowance for evaporation and silting of reservoirs, is estimated to be sufficient to regulate the flow to afford a continuous draught at the diversion for power purposes of not less than 3,000 cubic feet per second. This is 80 per cent of the mean discharge, which is considered close to the economic limit of regulation when the cost of storage works is taken into account. The continuous power output resulting from this flow at an average effective head of 1,300 feet is estimated at 354,000 horse power.

The storage sites and their respective capacities and heights of impounding dams are shown in table No. 2.

Table No. 2.—Proposed Storage Reservoirs.

Location	Controlled Water Level Elevation	Storage acre-feet	Type of Dam	Max. Height above Ground Level feet
Lower basin....	2,128	751,945	rock fill	185
Upper basin.....	2,420	361,084	" "	190
South Fork.....	3,255	82,772	" "	165
Gun lake........	2,947	98,988	earth fill	45
Total...........	....	1,294,789	....	....

Proposed Programme of Development

While the full development of the enormous power resources of the Bridge river extends many years into the future and its progressive accomplishment will depend largely upon the economic conditions affecting the demand for power, it has been necessary, in order to study and determine consistently the initial steps in the progression and their relation to the ultimate, to set up a programme of development incorporating the successive stages as nearly as they can be visualized at the present. Three stages of development are indicated, which may be briefly described as follows:—

First Stage

The first stage is essentially the development of the stream flow, *without storage* except minor forebay storage sufficient to regulate against load fluctuations and low river stages resulting from freeze-up conditions. For economic reasons, the first stage is divided into two steps, called, for convenience, the "initial development," now being undertaken, and the "second development."

The principal structural elements involved in the initial development will be a diversion dam on the Bridge river, a 13,200-foot tunnel with intake, surge chamber, penstock tunnel and outlet structures, two penstocks from the tunnel outlet to the power station, a station building to house two 20,000-kw. hydro-electric generating units with outdoor

Table No. 1—Summary of Mean Monthly and Yearly Flows of Bridge River at Mission Bridge.
(Three miles above Diversion Point)
Discharge in Cubic Feet per Second

Year	Oct.	Nov	Dec.	Jan.	Feb.	Mar.	April	May	June	July	Aug.	Sept.	Mean.
1912-13.....	.....	.....	.....	.....	.....	.....	.....	.....	9,240	10,300	9,640	3,670	.....
1913-14.....	2,560	1,240	943	772	700	857	1,650	5,530	9,180	12,200	7,760	3,520	3,909
1914-15.....	3,790	2,030	879	650	600	883	2,250	4,939	8,136	10,720	11,340	4,497	4,226
1915-16.....	1,800	767	530	520	858	1,000	1,320	4,000	12,000	11,300	9,300	2,710	3,842
1916-17.....	1,800	728	466	450	425	470	584	2,450	7,020	9,190	8,670	4,490	3,032
1917-18.....	2,620	1,780	1,240	1,880	700	673	1,540	4,590	10,000	14,500	8,330	5,790	4,470
1918-19.....	2,930	1,080	450	450	400	443	1,040	3,010	5,950	11,500	9,790	4,260	3,444
1919-20.....	1,280	1,240	561	600	467	471	549	1,230	4,100	13,500	9,410	3,390	3,066
1920-21.....	2,520	1,010	724	495	520	584	876	4,530	11,500	9,740	8,520	2,520	3,628
1921-22.....	2,570	2,260	818	626	542	486	757	3,260	12,900	13,000	9,120	6,030	4,364
1922-23.....	2,210	876	585	535	479	492	1,050	3,730	10,300	11,300	9,520	5,740	3,901
1923-24.....	1,970	710	565	490	610	535	795	7,000	10,000	10,300	9,370	4,850	3,933
1924-25.....	2,040	1,100	932	525	558	633	1,300	7,280	8,870	10,600	8,070	3,900	3,817
1925-26.....	1,340	571	709	412	439	597	1,760	3,106	6,330	9,730	7,726	3,500	3,018
1926-27.....	2,194	942	633	513	389	449	720	2,349	11,033	9,932	9,029	5,233	3,618
1927-28.....	4,309	1,880	1,148	941	592	783	.....	.....	.....	.....	.....	.....	.....
Mean for 1912-13-1926-27...	2,261	1,167	717	637	549	612	1,157	4,072	9,094	11,251	8,997	4,317	3,736

transformers and switchyard, a single-circuit, 154-kv., 60,000-kw. transmission line connecting the power station to the company's existing system at Vancouver, and a receiving station at Vancouver to handle the input from the new plant.

It is planned to complete the initial installation in the fall of 1931.

The second development of the first stage will follow closely upon the first, being planned for completion in the fall of 1933. It will consist of the addition of a third unit similar to the first two and will involve only the installation of an additonal penstock, an additon to the power house and the installation of the necessary hydraulic and electrical equipment. No additions nor changes in dam, tunnel or transmission line will be required.

With the completion of the third unit, the plant will have an installed capacity of 60,000 kw. The average output, limited by the available stream flow, will be approximately 45,000 kw.

Second Stage

The second stage of the development, as planned, will likely not be the next step of the company's development programme, but will be deferred until about 1938, if present forecasts are borne out, and, in the meantime, the Ruskin plant, on the lower Stave, will be built to come into service about 1935. This plan seems best to fit economic policies and load requirements.

The second stage contemplates the average utilization of 1,650 cubic feet per second of water, and will involve the building of a storage dam at or below the diversion, impounding some 750,000 acre-feet of water to afford the required regulation, the driving of a second tunnel, 14½ feet in diameter parallel to, and approximately 400 feet west of, the initial tunnel, the progressive provision of penstocks, hydro-electric units and power house extensions for additional generating capacity of 180,000 kw., thus bringing the total capacity of the plant at this stage up to 240,000 kw.

A second transmission line at 220 kv., 110,000 kw., paralleling the first, must be provided, and before the full capacity is brought into service the first line must be reconstructed for 220 kv. and its capacity raised to 110,000 kw.

Third Stage

The third, or ultimate, stage of the development is, in point of time, a means of meeting the demands of a long future,—so long, in fact, that no serious attempt has been made to set any definite dates for its accomplishment.

With its consummation, the final and full resources of the stream's regulated flow of 3,000 cubic feet per second will have been utilized. Aside from the hydraulic and electrical machinery, its construction will involve the enlargement and lining of the initial tunnel, (the tunnel now being bored), the boring of a branch tunnel to the east to serve additional units, the development of large additional storage by building dams at La Joie falls, South Fork and Gun lake and the provision of two additional heavy transmission lines, probably following an entirely different route, from the plant to Vancouver.

This stage will add 200,000 kw. to the capacity and will bring the ultimate installed capacity up to 440,000 kw.

In speaking of the second and third stages of the development of the Bridge river project, it is somewhat presumptious to attempt to outline with any definiteness their component parts. So many things may happen to influence their form and arrangement, and the times and order of their installation, that it would be verging upon futility to do so. The load requirements may not grow in conformity with the forecasts; advance in the arts of manufacture may change entirely the sizes, types and characteristics of electrical and hydraulic machinery and many other influences may work to upset present planning for such a distant future.

Initial Development

The planning of the structures of the initial development has now advanced to a middle stage and some of the actual construction work has been started.

The major structures and equipment for the initial development will be described.

Diversion Storage

While it is not the purpose to include in this paper any descriptions of construction features involved in stages two and three, other than the general remarks occurring previously in discussing the programme of development, it would be difficult, in discussing the diversion dam for the initial development, to avoid touching upon some of the features of the storage dam for the second stage, which is planned to occupy the same site, and which, in its problems of design and construction, is rather intimately related to the initial structure.

One of the most difficult problems of the investigation of the Bridge river project was found to lie in establishing a site for a storage dam for the lower basin. The years of investigation before its purchase by the British Columbia Electric Railway Company had failed to solve this most important problem, which so vitally affected the value of the project. Subsequently, two seasons of time and many thousands of dollars were spent in test borings in the box-like canyon below the basin, but no bedrock foundation could be found in the narrow channel flat, although towering bluffs of solid granite shouldered its margins and plunged diagonally below its level.

Many favourable looking sites, extending some four miles down the canyon, were drilled to depths ranging up to 200 feet without bottoming the river wash. As a last resort, the drill was moved up to the quiet waters at the lower end of the basin, and here, although the bedrock quest was not rewarded, there was revealed a massive band of clay underlying the river bed 30 to 50 feet, which joined the solid rock walls of the underground canyon with a barrier almost as impermeable as the bordering rock walls themselves.

After many tests of the permeability and bearing values of the clay bed and its thickness and extent, the proposed plans for the two dams were worked out.

The degree of permeability of the clay,—as determined in the field by casings sunk into it in pits bottomed on the clay bed itself,—was quite satisfactory. Laboratory analyses bore out the field results. The bearing values were, however, a more difficult problem. An elaborate set of tests demonstrated that the clay settled materially under loads as small as ½ ton per square foot, the rate decreasing until rest occurred. Successive additional loads produced more pronounced settlements, which decreased similarly, and, in each case, rest was restored. In each case, the state of rest partook more of the nature of a state of unstable equilibrium; any disturbance causing further settlement. No lateral displacement or bulging of the surface adjacent to the test block was observed.

After considering all the conditions disclosed by the tests, and with due regard for the limitations of the site, the plan of placing the cut-off upstream from the body of the main dam at a point where the clay bed is thickest and most competent to perform its cut-off function, and of placing the heavy dam on on area underlain with the thinning layer of clay with boulder formation predominating in the overburden, thus rendering it more able to withstand the heavy weights without danger of destructive settlements,

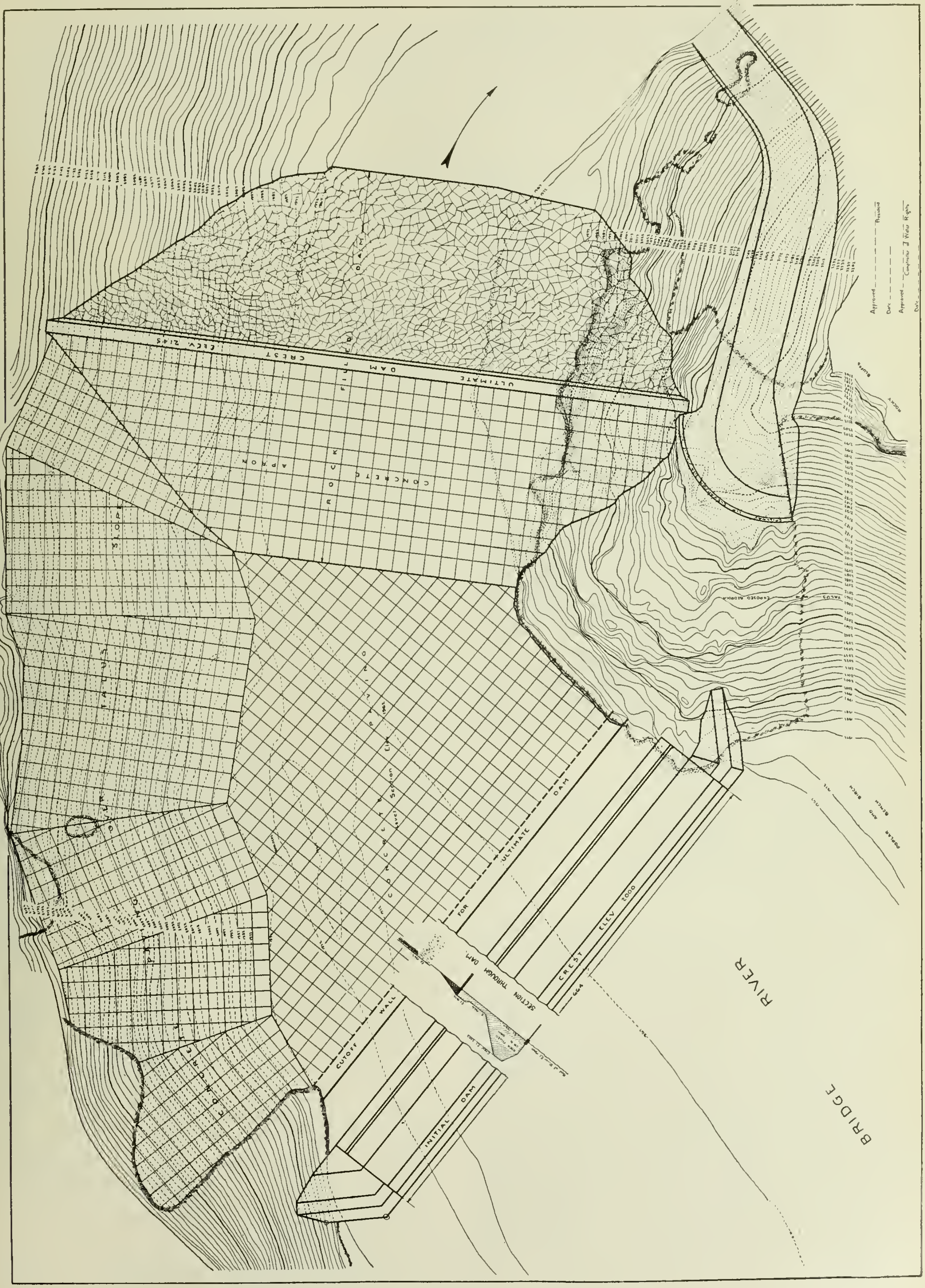


Figure No. 6.—Plan of Initial and Ultimate Dams.

and of connecting the two elements with a water-tight concrete cover extending over the bottom and up the sidewalls of the canyon to solid rock and up the face of the dam to its crest was worked out.

Preliminary plans and some details of the initial diversion dam and the ultimate storage dam are shown in figures Nos. 6 and 7.

Diversion Dam

The first diversion will be accomplished by erecting a log crib rock-filled type dam at the site of the larger storage dam, but located upstream and in such a position that it will not interfere with the ultimate structure but will serve as a cofferdam for its construction.

The log crib dam will be of the overflow type, with crest at elevation 2,000, 40 feet above stream bed. Its crest length is 900 feet. A pool or bucket is provided at the downstream toe to absorb the destructive energy of the descending sheet of water which, at the maximum stages assumed in the design, will have a depth of 7 feet on the crest of the dam. Timber sheet piling will protect the toe from undercutting, and heavy riprap will be used as a further protection.

The timber structure will be of standard round-log construction, with pockets 10 feet square to contain the rock filling. Sheathing will be heavy sawed planks. The upstream sheathing will connect with a curtain of interlocking steel sheet piling driven some 40 to 60 feet below the stream bed into the impervious clay stratum underlying the stream gravels, thus forming a cut-off for the dam.

During the construction period, the river flow will be carried through the dam by means of a series of timber-lined culvert openings which, upon completion, will be closed with flap gates and filled with rock. The closing sections of the dam will be built during the winter months, when high water stages are not above 4,000 to 5,000 cubic feet per second.

The storage afforded by the dam will amount to 13,500 acre-feet, which will amply meet the requirements for daily regulation of draught, to carry over the freeze-up periods previously described and to provide an allowance for silting during the period of its use.

Bridge River Intake

The intake structure to control the diversion will be set on the south bank of the valley, about 2 miles upstream from the diversion dam. Its location is governed both by the considerations of tunnel length and suitable rock structure for its foundations and for the entrance of the tunnel into the mountain. Fortunately, a site was found to meet both these conditions.

The intake tower will be a massive concrete structure circular in form with base spread and buttressed for greater stability and to afford two entrance bays with water passages through the base and leading up into the interior of the tower and thence into the tunnel.

The control gate for the intake will be of the balanced cylindrical wet-pipe type. It consists essentially of a plate steel cylinder or pipe, 20 feet in diameter, with open bottom which sits in an upright position on an annular seat encircling the water opening in the base of the tower. When the gate is in the closed position, the water of the reservoir rises to its level *within* the cylinder, but the annular space surrounding the cylinder and connecting to the tunnel opening remains dry. When the gate is opened, which is accomplished by lifting the pipe, the water flows freely into the tunnel. Since the forces exerted by the water upon the gate are balanced there is little resistance to be overcome in lifting the gate beyond the weight of the cylinder which may be largely offset by counterbalancing weights at the top of the tower.

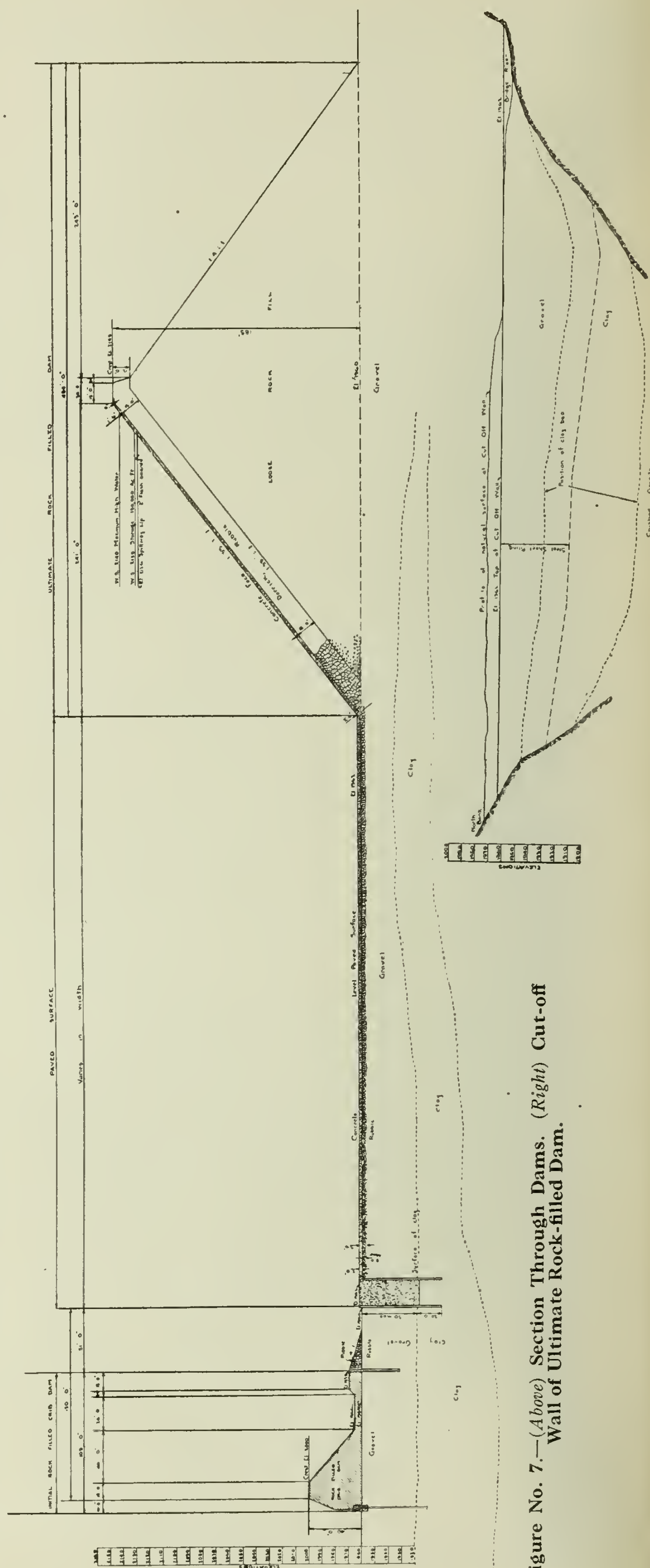


Figure No. 7.—*(Above)* Section Through Dams. *(Right)* Cut-off Wall of Ultimate Rock-filled Dam.

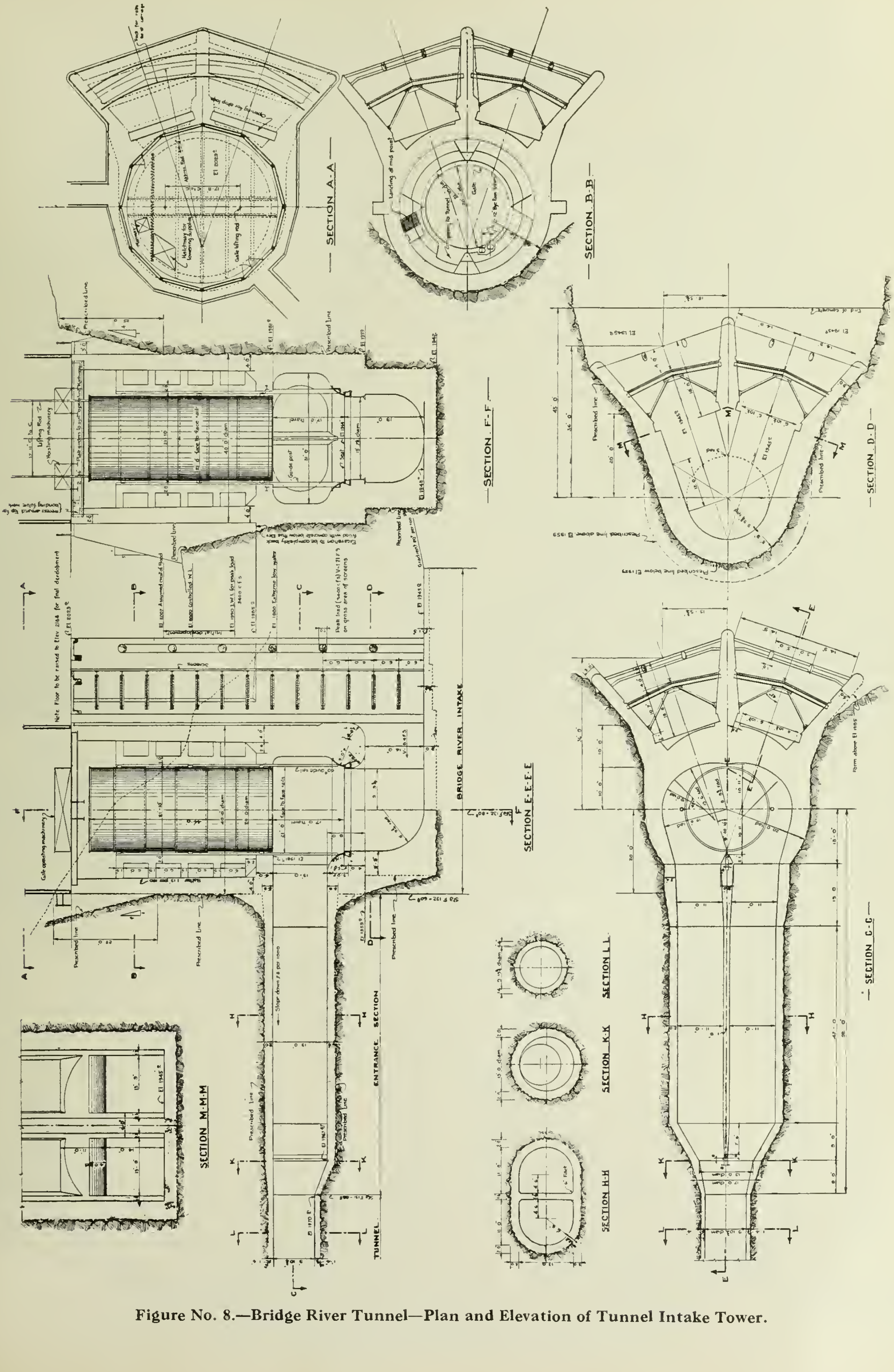


Figure No. 8.—Bridge River Tunnel—Plan and Elevation of Tunnel Intake Tower.

This type of gate is of recent development and has been successfully used on several installations where large quantities of water are to be handled under moderately high heads. Its first use under these conditions was made by the Southern California Edison Company in its Big Creek No. 3 plant.

Screen racks of adequate area to afford entrance velocities at low water, not to exceed 1¾ foot per second on the gross area, will protect the intake openings. Trash rakes and gate operating equipment will be mounted on the deck of the tower.

An outside barrier, upstream from the screens, will be provided by means of a heavy grillage of concrete columns and beams tied to the buttresses of the intake and extending up to the high water level. These are intended to fend off heavy floating ice and other coarse debris and prevent their approach to the screens.

Although temperatures of 30° below zero occur in the valley, observations of ice conditions on the river, indicate that no trouble will be experienced from frazil ice at the intake, which is deeply submerged in an extensive pondage of quiet water.

While the initial structure will only be called upon to control reservoir water levels up to elevation 2,007, the dimensions of water passages, screen areas, etc., and the strength of all the structural features of the intake and gate will be designed to conform to the requirements of the ultimate tunnel after enlargement to 16 feet 6 inches in diameter, and to meet the pressures imposed by the head of the ultimate reservoir level at elevation 2,140.

While the tower structure in its initial stage will be only 84 feet high from base to deck, its broad base and heavy walls are designed to be carried to an ultimate height of 217 feet. Its design was largely influenced by considerations of heavy thrusts which may be imposed by ice formations and floating debris. As the extent of these loads cannot be definitely fixed in advance, the design of these elements of the design becomes largely a matter of judgment.

The general arrangement and details of the intake are shown in figure No. 8.

Tunnel

The main tunnel will be straight in alignment, equivalent to 12 feet in diameter, 13,200 feet in length, with a constant gradient from intake to surge chamber of 7.3 feet in 1,000 feet. It will be constructed from two portals or headings and will traverse in its length rock formations of varying degrees of hardness.

One type of section will be employed throughout in the excavated bore. Normally, it will be unlined, linings only being used where rock conditions or water tightness require. Several types of linings may be employed, depending upon conditions developed in the boring work. The types of lining contemplated in the contract include:—

Type R.—Untimbered and Unlined Rock Section.—This section will be used in solid rock where no timbering is required.

Type S.—Untimbered and Lined Horseshoe Section.—This section will be used in rock that will stand without timbering, but which is lined with plain concrete to secure water-tightness.

Type U.—Timbered and Lined Horseshoe Section.—This section will be used where the rock requires timbering, but where no excessive unbalanced internal or external pressures are likely to occur.

Type T.—Untimbered and Lined Circular Section.—This section will be used where the rock will stand without timbering, but where heavy external pressures are likely to occur.

Type V.—Timbered and Lined Circular Section.—This section will be used where the rock requires timbering and where heavy unbalanced external or internal pressures are likely to occur. Adjacent to the intake or at other locations where heavy external pressures may occur it will be used without reinforcement. Adjacent to the outlet where heavy unbalanced internal pressures may occur it will be used with reinforcement.

The contract stipulates that all concrete linings for tunnel, surge chamber and shaft are to be placed by pneumatic methods and after setting are to be backed up by pressure grouting. Where rock is comparatively sound, the grouting will be relied upon as a final, positive filling or plugging of all spaces between concrete linings and rock walls to enable the linings to withstand the internal pressures. Where rock is not considered fully adequate for support, and particularly adjacent to the outlet, circular bands of reinforcing steel will be employed. The amount of this reinforcing will be proportioned to withstand the full water pressure without stressing the steel beyond its elastic limit. In the surge chamber design, these assumptions lead to the use of 1¾-inch square bars.

Surge Chamber

The surge chamber will take the form of an enlarged tunnel section, circular in form, with its bottom circumference tangent to the tunnel gradient and a vertical shaft extending some 300 feet to the ground surface. The combination of enlarged tunnel section and shaft affords something of a differential action for meeting the hydraulic conditions imposed by variations in load on the waterwheels

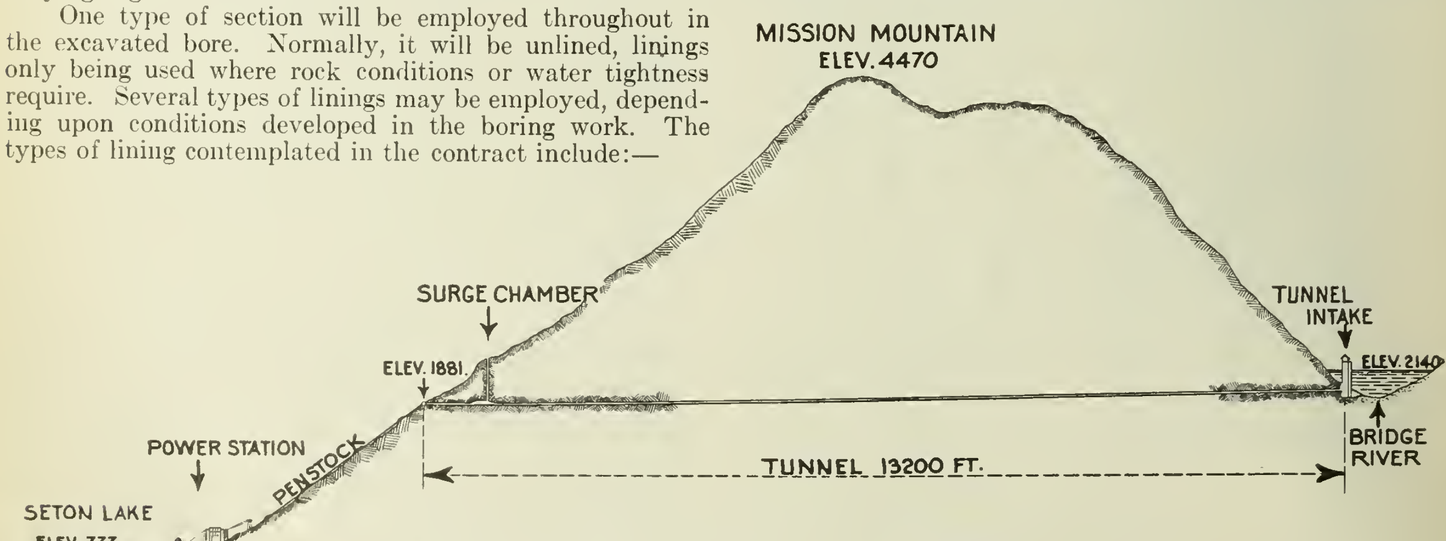


Figure No. 9.—Schematic Profile of Tunnel and Penstock.

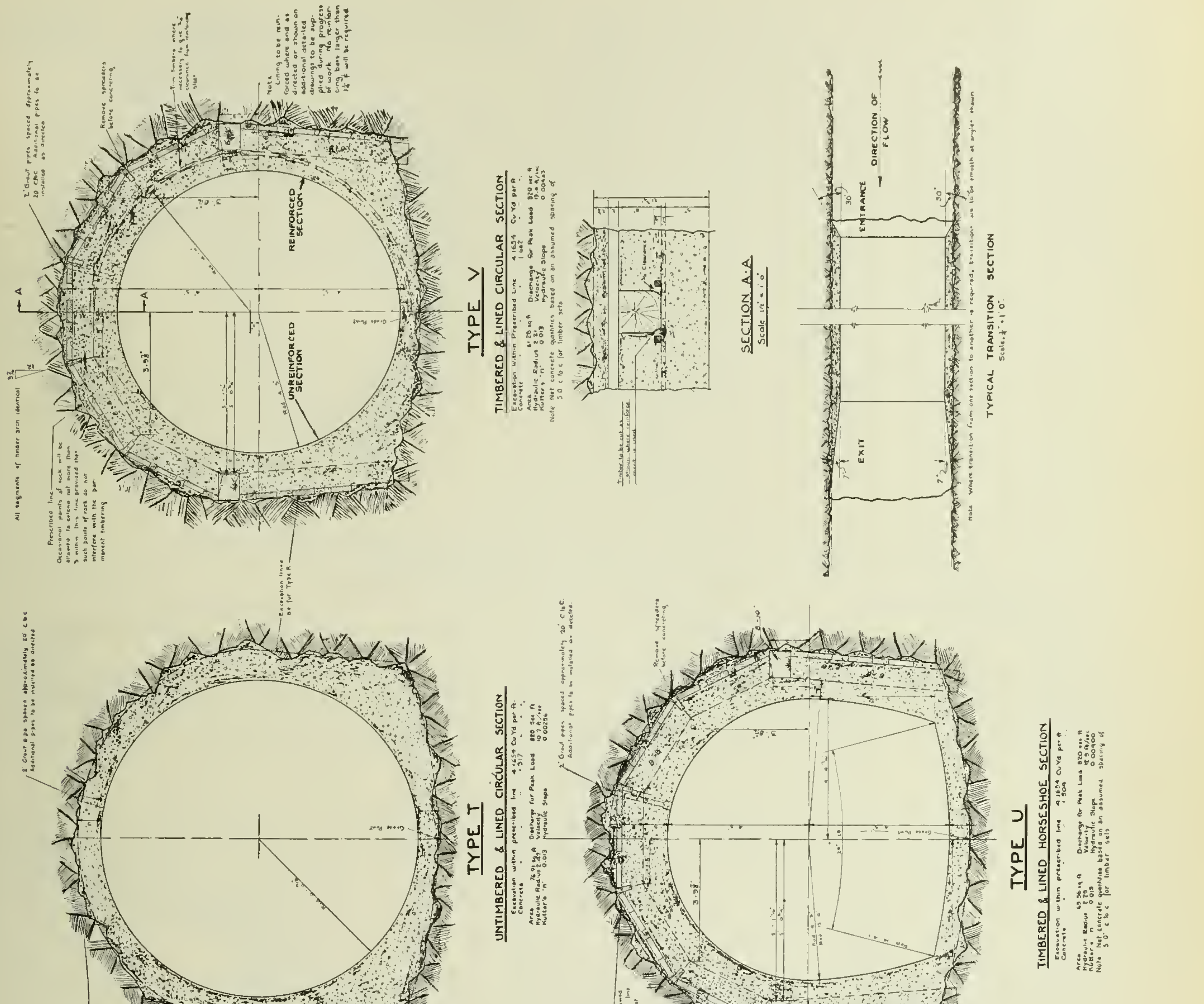


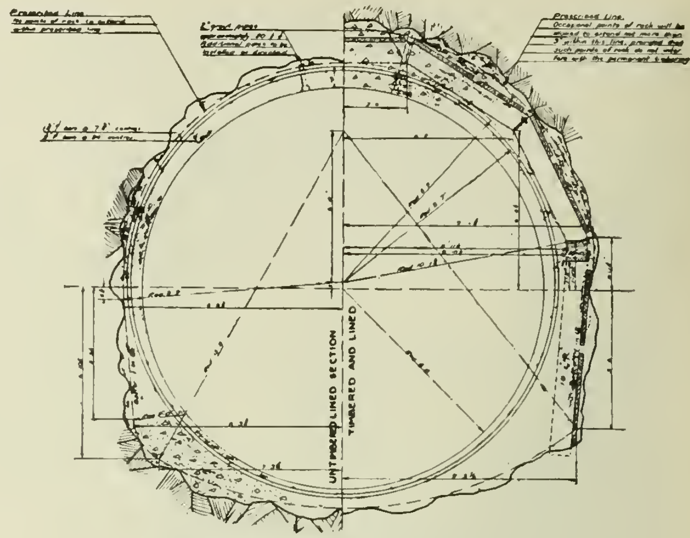
Figure No. 10.—Cross-sections of Main Bridge River Tunnel.

and the consequent varying rates of flow in the tunnel, due account being taken of the changing levels of the head water when the diversion storage dam is built. The shaft serves as well as a relief standpipe and a means of entering the tunnel for maintenance or repair work. The shaft collar is located above the greatest height that will be reached by the surge, thus avoiding overflow which would be very difficult to take care of at the location. Anticipating movements of debris from the floor of the unlined tunnel sections, the surge chamber is provided with a sump to receive any wash of this character which may be then removed through the shaft by means of a hoist and bucket. No means of flushing or blowing off wash material from the tunnel is feasible. A screen, with bars 2 inches clear spacing, is set in the surge chamber just downstream from the sump.

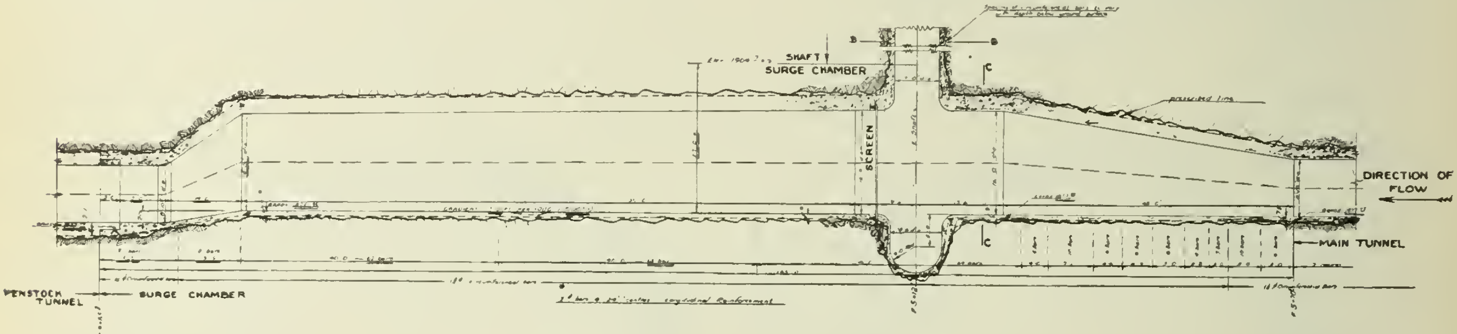
The design of the surge chamber is based upon the following limiting load assumptions:—

¼ load to full load in 22½ seconds—forebay level 1,990. Full load to zero load in 2½ minutes—forebay level 2,140.

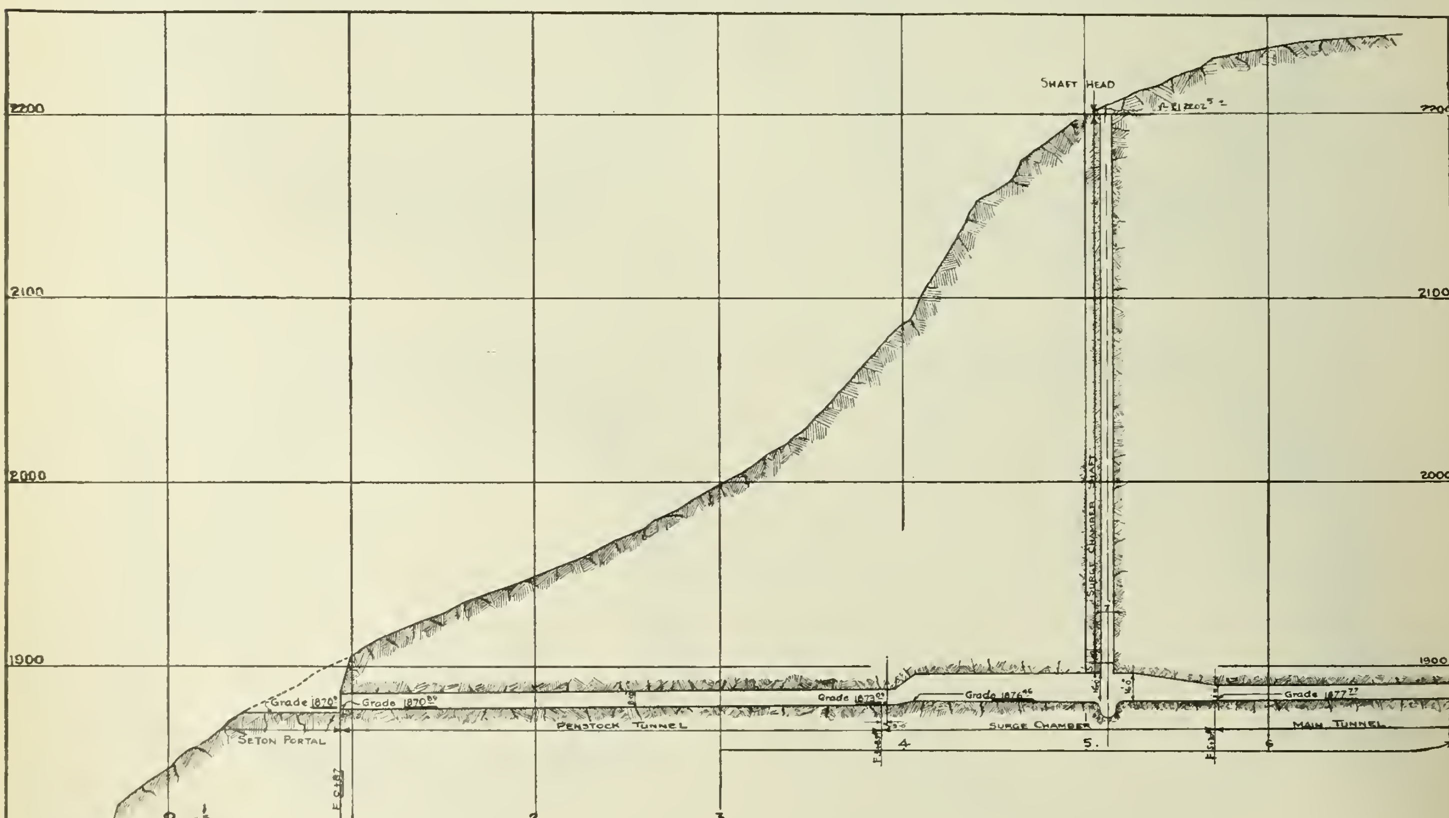
Plans and details of surge chamber, shaft, etc., are shown in figure No. 11.



Cross-Section Through Surge Chamber at C-C.

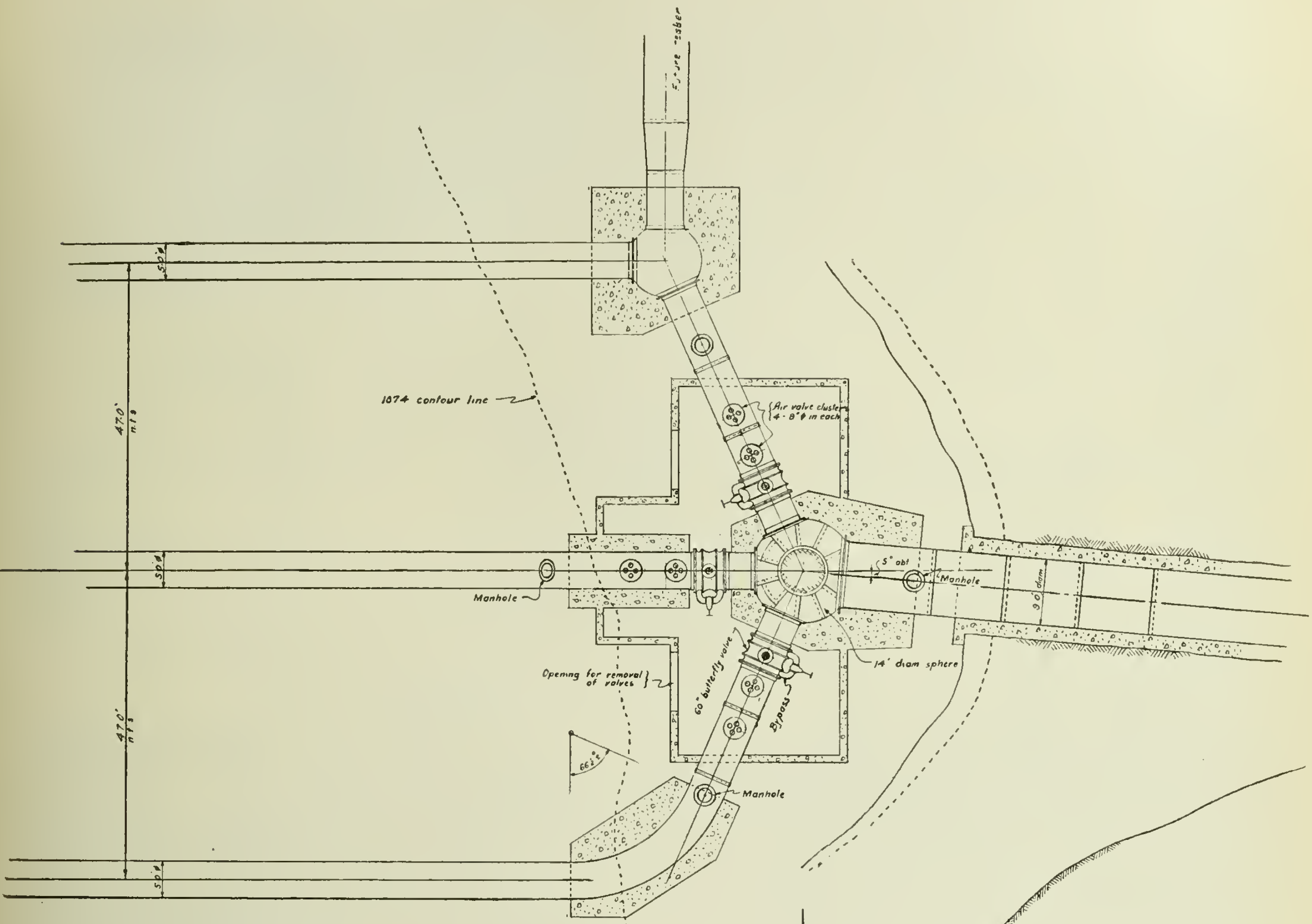


Longitudinal Section Through Surge Chamber.

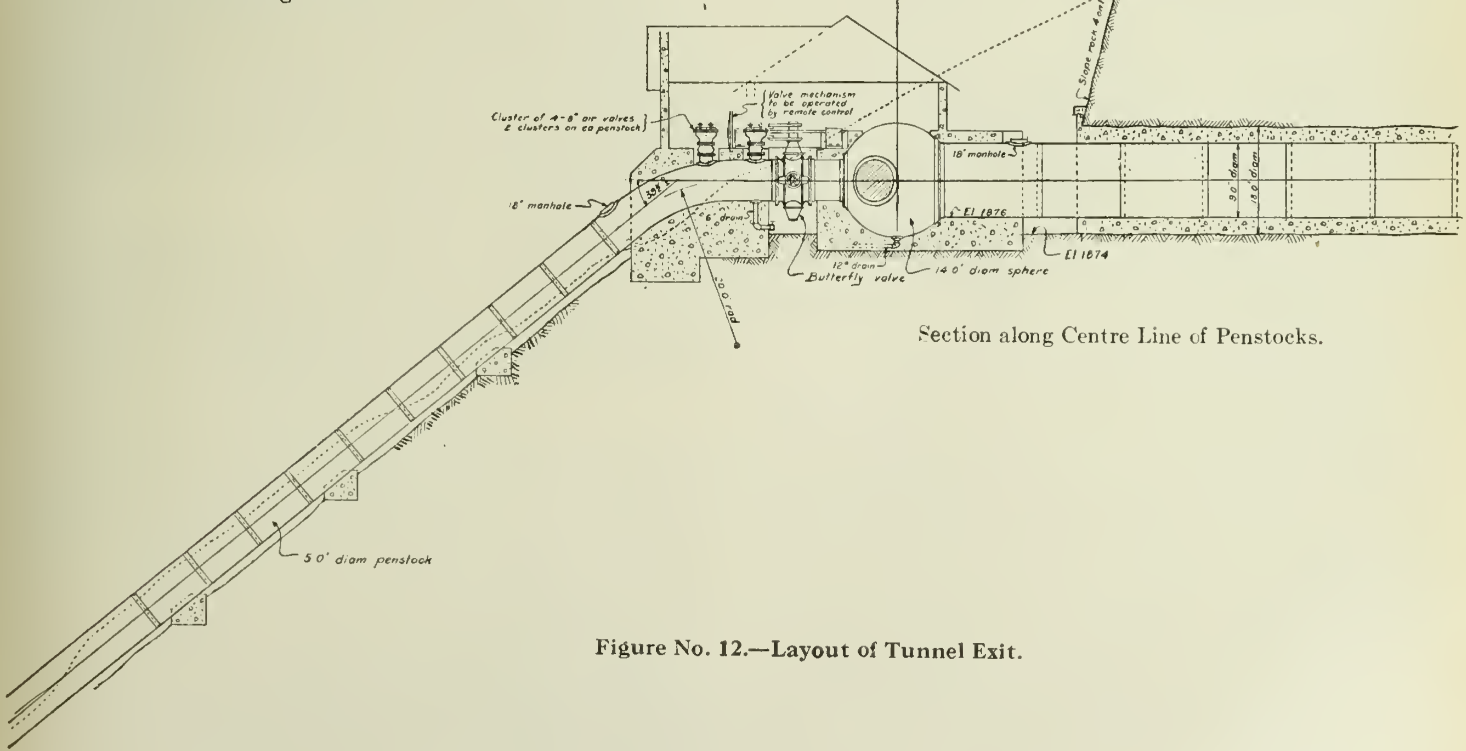


Longitudinal Section at Tunnel Outlet.

Figure No. 11.—Surge Chamber and Shaft.



Plan showing Penstocks.



Section along Centre Line of Penstocks.

Figure No. 12.—Layout of Tunnel Exit.

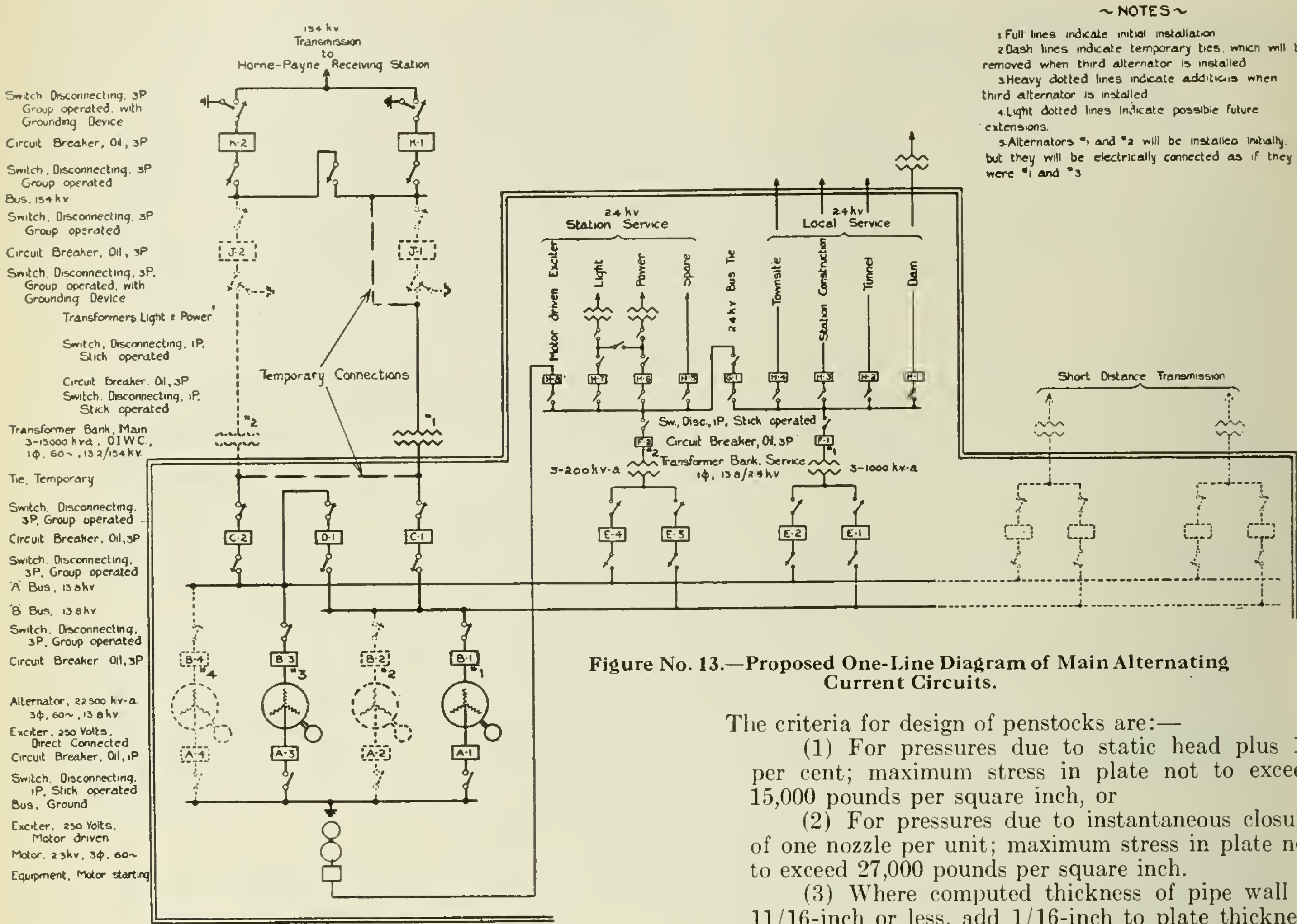


Figure No. 13.—Proposed One-Line Diagram of Main Alternating Current Circuits.

Penstocks

The penstock proper begins at the outlet of the surge chamber. The first section of 9-foot diameter riveted steel pipe, set in tunnel and solidly backfilled with concrete, will terminate just outside the Seton portal, in a spherical riveted steel manifold 14½ feet in diameter. Provision will be made in the manifold for connecting three riveted steel penstocks 5 feet in diameter. Two penstocks only will be built in the present development. A cross-connecting header will be provided at a later date to supply the initial units with water from the second tunnel while the first tunnel is being rebuilt and enlarged for the ultimate stage.

Butterfly valves, motor operated and closed by remote control from the power station, will be set in the penstocks at the gate house immediately below the manifold. No standpipes will be provided, air valves being employed in their stead. From manifold to power house wall,—about 2,200 feet,—two riveted steel penstocks varying in diameter from 60 inches at the top to 51 inches at the bottom and in plate thickness from ⅝-inch to 1 5/16-inch, will be installed. Heavy concrete anchor blocks will be provided at all bends and lighter concrete supporting piers for each section of pipe will be set between the anchors. Generally the pipes will be well above the ground surface. At the crossing of the Pacific Great Eastern Railway tracks the penstocks will be taken through concrete lined culverts which will continue nearly to the power house wall. A cross-connecting header with gate valve between penstocks will be set just upstream from the wye pipes supplying the nozzles.

The criteria for design of penstocks are:—

(1) For pressures due to static head plus 15 per cent; maximum stress in plate not to exceed 15,000 pounds per square inch, or

(2) For pressures due to instantaneous closure of one nozzle per unit; maximum stress in plate not to exceed 27,000 pounds per square inch.

(3) Where computed thickness of pipe wall is 11/16-inch or less, add 1/16-inch to plate thickness to allow for deterioration. Maximum thickness of plate 1 5/16-inch. Minimum thickness ⅜-inch.

In general, criterion No. 1 governs the design for the lower portions of the penstock, and criterion No. 2 for the upper portions. The 15 per cent pressure rise is that due to the mechanical lag of the relief nozzle, and is a condition which will occur in the normal operation of the units, while the condition provided for under criterion No. 2 is of very remote probability.

The annual cost of the pipe in place, (interest, plus depreciation, plus value of lost power), was computed for a number of different diameters and combinations of diameters. As a result of this economic study a penstock consisting of 980 feet of 60-inch diameter pipe and 1,175 feet of 51-inch diameter pipe was decided upon.

Generating Station

While detailed plans for the station can not be carried beyond their preliminary stages until equipment contracts are awarded and manufacturer's drawings are available, studies of a general nature have fixed, with considerable accuracy, the major features of the initial installation. Consideration of the expected intervals between successive stages of development, and the probable changes in equipment design during those periods, early pointed to the inadvisability of attempting to plan a station that would provide for all future extensions. It was decided to limit the design to a station that will reasonably accommodate the initial development, giving due thought in the way of space requirements and structural clearances to the relation of this first station to subsequent stations.

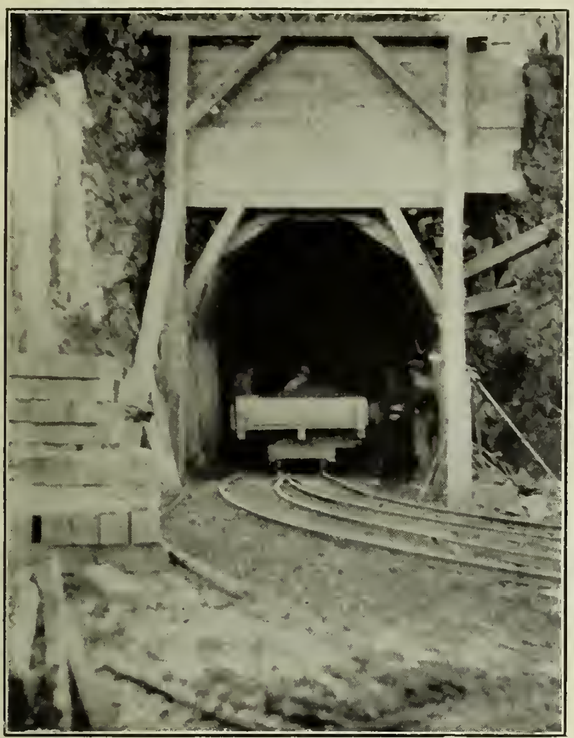


Figure No. 14.—Bridge River Tunnel Seton Portal.

Station No. 1, as planned, will provide for the 60,000 kw. of power to be developed under the first stage. It will be a concrete structure with steel frame, fronting on the lake and situated between the lake and the railway. The generating units will consist of two horizontal shaft alternators rated at 22,500 kv.a., at 90 per cent lagging power factor, 13,800 volts, each driven by a double overhung, single-jet impulse water-wheel designed to develop 28,000 b.h.p. under an effective head of 1,097 feet. The speed is not set but will be between 200 and 260 r.p.m. Each unit will have its own direct-connected exciter, but, for spare and emergency purposes, an additional motor-driven exciter will be provided. A third main unit of the same rating and type will be installed as the second development of the first stage. Structural arrangement will be made for a fourth similar unit, although the plan is not definitely committed to any type of units for the second stage.

The main generating units, exciters, low tension oil circuit breakers, low tension buses, switchboard and other auxiliary equipment will be housed in the station building. The step-up transformers, high tension oil circuit breakers, and high tension buses will be given an outdoor setting, the transformers immediately adjacent to and behind the station building, and the breakers and buses in a high tension switch yard on a bench above the railway tracks.

A one-line wiring diagram, figure No. 13, shows the proposed arrangement of main alternating current circuits.

To provide for the developments under the second stage, a new and separate generating station is visualized. It is expected that larger units may then be used.

Preliminary specifications for the hydraulic and electrical equipment have been prepared, but tenders will not be taken before the early part of 1929.

Transmission Line

The bulk of the power developed will be delivered to the company's system at Horne-Payne receiving station in Vancouver, approximately 130 miles transmission distance from the generating station.

For the first stage, a single circuit transmission line largely supported on H-frame cedar pole structures will be used. For about one half mile at the sending end and for some seven miles at the receiving end, steel towers will be employed. The line voltage will be 154 kv., and the conductor 397,500 c.m. steel core aluminum or its equivalent.

When the second stage is entered upon, the transmission voltage will be raised to 220 kv. Coincidently one or more new circuits of larger conductors, probably 795,000 c.m. steel core aluminum or equivalent, carried entirely on steel towers, will be erected.

Receiving Station

The Bridge River transmission circuits will terminate at Horne-Payne receiving station No. 2. This new station, although constructed adjacent to the existing Horne-Payne station, will be entirely distinct and treated as a separate unit.

The station, including both indoor and outdoor facilities, will be progressively constructed and equipped to provide for the energy produced under the various stages of development. It will contain synchronous condensers and other equipment for controlling and stepping down the transmission voltage to 60 kv., at which voltage the energy will be absorbed into the system.

Construction Progress

It has been attempted, in the above pages, to set out with consistent brevity, a comprehensive description of the engineering aspects of the project. Discussion of details of design and methods of construction has been necessarily limited to a few of the more important points which in their study have proved most interesting to the designing engineers. It is felt, however, that the paper would not be complete without including in it some statement of the status of the construction work.

Preparatory work at the site was started in May 1927. Since that date a permanent headquarters camp has been established on a scale sufficient to meet the requirements of the whole job. Twenty-four bunk houses, each lodging eight men; a community building with dining and kitchen facilities for two hundred and fifty men, and lodging for fifty staff; and fifteen temporary family cottages have been provided. Five permanent cottages, including guest cottage, superintendent's cottage and three operators' cottages have been erected. A water supply system, sewer system with septic tank, and a lighting system are in operation.

A construction power plant, consisting of two 610-h.p. Diesel engines, direct connected to 520-kv.a. generators, furnishes light and power to the main camp, contractor's camps and for driving the tunnel. Roadways over the mountain down to the diversion dam have been built and are being used for hauling supplies by motor truck for the tunnel work. An inclined tramway of standard gauge connects the railway yard with the Seton portal of the tunnel.

The tunnel contract was awarded in October, 1927. Based on the estimated quantities the price amounts to $1,252,000. Good progress has been made by the contractor. Camps and machinery equipment are installed at each portal and the work of boring has progressed about 1,200 feet at the Bridge River portal and about 1,000 feet at the Seton portal.

Transmission line surveys are practically completed and rights-of-way about two-thirds purchased. About 15 miles of clearing has been done.

The Construction of Isle Maligne Transmission Line

General Features of Design, Organization and Construction of a 3-Phase, 60-Cycle, 165,000-Volt Line through 130 miles of Undeveloped Territory

T. M. Montague, A.M.E.I.C.,
Construction Engineer, The Shawinigan Engineering Company, Limited.

Paper read before the Quebec Branch of The Engineering Institute of Canada, March 19th, 1923

The Isle Maligne transmission line was built as a means by which electrical energy generated at the Grande Décharge on the Saguenay river, at the outlet of lake St. John, could be made available for consumption in the city of Quebec and the adjoining territory. It was built by the Shawinigan Water and Power Company and is operated by the company as an integral part of its already extensive transmission system. The terminal station outside the city of Quebec provides a link by which it is interconnected with that system.

Although this paper is written from a construction viewpoint, yet, in order that this may be better understood, it is necessary to give some of the basic features of the design, and also describe to some extent the country through which the line passes.

Features of Design

The line is 130 miles in length, and for over 100 miles it traverses an absolutely undeveloped country, and in that distance crosses the complete range of the Laurentian mountains. This country is for the most part heavily timbered and interspersed with many lakes, rivers and swamps, which tended to make the project much more difficult. It involved, in fact, the cutting and clearing of a right-of-way 150 feet in width by 100 miles in length; the building of a road 100 miles long, with the necessary bridges capable of carrying very heavy loads; and the construction of large camps at frequent intervals as living quarters for the men employed; all of this before the actual construction of the line could be commenced.

The line, as located, probably follows the shortest practical route between the power house at Isle Maligne and the terminal station at Quebec city. Where possible, the location follows along the valleys of the various rivers and chains of lakes, but it was necessary to cross several mountain ranges in order to follow this route. The line was located in as long tangents as the very rough topography of the ground would permit, and it rises at the highest point to an altitude of 3,000 feet above sea level.

The towers are of a square type with three cross-arms each, and are of galvanized steel resting on concrete foundations. All told, there are some eight hundred and twelve towers. Three types of towers are used, each style being designed to meet certain definite conditions. These types were designated as follows:—light, semi-anchor and anchor. Light towers are used on tangents where the span does not exceed 1,000 feet and at angle points where the angle does not exceed 4 degrees. This tower is 85 feet high overall and weighs in the neighbourhood of 5 tons. The concrete foundation for each leg is round, 2 feet diameter at the top and 7 feet at the bottom, and is carried 7 feet 6 inches into the ground. Each foundation requires at least 2 cubic yards of concrete, or 8 cubic yards per tower.

The semi-anchor tower is used where the span is over 1,000 feet and where the angle is less than 20 degrees. It is also used at points of special strain and crossings over roads. These towers are 88 feet high overall and weigh in the neighbourhood of 9 tons. The foundations are similar in shape to those of the light towers, but are 3 feet in diameter at the top and 9 feet at the bottom, and are set 9 feet 6 inches into the ground. Both of these types of towers are held down by eight large anchor bolts extending to the bottom of the foundation.

The anchor towers are used to carry extremely long spans, up to 1,700 feet, or at points where the angle is very large and also at dead end points. In this case, the tower must withstand the unbalanced pull of all the conductors under the worst possible conditions. The foundations are square reinforced concrete spread footings. The large angles forming the tower legs extend to the bottom of the concrete. These towers weigh approximately 10 tons and the foundations require 30 cubic yards of concrete per tower.

The towers and foundations are designed to withstand an 8-pound wind-pressure with a covering of one-half inch of ice on each of the conductors. The line, as built, provides two circuits for 3-phase, 60-cycle current at 165,000 volts. It has a calculated capacity of 100,000 horse power carried on 397,500 C.M. conductors made up of a number of strands of aluminum wire spun on a central core of galvanized steel cable.

The electrical features of this transmission line have been fully covered in a paper by Professor C. V. Christie, M.E.I.C., published in The Engineering Journal for January 1927.

Construction Organization and Equipment

For construction purposes, the transmission line was divided into two sections. Section number one, at the north

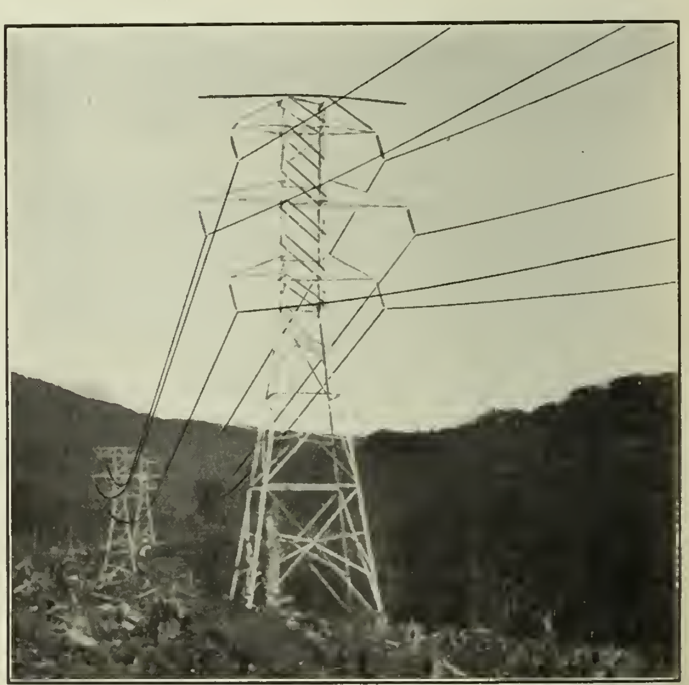


Figure No. 1.—Isle Maligne-Quebec Transmission Line—Standard Towers on Slight Angle.

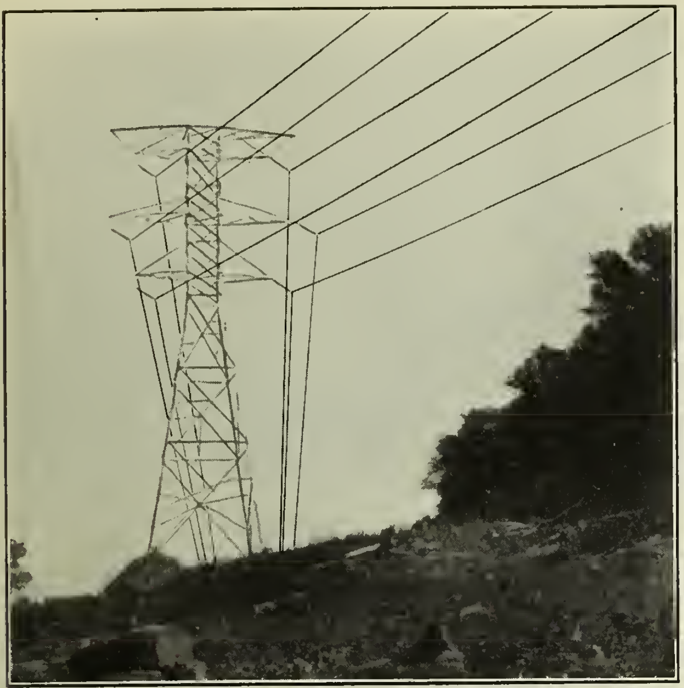


Figure No. 2.—Isle Maligne-Quebec Transmission Line—Semi-heavy Strain Tower on Angle.

end, had headquarters at Hebertville, Que., and section number two, at the south end, had headquarters at Stoneham, Que. This division was necessary because the two ends were obviously the only points from which the work could be carried on, and headquarters of each section were the furthest advanced points to which rail transportation was available. The administration of these sections were entirely separate, but they both were under the supervision of the head office of the company.

There was a superintendent for each section, and under him came the headquarters organization and field organization necessary to accomplish the work. At the outset, it was recognized that one of the greatest problems to solve would be that of transportation, since from rail head to the end of either section was 55 miles.

To take care of this, the following mechanical transport was provided:—twelve Linn tractors, each of which with trailers could haul 20 tons of material over the ruling grade; two 10-ton Holt tractors; four 3-ton trucks; sixteen Fordsons, ten of which were equipped with compressor units; six 1-ton trucks; and automobiles for supervision and inspection. This equipment was kept in repair at garages at each headquarters and at other convenient points along the line.

A good road, capable of sustaining very heavy traffic, was essential, and naturally had to be built first. A large force of men worked on this continuously in order to keep ahead of the other construction crews. Many bridges were necessary to cross the creeks and rivers, and these included several spans of over 50 feet which were designed to carry a concentrated live load of 20 tons. Very little good road material was available immediately adjacent to the location, so that long hauls were necessary, and in places rock crushers were installed and quarries opened to provide this material. The many swamps required a great deal of corduroy as a base. In most places the ground was thickly covered with large boulders which, together with ledge rock, required much drilling and blasting to prepare a foundation.

The construction of the camps followed immediately behind that of the road. These were built at intervals of 6 to 7 miles, and were for the most part of boards covered with tar paper; some, however, were built of logs, while in others a combination of tents and logs were used. They consisted in general of an office, store house, dining room and cook-house, bunk-houses and stables, and were each capable of accommodating one hundred and fifty men and twenty to thirty teams. Altogether, twenty camps were established, in addition to the two headquarters. The foregoing work was only a preparation for the actual construction of the line itself, and yet required considerable time and large crews of men in order that line construction would not be held up.

Construction of Tower Bases

The construction of the tower bases was probably the most difficult part of the whole operation, on account of the nature of the ground encountered, which was for the most part solid rock, swamp or wet sand. The method of putting in these foundations depended altogether on the class of material to be excavated. The ideal condition is that in which the earth will permit opening up the excavation at 2 feet diameter for the light tower and gradually widening out to the full spread of the base of 7 feet. After the setting of the anchor bolts, these excavations are filled with concrete. This method is very economical, in that it saves excavation and forms and also permits the superimposed earth to be developed to the greatest extent as a holding down load.

Where the ground was soft and wet, this method could not be used, and it was necessary to excavate a square hole somewhat larger than the greatest diameter of the base and support the sides with sheet piling. To place the concrete, specially designed collapsible steel forms were used, which were removed when the concrete had set, the sheeting pulled and the excavated ground backfilled.

Where rock was encountered, an excavation was made deep enough and large enough to accommodate the anchor bolts. The hole was then filled with concrete. A great deal of pumping was necessary at all times. This was done with gasoline-driven diaphragm pumps, or, where the amount of water was less, with hand pumps.

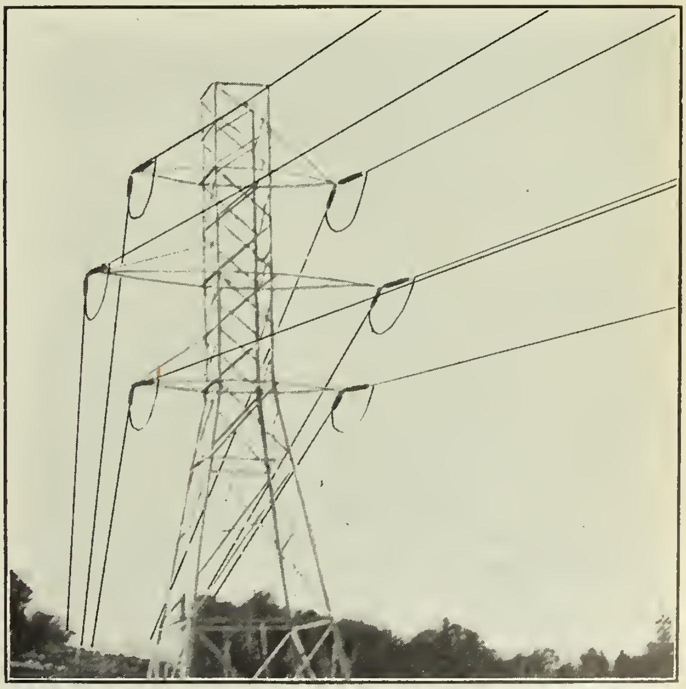


Figure No. 3.—Isle Maligne-Quebec Transmission Line—Heavy Strain Tower on Angle.

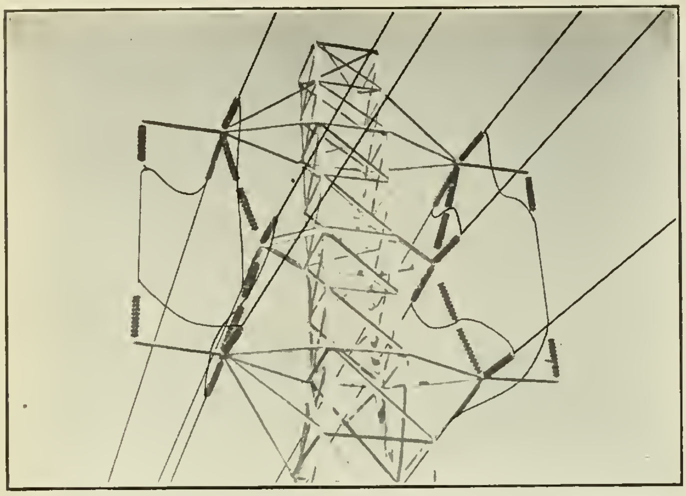


Figure No. 4.—Transposition Tower—One of Two on Isle Maligne-Quebec Transmission Line.

The concrete used for the bases was a 1-2-4 mix. The aggregate employed was both crushed stone and sand or gravel, depending upon the location. At the south end, good aggregate was very scarce and it was necessary to open up eight quarries and instal crusher plants to provide this material. At the north end good gravel was available at convenient locations.

The mixing was done with a gasoline-driven machine of 1/6 cubic yard capacity. Due to numerous steep side hills, together with other transportation difficulties, the weight and quantity of all equipment had to be reduced to a minimum. It must be borne in mind that every time a tower was completed the whole plant had to be moved.

A great many bases were put in during the winter months, and this presented some difficulties on account of the small amount of equipment that could be made useful. The water was heated in large sheet steel tanks mounted on skids. The stone was warmed by fires built around the piles and as close as possible to them. After pouring, any exposed concrete was protected as well as conditions would permit. In cases where forms were used, a small stove was put in each excavation and fired for a day. Where the concrete extended above the ground, fires were built around the foundations, and where they were all below ground the exposed surface was covered with stable refuse and tar paper.

The anchor bolts were held in their exact position during the concreting by means of large steel templates which spanned the four holes. When these were centered and levelled the anchor bolts were in their correct position. These templates were made collapsible for convenience in moving. When the concrete in the foundations was poured, it was kept down 6 inches to permit capping. This was done in order that the foundations might be brought to a dead level after the bulk of the concrete had set. It was found that if one leg of a tower was ¼ inch out of level the tower steel could not be put together.

Erection of Towers

The erection of the steel towers followed closely behind the foundations. The steel was shipped knocked down from the factory in car lots, each car made up of a certain number of complete towers. Each piece of steel was stamped with a number, and a diagram indicated the number of pieces required to complete a tower. It was unloaded at the headquarters and checked and separated into individual towers. These were then hauled up the line to the various camps by the tractors and distributed to the tower sites by teams.

On transmission lines where the steel is lighter, it is customary to assemble the tower completely on the ground and then raise it by means of heavy tackle and sheer legs. This method could not be used on towers of this type, so that a different method had to be developed. This was as follows:—The two sides of each tower, up to the lower cross-arm, were assembled on the ground and raised separately by means of sheer legs. The connecting bracing was then filled in piece by piece. The top portion was then assembled in two sections and the sheer legs were raised to the top of that portion of the tower already erected, when the top sections were lifted into position and bolted fast. The cross-arms were raised separately and connected to the tower. A well-trained crew and foreman could complete one of these towers per day. A crew consisted of one foreman, eight climbers, four ground men, a team and a driver.

A semi-anchor tower was erected in substantially the same manner, but, due to its greater weight and a greater number of bolts, required from two and one-half to three days to complete, the anchor towers required from three to four days, depending on their location.

Stringing of Conductors

The next operation was the stringing of the conductors and ground wire. The conductor came in reels of approximately 4,000 feet, each weighing in the neighbourhood of 1¾ ton. Twelve reels were distributed at every tenth tower and reeled out both ways. The different lengths were united by means of compression sleeves; a steel sleeve for the steel core and an aluminum sleeve for the aluminum covering. These sleeves were pressed on by means of an hydraulic press developing a pressure of 2,000 pounds per square inch.

The wire was reeled out by teams. Specially-made snatch blocks were suspended from each cross-arm, and as the wire advanced from tower to tower it was passed through these blocks. In this way the wire was protected from abrasion and the unreeling expedited. When the wire which was being reeled out met that which had already been completed they were joined with the compression sleeves and that last strung was sagged.

The amount of sag given to the conductors varied with the length of the span and the temperature at the time the work was being done. The method adopted to do this was as follows:—After determining the amount of sag for a particular span from tables provided, targets were placed

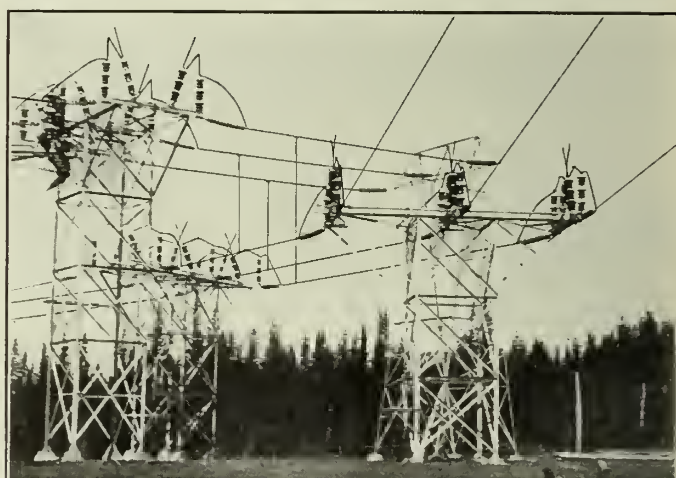


Figure No. 5.—Circuit Opening Switches—Two of these on Isle Maligne-Quebec Transmission Line at First and Third Quarter Points.

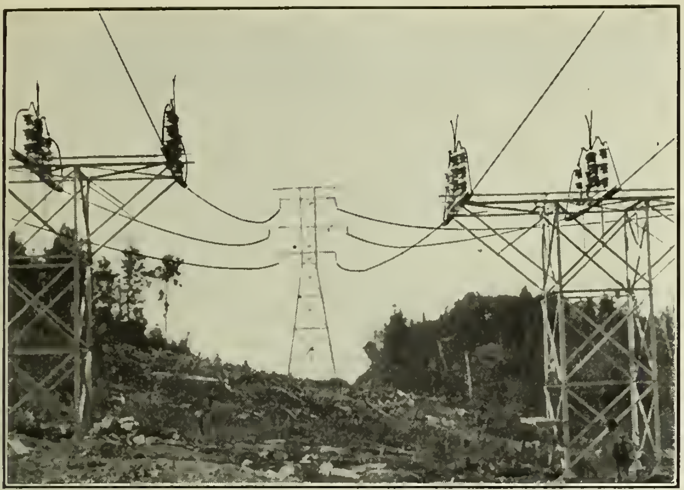


Figure No. 6.—Portion of Circuit Opening and Circuit Crossover Switches—One at Centre Point of Isle Maligne-Quebec Transmission Line.

on the towers at either end at the correct distance beneath the point of suspension of that particular conductor. The conductor was then tightened until it was in line at its lowest point with the targets. As a rule, four or five spans were sagged simultaneously. The conductor was then freed from the snatch blocks, clamped to the insulator, and the armour wire applied, for protection, at the point of suspension.

The ground wires were strung in much the same manner, but were clamped rigidly to each tower.

The final operation on the line was carried out by an inspection crew. Each tower was examined for any missing steel or bolts. The bolts were all tightened and centre punched; that is, a centre punch was driven into the bolt at its junction with the nut to prevent their working loose.

Method of Hauling Tower Material

A short account of the method used to haul the tower material to the site of operations may be of interest. As has been stated, all this material, such as tower steel, anchor bolts, insulators, cement, conductors, equipment and supplies for the camps were all transported to the two headquarters by rail. This material approximated 30 tons per tower. The experience of the summer months was that economical and successful transportation could only be done over snow roads, which were available about the first of January.

The hauling was done exclusively by the Linn tractors, with sleighs replacing the front wheels. Two heavy sleigh trailers were provided for each Linn. The crew consisted of a driver and a helper. As the tractors were loaded, a complete bill of lading was made showing the destination of the load. On section number two there were established two refuelling stations, one 20 miles and one 40 miles above Stoneham. At each of these there was a garage with mechanics capable of making all repairs, and at the upper one relief crews for the tractors were stationed.

The routine was as follows:—A loaded tractor with trailer would leave headquarters routed to the end of the line. At the first filling station a stop would be made, fuel and oil taken, any minor repairs made, and the journey continued. At the next filling station the operation was repeated and the crews changed. The fresh crew would continue on immediately to the destination, where a crew would unload the material, check it and sign the bill of lading, noting any shortages. The tractor would then return direct to headquarters, stopping only to refuel. A fresh crew would take over and the operation be repeated.

A round trip to the end of the line required, on an average, thirty hours, and the average load was 20 tons. The roads remained in good condition for three months, and during that time material weighing some 12,000 tons, exclusive of foundation material, was hauled on the two divisions.

A telephone line of first-class construction was built paralleling the transmission line for operating purposes. This was carried along with the transmission line itself and used for communication during construction. Six well-built houses were also constructed at different points for the use of the patrol men.

Construction was actually started on this transmission line the first part of June 1926. During that summer and autumn, all branches of the work were pushed vigorously, and by the time winter set in the road had been completed. The camps were finished soon afterwards, and a great many tower bases were made. Good progress had also been made in the erection of the steel towers and stringing the wire. During the following winter these construction operations were continued, although on a smaller scale; the chief concern being the hauling and distribution of material. This was advanced so well that when the roads broke up in the spring of 1927 all the material for the construction of the towers was at the sites. This included the sand and stone or gravel, as the case might be, steel, insulators and conductors. The cement was stored in sheds at convenient intervals.

In the spring of 1927, construction operations were again pushed actively, so that by July the transmission line was complete. It was tested out and put into operation on August 7th the same year, fourteen months after the commencement of construction.

Discussion of Paper on the Chippawa Creek Syphon Culvert of the Welland Ship Canal by A. J. Grant, M.E.I.C.[1]

A. J. Grant, M.E.I.C.[2]

The author, in presenting his paper, observed that the maximum discharge of Chippawa creek may reach 10,000 cubic feet per second, under the conditions of a heavy snowfall in the winter followed by heavy rains in the spring. The water surface of the creek, for 27 miles from the Niagara river westward, was practically level in the summer at elevation 562.0 above sea level and west of the canal during spring freshets it rose to about elevation 569.0. The summit level of the present canal was open to lake Erie and its water surface varied between elevations 570.0 and 579.0.

The creek crossed the canal at the city of Welland, about 8 miles from lake Erie. At the site of the culvert the material overlying the rock surface was about 100 feet deep and consisted of soft blue clay with underlying glacial deposits. The clay was mixed with a very fine sand, and some small stones and a few boulders. Immediately over-

(1) This paper was presented at the Annual General Meeting of The Institute, Montreal, February 15th, 1928, and published in The Engineering Journal, February 1928.

(2) Engineer-in-Charge, Welland Ship Canal, St. Catharines, Ont.

lying the rock they had found a layer of hard boulder clay. In making test borings water was encountered at the surface of the rock immediately after penetrating it. The water in the test pits rose as high as elevation 584.0, or from 8 to 10 feet above the level of the present canal.

Owing to the congested area of the culvert site in the city of Welland it was found practically impossible to locate the syphon culvert for the canal on the south side of the present aqueduct, and in order to make its construction as economical as possible the centre line of the culvert north of the aqueduct made an angle of about fifty-nine degrees with the centre line of the canal. On account of the eastern end of the culvert pit projecting into the present canal about 125 feet, there was at that point a letter *S* turn in the canal which had given some trouble to the captains of ships navigating the canal.

The culvert consisted of six parallel tubes, each 22 feet in diameter and 353 feet long between the end wells of the tubes. The bottom of the culvert pit was about 80 feet below the surface of the ground. Across each end of the tubes a massive concrete wall had been built, the adjacent faces of which are 244½ feet apart. The piers separating the wells of the tubes were provided with stop-log checks, so that in the future, should the tubes become choked, stop-logs can be placed in front of any of the three pairs of tubes, and the latter pumped out to enable them to be cleaned.

The tubes and walls of the structure were carried on timber bearing piles 22 feet long. Under normal conditions, with the water in the canal, the piles under the tubes would carry a load of 9 tons each, and those under the head walls would carry a load of about 35 tons.

In order to permit the construction of the culvert, a cofferdam consisting of twenty-six cells each 36 feet long by 26 feet wide, and built of Lackawanna steel sheet piling, had been driven around the east end of the culvert pit to cut off the present canal. The excavation of the culvert pit had been taken out in two layers, each 40 feet deep. The upper portion of the excavation had been done largely by dredging concurrently with the construction of the cofferdam. The lower half had been done in steel sheet pile trenches or pits braced with timber. It was the construction of these trenches which had made the work so interesting on account of the difficulties encountered.

These pits varied in size from 26 by 43 feet up to 65 feet wide by 111 feet long.

The steel piling used in the construction of the pits had a maximum length of about 83 feet. Owing to the character of the material in which the structure was founded, they had generally been able to drive piling to that depth with considerable accuracy with reference to a vertical plane, although in some cases there were considerable divergencies from those lines.

Owing to the heavy pressures encountered in these pits it had been necessary to use very large timbers; the struts used ranged from 12 by 12 and 14 by 14 to as high as 24 by 24. In the wider pits the struts had been calculated as unsupported columns. They were braced together in pairs, which left every alternate opening free for the working of the machines excavating the material.

It was hoped to complete the main portions of the culvert about July 1st, 1928, barring accidents.

Major A. S. Dawes, m.e.i.c.[3]

Major Dawes remarked that during the execution of the work the manner in which the engineers had handled the difficult problems that had arisen had given the contractors great confidence in the ultimate outcome. He felt that Mr. Grant, as the head of the engineering organization, deserved great credit, and it was gratifying to note that the engineers on the Welland canal are practically all Canadian-born and educated in Canada.

O. O. Lefebvre, m.e.i.c.[4]

Mr. Lefebvre said that he had been fortunate enough to visit the Welland canal work and had found that the problem of laying the culvert or syphon underneath the new Welland canal in order to pass the flow of the Chippawa creek was of great interest.

The size of the culverts and their depth, and so on, had all been planned in the usual manner, and the contractors were asked for a bid on the work. Generally, the contractor was not given any layout as to the method which he should follow in executing a certain work; he was left more or less free to approach the solution of the problem in his own way. But in this instance everything had been planned out ahead; the whole layout and the method of approach had been determined by the engineers in charge of the construction. The only thing that was left uncertain, and for which the contractors were asked to bid a lump sum, was the pumping.

Engineers knew that in most cases when tenders were asked, say for the construction of a dam, it was stated that the site of the dam would have to be unwatered. Decision as to what method should be followed, or which part of the river should be tackled first, and what proportion of the river should be dealt with at one time was usually left absolutely in the hands of the contractors. Everyone bidding on the job could look at the problem in his own way. That system might be a mistake, and in his opinion engineers, when preparing such plans, should also provide for the method which they consider should be followed to unwater the river section, so that the contractor would not be called upon to face the uncertainty which is connected with any unwatering problem.

Another feature, which he had noticed, was the behaviour of the steel sheet piling. The author had mentioned that at a certain depth some steel sheet piling had separated, which meant that such piling is not absolutely dependable when water-tightness is desired.

He would say, further, that while there might be differences of opinion as to the advisability of having built the Welland canal at all, and there might be differences of opinion as to the effects of that work on the cost of transportation, when it came to the engineering features of that great work, there were no differences of opinion regarding the successful and creditable work of the engineers of the Department of Railways and Canals and the engineers of the Welland ship canal in carrying out this large undertaking.

T. Kennard Thomson, m.e.i.c.[5]

Mr. Thomson remarked that from the drawings it appeared as if the culvert tubes were not as heavy as the material displaced, and he enquired whether, if the tubes were unwatered with no water above them, there would be danger of the structure being lifted by the water pressure below them.

The author, in reply, stated that all the tubes could never be unwatered at one time; it was possible to have two tubes unwatered, but not all of them, as that would involve obstructing the flow of the creek, which would be too dangerous to contemplate.

He pointed out further that the steel sheet piles that surrounded the perimeter of the culvert were left in place

[3] President and Managing Director, Atlas Construction Co., Ltd., Montreal.

[4] Chief Engineer, Quebec Streams Commission, Montreal.

[5] Consulting Engineer, New York City.

and that these piles would act as an anchor to keep the structure down. The culvert was constructed with vertical joints at frequent intervals in the length of each tube.

Wm. McG. Gardner, A.M.E.I.C.[6]

Mr. Gardner enquired how the tunnelling was executed under the canal section, why piles were necessary there, and why a depth of 3 feet from the bottom of the canal to the top of the concrete was selected.

Mr. Grant.

The author replied that there was no tunnelling done in constructing the culvert. The excavation was all done in the open. For the upper 40 feet the excavation was all done in one large open pit, and below that the excavation was done in a series of open steel sheet pile trenches.

As regards the proper depth for the concrete below the bottom of the canal, it was a matter of discussion as to whether the upper surface of the concrete should be finished in the plane of the bottom of the canal for 30-feet navigation, or whether it should be carried down a little more. It was decided that in the event of the canal being required for 30-feet draught it would be better to give the ships some water under them over the culvert, and avoid the danger of the ships' keels scraping the top of the concrete and injuring the culvert, so an additional depth of 3 feet was decided upon over the top of the culvert.

The length of the locks had never been questioned, though some engineers had questioned the width and others the depth. One prominent engineer advocated 32 feet of water for 30-feet navigation, but the author thought that was a matter of opinion. Today the depth of navigation was 14 feet, which was used to the last inch; in fact boats in passing through the locks scraped the mitre sill platforms. For 14-feet navigation the locks should have a greater depth of water over their sills than 14 feet.

In regard to Mr. Lefebvre's remarks, he might say that the contractor was not given any option in the type of cofferdam he could use in closing the east end of the pit. One of the main problems had been to maintain uninterrupted traffic in the present Welland canal. If that had been obstructed, even for a few days, the consequences would have been serious; careful plans were therefore made for the cofferdam, and the contractors were informed both by the specifications and the plans how it was to be built. The only question at issue was the amount of pumping necessary to be done.

In order to give some idea of the pressure which had to be dealt with in the lower pits, the author pointed out that all of the 12 by 12, 14 by 14 and 14 by 16 struts were supported at their ends by 1-inch steel plates bolted to the corbels. Some of these steel plates had been bent to such an extent that they had been forced 5 inches into the corbels and had remained there when the corbels were finally removed from the pits.

The 18 by 18 struts had crushed as much as 2½ inches into the oak corbels, which were 8 inches thick and 22 inches wide and had a minimum length of about 6 feet. Those corbels bore against 24 by 24 inch Douglas fir wales, and in many of the pits the corbels had been completely destroyed, especially in pit "*H*" at the northeast corner of the structure.

For the support of the north wall of pit "*E*" it had been necessary to carry across the culvert to the north side of the northern tube 24 by 24 struts which were supported against 24 by 24 wales. The ends of these struts had crushed into the wales 5 inches, and in some cases had practically destroyed the wales themselves, and in doing so had put a bow in the 24 by 24 wales of at least 12 inches in a length of about 6 feet.

Another feature of the case which would perhaps illustrate some of the difficulties more clearly even than the crushing of the timber struts and wales was an occurrence in the southeast corner of the culvert pit. In pit "*F*," which was, roughly speaking, about 65 feet wide and 90 feet long, and contained about 5,500 yards of concrete, this mass of concrete was about 70 feet high. The superintendent on the work at three o'clock one afternoon felt the timber trestle surrounding the east end of the culvert pit shake under his feet, but on looking around nothing seemed to be wrong, so he forgot all about it. The next morning he requested the engineers to lay out some work in an adjacent pit, when it was discovered that the mass of concrete in pit "*F*" had moved 2 feet to the northwest. An examination showed that it had not leaned over and had not gone out of the perpendicular, but had shifted bodily in a horizontal plane. This incident gave some idea of the unstable character of the foundation against lateral pressure.

C. S. G. Rogers, A.M.E.I.C.[7]

Mr. Rogers observed that the author had favoured several of the local branches of The Institute with a broad general outline of the design and construction of the canal itself, and had now shown that some of the details of the work were in their own way as unique as the canal itself.

The problem of opening a large area of ground and building in it a concrete block enclosing a series of underground tunnels to act as a syphon to carry the Chippawa creek under the canal involved pits sunk to a depth of 80 feet,—a work that was rendered exceedingly difficult by the proximity of the excavation to the existing canal. The volume of flow of water into the excavation was the governing factor in deciding the feasibility of such a work. Cofferdams could be made to exclude the water from the canal, but the flow through the underlying rock strata was another problem.

It was very gratifying to note how nearly the results obtained from the borings made at the site confirmed the reasoned opinions based on such geological features as neighbouring water horizons and the direction of rock incline. The borings too had justified the change in design of syphon from that of tunnels through rock some 170 feet below ground to tunnels through the clay just clear of the bottom of the canal. He thought it very doubtful whether the work as originally designed could have been carried to a successful conclusion, except at prohibitive cost, or whether the original scheme would have resulted in a structure capable of the future inspection and maintenance that were provided for in the altered design.

The method of handling the excavation showed a broad grasp of the problem to be met. The first step entailed an open pit excavation, with one end a bank cut to natural earth slope, and the other end protected by a most interesting cellular type steel pile cofferdam. The second step divided the lower half of the excavated area into a number of vertical walled pits of the open steel sheet-piling cofferdam type.

He noted that some of the cells of the cofferdam had tilted inwards and settled on their inner edges, and believed that this was due to a mistaken assumption in design. The design contemplated the distribution of base pressures over the total area of the horizontal cross-section of the cells, but this would be prevented by the fact that the earth filling adjacent to the point of application of side pressures would compress, and so would not pass on the applied force to

(6) Special Trackwork Engineer, Montreal Tramways Company.

(7) Engineering Department, Canadian National Railways, Moncton, N.B.

the area of base covered by the earth fill. On the other hand the transverse walls of the cells would actually carry the pressure across and apply it as a toe pressure, that is, as a downward thrust on the inside pile wall, with the result that settlement actually took place.

The fact, too, that the walls carried practically the total horizontal pressure, and converted it into a downward thrust on the inner walls, accounted for the steel pile walls bursting apart.

He would submit that in designing cofferdams of this kind, either the filling of the cells must be of a nature to transmit the applied pressures to the base, or the inner and outer walls must be figured to resist the downward pressure or the uplift, as the case might be.

If a criticism of this paper might be offered it would perhaps be that the honesty of the engineer had forced him to emphasize the minor failures encountered, particularly in the bracing of the open pit cofferdams,—failures which were relatively unimportant, having regard to the magnitude of the success.

Mr. Rogers would suggest an interesting study which might throw light on an aspect of open cofferdam work that is always a matter of doubt. The author had stated that in designing the bracing for the pits a weight of material of 120 pounds per cubic foot was assumed, with angles of repose of 4 to 1 and 3 to 1. In analysing the failures of struts involved, the computed stress is known, the weight of material is to all purposes correct, and the ultimate strength of Douglas fir timbers is pretty well known. Would it not be possible then from these known factors to work back and find out the actual pressure of earth, and make a check on the assumed angles of repose of 4 to 1 or 3 to 1, as the case might be?

Pits of this depth and length of side were seldom encountered, and data obtained from them would give a real indication of earth pressures, as they would be relatively free from the arching action of the earth walls that occurred in pits of lesser dimensions. The failures of timbers recorded seemed to indicate pressures just producing collapse and no more, so that they would appear to offer a fairly accurate solution of this question.

Might he be permitted to express the very real pleasure and satisfaction he had felt in the study of the paper?

D. W. McLachlan, M.E.I.C.[8]

Mr. McLachlan remarked that in the years which followed the power developments made at Niagara falls between 1902 and 1906, a number of schemes for overland power canals from lake Erie to lake Ontario had been advanced. One of these proposed to carry the level of lake Erie across the country from Wainfleet to Jordon, where almost the full head between lakes Erie and Ontario was to be concentrated in a power house with about one mile of pipe line, and he had been employed on the survey of this project. Other projects had also been considered at this time, notably the Queenston-Chippawa route, afterwards utilized by the Hydro-Electric Power Commission of Ontario.

Further, in 1911 and 1912 the idea of building a deeper navigation canal between lakes Erie and Ontario began to develop, but as the problem of getting down to the lower level with a navigation canal differed from that involved in power development, the engineers connected with the work looked for a route along an obvious depression in the country west of Decew falls. This proposed route followed the Welland canal from lake Erie to Port Robinson, thence west to the Twelve Mile creek, and then down the Fifteen Mile creek to lake Ontario. Borings made on this route showed great deposits of quicksand, and then it was discovered that the route followed a pre-glacial outlet of lake Erie, and solid rock was very far below the surface of the ground. Further light on the situation came from an examination which Mr. McLachlan had made of a report by Dr. Spencer, which was printed in 1905. Dr. Spencer's sketches indicated that the valley could be avoided by following a route directly north from Thorold to lake Ontario, or going west of it, via Jordon. The fall in the country near Jordon or the Twenty Mile creek was too rapid for a canal with ordinary lifts, so borings were made on the Thorold-Ten Mile creek route. These showed the rock surface to drop gradually from about elevation 350 at the foot of the escarpment to about 210 near lake Ontario. This enabled three locks with lifts of 46½ feet to be introduced at intervals of about one mile. At the escarpment some locks had to be placed in flight to follow the ground surface, and in that case they had to be twinned to maintain traffic capacity. The country between Thorold and lake Erie, being flat, geological conditions did not dictate the route to be followed there. In this territory nothing would have been gained by departing from the alignment of the old canal, except where solid rock was encountered in quantity. At these points deviations were made to enable the rock section to be removed in the dry. The flight lock arrangement on the canal had been evolved by Mr. Sterns after he joined the canal staff in 1912.

The two most difficult problems on the canal were the building of lock No. 3 and the Welland aqueduct. In preparing the early plans for the canal, it was thought that the building of the aqueduct could be avoided by taking the Welland river into the summit level of the canal, and discharging flood flows at Port Robinson over a dam there. However, years of study and consideration brought a change, the idea was finally given up, and the new canal, like former canals, crosses the Welland river by an aqueduct without affecting its level.

Mr. McLachlan had had nothing to do with determining the length, width and depth of the locks selected, and did not know how they were arrived at. He did, however, remember the low elevation of solid rock at locks 1, 2 and 3 being advanced as an argument for giving 30 feet depth to those locks. As explained by Mr. Sterns, it was first intended to equip the locks with single leaf gates at both ends. In fact, parts of some of the locks had been built with this scheme in view. However, the practicability of single leaf gates was investigated by Mr. McLachlan early in 1920, and he had succeeded in persuading Mr. Alexander Grant and the late chief engineer of the Department of Railways, Mr. W. A. Bowden, to change back to mitering gates. Single-leaf gates were first adopted because it was thought they could be slammed in case of accident. Later investigations showed that this could not be done without departing from pintle and yoke construction, because the deflection of the gates under load would set up a leverage action by contact with the hollow quoin casing during slamming. Later investigations also showed the single leaf gate to be too heavy to lift by floating pontoon except with the gate in its recess. This was thought to be a dangerous state of affairs to leave for posterity to deal with. The change back to mitering gates was chiefly made because of these difficulties.

In the Welland ship canal, a new type of lock valve was being tried out, and lift bridges were introduced on a large scale for the first time. These were the most important advances from the former works of this kind.

The summit level of the canal was protected by a pair

(8) Department of Railways and Canals, in charge of St. Lawrence Ship Canal and Hudson Bay Railway Terminals.

of guard gates in accordance with the practice established by Page, Munro and others many years ago, double gates at the head and foot of locks standing against traffic whenever large quantities of water are held back.

The Welland ship canal was being built on conservative lines, and estimates showed that it follows the cheapest route for such a canal between lake Erie and lake Ontario. In fact, a canal on the United States side would have cost twenty per cent more than a similar canal on the Welland route.

Discussion of Paper on Bridges over the Welland Ship Canal by M. B. Atkinson, M.E.I.C.[1]

M. B. Atkinson, M.E.I.C.[2]

The author, in presenting his paper, stated that he wished to correct a very unfortunate printer's error on the last page of the paper, in the last paragraph but one, as a result of which the names of the consulting engineers and the Canadian Bridge Company had been omitted from the list of those organizations whose staffs had done so much to ensure the successful completion of the work. He then presented and described a series of lantern slides of views which, for lack of space available, could not be included in the paper. These showed the variety of work required for the bridges over the canal, including, as they did, long reinforced concrete spans for both highway and railroad traffic, substructures, bridge sites at the canal locks, temporary bridges for diverting traffic during the construction of the new substructures and superstructures, reinforced concrete bridge houses and their cantilevering supports, old swing-spans, new bridges built, etc.

W. Chase Thomson, M.E.I.C.[3]

Mr. Thomson remarked that the author was to be complimented on his very complete description of the bridges over the Welland ship canal.

From an aesthetic point of view, the vertical-lift structures were fairly satisfactory; and the double-leaf bascule at Queenston road had very good lines. On the other hand, the best that could be said of the single-leaf bascules with overhead counterweights was that they were more useful than ornamental. They seemed to be necessary evils where located close to lock gates; but, in cases where there was sufficient room, simple bob-tail swings would have been more economical, both in first cost and in operation, and also less offensive to the eye.

The late Mr. W. A. Bowden had been sufficiently impressed with some preliminary sketches for a double-swing design which Mr. Thomson had submitted to suggest that he should design a bridge of this type for the highway crossing at Port Robinson, in accordance with the Welland ship canal specification and the substructure drawings which he provided.

A design was prepared accordingly, in which Mr. Thomson had placed the pivot piers sufficiently far apart to provide the full clearance for navigation required by the specification, the bridge being fully protected, when open, by massive concrete retaining walls on both sides of the waterway, instead of fenders composed of pile clusters or floating booms, as mentioned in the paper. The bridge was counterweighted to balance the dead load; and, when closed, the shore ends were anchored to provide the negative reactions for the live load over the waterway. In all other respects the structure was similar to ordinary swing-spans, and the details were exceedingly simple. The provision of a satisfactory end anchorage, however, required a good deal of study.

In accordance with the requirements of the specification, this bridge had a 20-foot roadway, with two sidewalks, each 5 feet wide in the clear; and it was designed for a live load of 100 pounds per square foot on roadways and sidewalks; or for two 20-ton motor trucks, passing each other on the roadway, with 100 pounds per square foot on the sidewalks. The length of the anchor arms was 60 feet, and that of the cantilever arms 120 feet. The trusses were 23 feet 2 inches centre to centre; and the distance between centres of pivot piers was 243 feet. The counterweights were underneath the floor, and thus out of sight.

Some of the advantages incident to this type of bridge, as compared with others designed to meet the same requirements, might be stated as follows:—

(1) In the event of a collision, the damage to the structure would be less serious than to a bascule or to a vertical-lift bridge; for the applied force would mainly tend to swing the individual leaves in their normal path; moreover, there would be no overhead counterweight to drop. At the worst, the bridge could be cleared away far more readily than any of the other types.

(2) The stresses in all members would be readily determinable, and there would be an entire absence of reversals. Thus the danger of failure due to stresses which might be incalculable and difficult to estimate would be eliminated.

(3) The first cost of this type of bridge would be much less than that of a trunnion-bascule, rolling-bascule or vertical-lift, due to less structural steelwork with simpler details, less counterweight and easier erection.

(4) The cost of operation and maintenance would also be much cheaper, because it could be operated with less than one-half the power required for any of the other types, and because it had no complicated parts likely to get out of order.

(5) A concrete floor could be used with it, an advantage which did not apply to some of the other types.

(6) It could readily be operated by hand-power, should the electric motors and gasoline engines fail.

The cost, in accordance with this design, of the superstructure alone was estimated at the time as follows:—

Structural steel work, 828,000 lbs. at 8c	$66,240
Heavy machinery, 100,400 lbs. at 34c	35,140
Reinforced concrete floor, 175 cubic yards at $40.00	7,000
Concrete counterweight, 187 cubic yards at $10.00	1,870
Electrical equipment with incidental machinery	15,000
Operator's cabin	2,000
	$127,250

being less than one-half the cost of a double-bascule or of a vertical lift bridge.

Mr. Thomson further pointed out that the dependability and low cost of maintenance of swing bridges were well known, for swing bridges were far more common than any other type of movable structures. It was true that double-swing bridges were uncommon. Two were men-

(1) This paper was presented at the Annual General Meeting of The Institute, Montreal, February 16th, 1928, and published in The Engineering Journal, February 1928.

(2) Structural Engineer, Welland Ship Canal, St. Catharines, Ont.

(3) Designer, Dominion Bridge Company, Limited, Montreal.

tioned in the paper, and, as a matter of interest, he wished to point out that there was another at Mira, Cape Breton, near the line of the Sydney and Louisburg Railway.

Referring to the double-swing bridge at Cleveland, which was built in 1895, and located in the downtown district, where the traffic, consisting largely of motor trucks, was exceedingly heavy, he had reliable first-hand information to the effect that the operation of this structure had been very satisfactory and inexpensive, which the author had admitted in the paper under discussion. In the same sentence, however, he had proclaimed that not another bridge of this type had since been built; and he apparently considered this fact to be an adequate reason for its condemnation.

It might be pointed out that there were fashions in bridges, as well as in clothes and hats. In swing bridges, whether single or double, there were few patentable features. On the other hand, other types of movable bridges had been covered by many patents. Consequently, such structures had been intensely advertised by the holders of such patents. The result had been that many bascule and vertical-lift bridges had been adopted where simple swings would have given far better service at much less cost.

Some criticism of the speaker's design having been made on the ground of excessive cost of substructure, due to the mass concrete guard walls on both sides of the waterway, an alternative design for the substructure only had been submitted subsequently. It was a very substantial reinforced-concrete structure, including a horizontal fender about 5 feet above the water line, supported on bents 30 feet apart. The fenders were 30 inches deep and 48 inches wide, suitably reinforced, and were designed for a horizontal load at the centre of 150,000 pounds. The bents consisted of a vertical member 30 inches square, and a diagonal backstay of the same dimensions. They were designed for a horizontal load at the top of 300,000 pounds. In this case the pivot piers were hollow, and capped by a heavily-reinforced slab 9 feet thick. The estimated cost of this alternative substructure was about $90,000.

J. L. M. Tait, A.M.E.I.C.[4]

Mr. Tait desired to ask whether cast iron gears or racks were permitted in the swing-span bridges, or whether cast steel had been employed. He would also inquire whether any difficulty had been found in providing a satisfactory type of rolling bed for the heavy bridges. In his experience it was difficult to get a satisfactory pier for a rolling-lift bridge, although such bridges had been used for the past twenty or twenty-five years.

Experience had shown that it was practically impossible to get a satisfactory rolling track. In almost every case the track buckled and the rivets sheared off.

Mr. Tait also asked the author to state what considerations had led to the selection of the lift-span type of bridge, for it would seem to the outsider that lift-span bridges were more liable to accident than almost any other type.

S. Blumenthal, A.M.E.I.C.[5]

Mr. Blumenthal referred to the point under discussion, and stated that the Canadian Pacific Railway had a double-track rolling-lift bridge with about 120-foot span at Fort William, which had been in use for fifteen years, and had never experienced any trouble with regard to the rivets shearing along the edges of the segmental girders.

(4) Structural Designer, Dominion Bridge Company, Limited, Montreal.
(5) Assistant Engineer, Bridge Department, Canadian Pacific Railway, Montreal.

Prof. Peter Gillespie, M.E.I.C.[6]

Professor Gillespie observed that the paper described work which displayed a care in design and an excellence in workmanship for which the Department of Railways and Canals was justly well known.

Mr. Tait had drawn attention to the design of the bearing plates for the segmental girders and for the supporting girders upon which they roll in the Scherzer type of bridge, and certain troubles incidental to their operation. In this case the area of contact between roller and girder was relatively small, while the deformation or "biting in" seemed to be proportional directly to the load, and to be independent of the diameter of the cylinder.

The investigations of Mr. Wilson of the Engineering Experiment Station, University of Illinois, and others, had indicated the magnitude of these quantities. While he did not recall the precise figures, they were substantially of this order: a 20-foot diameter cylinder loaded with 75,000 pounds per inch of length contacted over only about 2 inches and the deformation was only about 0.004-inch. Now, while such figures were interesting, there lay in their smallness a potential cause of trouble. If, for example, the upper face of the supports, transversely, were not parallel with the rolling face, the roller must "ride the ridge," and if the lack of parallelism were equal to the figured normal deformation for good contact, the first half of the load would produce the designed stress, and the whole load might occasion stress beyond the yield point. For greater lack of parallelism the undesirable effect would obviously be correspondingly increased. Such lack of parallelism might result from inaccuracies in workmanship, but more likely from errors in setting the supporting girders. The inference just drawn respecting the effect of such errors of course assumed a perfectly rigid support for the bearing plates—a condition never entirely realized.

To prevent the overstressing, to which Mr. Tait had referred, a generous bearing width was the first essential. A second was ample thickness of bearing plates,—not less than 6 inches generally. A third was accurate machine work in the shop and precision in setting the supporting girders. Finally, to produce a little more flexibility and consequently to facilitate the adjustment necessary because of lack of parallelism, it might be advisable to stagger the stiffeners on the rolling girder with those on the supporting girder beneath it.

P. L. Pratley, M.E.I.C.[7]

Mr. Pratley, the chairman, believed that the author had put his finger on the spot when he spoke of workmanship. Today, the vast improvements in methods, the increase in care, and the intelligent use of equipment in our fabricating shops all tended towards the removing of our fear of this high pressure or of these deformations. His present feeling was, that the shearing of rivets on rolling-lifts was caused by a possible lack in careful workmanship, but that with research along that line, with a careful study of the bridges of this type actually operating, and with thorough inspection during fabrication and erection, vast improvements were being effected in the detail construction and in the conditions under which such bridges had to operate. Under modern circumstances, then, it had been possible to re-establish this type in competition with other types such as those depending on lubricated trunnions.

(6) Professor of Civil Engineering, University of Toronto, Toronto, Ont.
(7) Monsarrat and Pratley, Consulting Engineers, Montreal.

Dean H. M. MacKay, M.E.I.C.[8]

Dean MacKay noticed that the figures given, in the list of bridges, as to the power required for operation indicated that the vertical-lift bridges required greater power than other types, other things being equal. Was this impression correct?

M. B. Atkinson, M.E.I.C.

The author, in reply, remarked that Mr. Thomson, in his discussion, had stated the advantages which he considered that the double-swing span had as compared with the other types of movable bridges investigated, but he did not propose to enter into controversy regarding the relative merits of various types of movable bridges, since the purpose of his paper was a description of the work involved in providing the necessary bridges for traffic crossing the canal. It was proper, however, to point out that the estimate of cost made by the Welland ship canal office for the superstructure of a double-swing span designed to the requirements of the Department's specifications was largely in excess of Mr. Thomson's estimate. Mr. Thomson seemed to have received from the paper the erroneous impression that the author was disposed to condemn the use of the double-swing span simply because no more had been built. What the author meant to convey was, that during the past thirty years there must have been many cases where this type of bridge should have received favourable consideration in competition against the many patented bridges that had been built, and he did not understand why this consideration had not been given. Double-swing bridges were unsuitable for railroad traffic, but were suitable for highway traffic. The cost of the superstructure should be less than for the others, but the approval of the use of a double-swing bridge by the engineer for a government, municipality or corporation would depend on what he would accept for protection; the deeper the depth of water required for navigation the greater the cost of the protection. As the locks of the Welland ship canal were built to take a ship of almost 80 feet beam, 800 feet length and 30 feet draught, he believed it would be evident why Mr. Thomson's design for protection had been unacceptable. Pile clusters were used a great deal to protect structures from being struck by large vessels, as their efficiency lay in their elasticity; they were now in use on the canal, and would be used at some of the new bridges. He believed it would be plain that in using, for estimate purposes, pile clusters as a protection to the double-swing span, the estimate of cost for that type had been kept down to the minimum.

In reply to Mr. Tait, the author would decline to discuss the reasons for the selection of the rolling-lift type, as the various designs submitted had been investigated by a board which reported to the chief engineer of the Department. Cast iron had not been permitted in the machinery drive and racks, the pinions were made of forged steel, the gears of cast steel, and all teeth were cut. With regard to the difficulties with the rolling tracks of rolling-lift bridges, there were in the city of Cleveland two double-track railway bridges, one designed for the Nickel Plate Railroad, and another earlier bridge of the same design, which was for another railway.

He believed that the same shop drawings had been used for the two bridges. One bridge had given trouble, but the other had given rise to no difficulty at all. The bridge engineer of the Nickel Plate Railroad had stated that in his opinion the satisfactory results from his bridge had been due to good inspection and good shop work. The two bridges in question were both across the Cuyahoga river and were operated to about the same extent. The tread plates were 2 and 2½ inches thick; the tread plates for the bridges of the Welland canal had a minimum thickness of 6 inches. He would point out that the American Railway Engineering Association's specifications called for a space to be left between the ends of the tread sections. The practice in Cleveland had been followed in the Welland ship canal, that is, the ends of the tread and track sections at the joints had been faced and brought to a bearing.

Mr. Blumenthal's remarks regarding the lack of trouble the Canadian Pacific Railway had experienced with their 120-foot span double-track rolling-lift bridge at Fort William during the fifteen years it had been in operation bore out previous reports regarding this bridge received some years ago by the Department.

Professor Gillespie had referred to the tests with large rollers now being carried on at the University of Illinois under the auspices of the American Railway Engineering Association; when these tests were finally completed and published they would no doubt be the subject of a large amount of discussion pro and con. It might be of interest to note that some of the large bridge companies in Great Britain had been building for some years past large rolling-lift bridges with tread plates only 3½ inches thick, but they cut the tread and track plates across at 45 degrees, thus leaving gaps due to the cuts at intervals of about 5 feet, the cuts in the tread plates being at right angles to the cuts in the track plates, and these British bridge companies had expressed themselves as being very well satisfied with the results obtained.

The author was in hearty agreement in every respect with the remarks of Mr. Pratley, but he would add, that after the structure had been properly fabricated, with the erection equipment now used by Canadian bridge companies, a reasonable amount of careful engineering in the field would ensure the erection of the bridge to the proper accuracy required.

With reference to Dean MacKay's remarks regarding the figures given in the list of bridges as to power required, the author would point out that the normal time of opening under electric power specified for all the vertical-lift bridges and the double-leaf rolling-lift bridge No. 4 was one and one-half minutes, and for all the other rolling-lift bridges it was specified as one minute, on account of their being over the entrances to canal locks. Fifteen seconds was allowed in both cases for the operation of signals and bridge locks, and this must be deducted from the normal time in order to get the actual time for bridge movement. It was therefore apparent that the 80-foot spans moved much faster than they would were the normal time of opening specified for them also one and a half minutes. In general it could be said, that under ordinary working conditions the rolling-lift bridges required much less horse power than did the vertical, but when the former were open against a ten-pound wind the torque required of the motor was greatly increased. It should be noted that the term horse power, when used for bridge motors, was liable to be very misleading, for the torque required of the motor was the quantity which really counted.

In closing, the author desired to express his appreciation of the discussions of the paper which had been presented, and he would also thank the chairman for his kindly remarks.

(8) Dean of Faculty of Applied Science, McGill University, Montreal.

THE

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The Western General Professional Meeting

The success of any meeting rests to a large extent with those in whose hands has been placed the responsibility of planning, arranging and carrying out the details, so that a great deal of credit is due to those western members of The Institute who, as a Committee of the Vancouver Branch, have directed and brought to a successful conclusion the recent Western General Professional Meeting at Vancouver, a meeting which has established a record as one of the most interesting and enjoyable gatherings of its kind.

Only those who have had the responsibility of arranging for such a meeting can appreciate fully the great amount of detail work involved, and the thanks of all members of The Institute are due to the individual members of the Committee of the Vancouver Branch through whose energy and resourcefulness the recent meeting was made possible.

It is, of course, essential to the success of a meeting that there be a good attendance, and in this respect the Vancouver meeting was well supported, particularly since at this time of the year the duties of the engineer are perhaps greater than at any other season.

The report of the meeting, which appears elsewhere in this issue, will give some idea of the features of the programme, but it is not possible in such a statement to record in fitting terms the generous and whole-hearted hospitality extended to the visiting members by those of the local branch.

The E-I-C News—A Weekly News Bulletin

Commencing on July 16th there will be issued by The Institute a weekly news bulletin to be known as the *E-I-C NEWS*, the purpose of which is to afford a means of transmitting information to the members of The Institute at more frequent intervals than is possible at present.

The News will be issued each week excepting that in which the Journal is published; the date of mailing of the latter being fixed as the first Thursday of each month.

This announcement will be of particular interest to members following the notice which appeared in the June number of the Journal relative to the extension of The Institute's Employment Service, as it will be possible through the News to keep the members advised of positions which may be available and at the same time bring to the attention of organizations employing engineers details of the qualifications of members seeking positions.

The publication of the News and the development of the work of the Employment Service Bureau have been undertaken on the recommendation of a committee appointed by Council to consider possible means of rendering greater service to the members of The Institute.

Further details regarding the weekly bulletin and the Employment Service Bureau will be published in the first and subsequent issue of the News. In the meantime, any member interested in the work of the Employment Service can secure full information by communicating with Headquarters.

Subject Selected for Past-Presidents' Prize Competition

The subject selected by Council for the competition for this prize for the year July 1st, 1928 to June 30th, 1929 is "Engineering Education."

The award of this prize is governed by the following rules:—

In recognition of the fund established 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 commitee.

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.

In preparing papers for this competition it will be noted that members of The Institute of all grades are eligible to compete, and it is suggested that in preparing their communications, members should be guided by the pamphlet "Suggestions to Authors" issued by The Institute, copies of which can be secured from Headquarters.

The Secretaries of all Branches are being requested to bring this prize competition to the attention of members.

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 main list last month:—

McGill University

Honours in the Graduating Class, Medals and Prizes

Benjamin, Archie, Outremont, Que.—British Association Medal, (Electrical Engineering); Montreal Light, Heat and Power Cons., First Prize; Undergraduates' Society's First Prize for Summer Essay.

Nightingale, Matt. Simons, Montreal West, Que.—Montreal Light, Heat and Power Cons., Second Prize.

Degree of B. Sc.

Abbott, Harold Felch, B.Sc., (El.), Prince George, B.C.
Benjamin, Archie, B.Sc., (El.), Outremont, Que.
Brain, Cecil, B.Sc., (Mech.), Grand Falls, Nfld.
Buchanan, Edward Trevor, B.Sc., (El.), Montreal, Que.
Budden, Arthur Napier, B.Sc., (El.), Montreal, Que.
Coleman, Sheldon Williams, B.Sc., (Ci.), Montpelier, Vt.
Curtis, Arthur E., B.Sc., (El.), Stanstead, Que.
Dalton, Peter Dudley, B.Sc., (Ci.), Montreal, Que.
Durley, Thomas Richard, B.Sc., (El.), Westmount, Que.
Fong, William Hin, B.Sc., (El.), Canton, China.
Fulton, Fraser Fowler, B.Sc., (El.), Fredericton, N.B.
Gagnon, Elmore Gerald, B.Sc., (El.), Montreal, Que.
Godwin, Harold Brandon, B.Sc., (El.), Ste. Anne de Bellevue, Que.
Groleau, Arnold John, B.Sc., (El.), Westmount, Que.
Hayes, Ronald Abram Hughson, B.Sc., (El.), Niagara Falls, Ont.
Jehu, Walter, B.Sc., (Mech.), Toronto, Ont.
Ketchen, William Arthur, B.Sc., (Chem.), Port Alice, B.C.
Lyons, Walter, B.Sc., (El.), Montreal, Que.
Nightingale, Matt. Simons, B.Sc., (El.), Montreal West, Que.
Palmer, William Henry, B.Sc., (El.), Heart's Content, Nfld.
Rhodes, Donald, B.Sc., (El.), Montreal, Que.
Taylor, Frank Denzil, B.Sc., (Chem.), Golden Ridge, Barbados, B.W.I.

University of Saskatchewan

The Saskatchewan Branch of The Engineering Institute of Canada Prize; the Governor General's Gold Medal

Sexton, Jack Kenneth, B.Sc., (Ci.), Seebe, Alta.

University of Alberta

Award of the Association of Professional Engineers of Alberta

Bowman, Ronald Fraser Patrick, B.Sc., (Ci.), Lethbridge, Alta.

Degree of B. Sc.

Hargrove, Paul, B.Sc., (Ci.), Edmonton, Alta.

Meeting of Council

Meeting of June 15th, 1928

A meeting of Council was held at 8 o'clock p.m. on Friday, June 15th, 1928. President T. R. Loudon, M.E.I.C., in the Chair, and five other members of Council being present.

The minutes of the meeting held on May 18th, 1928, were taken as read and approved.

The Financial Statement of The Institute for the period ending May 31st, 1928, was submitted and approved.

A letter was presented from the Lakehead Branch conveying an invitation to Council to hold the 1929 Annual Meeting at that branch, but as it had been decided at a previous meeting of Council that the next Annual Meeting should be held at Hamilton, Ontario, it was not possible to accept the invitation of the Lakehead Branch.

Professor T. R. Loudon, M.E.I.C., the chairman of the Service Bureau Committee, reported that in accordance with the Council's decision the establishment of a weekly bulletin was being proceeded with, and that arrangements had been made to extend the work of the present employment service at Headquarters.

The resignation of George R. MacLeod, M.E.I.C., as chairman of the Committee on Relations with the Provincial Professional Associations, was received and accepted with much regret, and S. G. Porter, M.E.I.C., of Calgary, was appointed Chairman of this Committee.

Dr. R. W. Brock, M.E.I.C., was appointed a member of the Leonard Medal Committee.

The lists of officers of the Hamilton and Niagara Peninsula Branches for the year 1928-29 were presented and approved.

A report was presented from the Board of Examiners and Education, announcing that a candidate who sat for The Institute's examinations under Schedule A. on May 28th and 29th had been successful in obtaining the necessary percentage for a pass.

Letters were submitted from Colonel David Lyell, M.E.I.C., and Lieut.-Colonel A. C. Macdonald, M.E.I.C., expressing appreciation at being chosen to represent The Institute on the occasion of the Centenary Celebrations of the Institution of Civil Engineers which took place in London, England, in June of this year.

It was decided that Council should not meet during the month of July, but a committee was appointed to canvass the ballot for the election and transfer of members which is to be opened on July 18th.

The ballot for the award of the Sir John Kennedy Medal was canvassed, which showed that the proposal to award the medal to Colonel R. W. Leonard had met with the unanimous approval of the members of Council. J. L. Busfield, M.E.I.C., was appointed Chairman of a Committee to secure a design for the medal to be submitted to Council for approval.

The recommendations of the Finance Committee in connection with four special cases were approved and four resignations were accepted.

The following elections and transfers were effected:—

Elections		Transfers	
Member	1	Associate Member to Member	6
Associate Members	8	Junior to Associate Member	5
Junior	1	Student to Junior	1
Students	2		

Eleven applications for admission and transfer were scrutinized and classified for the ballot returnable July 18th, 1928.

The Council rose at 10.30 o'clock p.m.

The Western General Professional Meeting

The Vancouver Branch of The Institute is to be congratulated on the success of the Western General Professional Meeting of 1928, which was held under their auspices on June 7th, 8th and 9th. The city of Vancouver forms an ideal location for such a meeting, and in framing its programme the local Committee took full advantage of the natural beauties of the neighbourhood and the opportunities for excursions and social events.

The chairman of the branch, W. Brand Young, A.M.E.I.C., presided at the opening session on the 7th, and the proceedings commenced with an address by His Worship the Mayor of Vancouver, who extended a cordial welcome to the city. The president of The Institute, Julian C. Smith, LL.D., M.E.I.C., and the vice-president from the Western Zone, S. G. Porter, M.E.I.C., of Calgary, were unavoidably prevented from attending, and the chairman, in opening the meeting, presented letters of regret from these and other officers of The Institute.

At the commencement of the first technical session, E. A. Cleveland, M.E.I.C., took the chair, and introduced E. E. Carpenter, M.E.I.C., who presented his paper on "Some Engineering Aspects of the Bridge River Project." In doing so, Mr. Carpenter pointed out that when ultimately developed, this would be one of the largest single sources of power in North America, with an effective head of 1,200 feet, at which head one second-foot would give 80-kw. The storage and regulation facilities to be developed would permit the control of the river flow to a minimum of 3,700 second-feet. The two main storage basins would be sufficient to raise the minimum discharge to the above-named figure from the existing minimum of 200 second-feet, which is occasionally experienced in very cold weather. A maximum flood discharge of 40,000 second-feet had been allowed for. The watershed area of about 1,500 square miles had a precipitation of only 18 or 20 inches per year, for it lay in a semi-arid area, and the flow of the Bridge river is largely derived from melting snow.

Mr. Carpenter described the characteristics of the dam site, the bearing tests which had been carried out, the provision against silting, and the arrangements which had been made for the construction of the tunnel now in progress. Preliminary data were given as to the transmission line and the methods to be adopted for its erection in such rugged and mountainous country. An active discussion followed, in which Messrs. Yuill, Webb, MacDonald, Muckleston, Brock, Foreman and others took part. This paper, which appears in this issue of The Engineering Journal, was of special interest, as it is unusual for an engineer to present for criticism and suggestions the details of a scheme, a large portion of which has still to be designed in detail.

The session was followed by a luncheon for members and ladies, at which a very attractive programme of music was given, and in the afternoon members were taken for a cruise on the harbour, by the courtesy of the Vancouver Harbour Commissioners, and through the kindness of G. E. Herrmann, AFFIL.E.I.C., were able to visit the creosoting works of the Vancouver Creosoting Company at North Vancouver, where Douglas fir ties and structural timber were being subjected to preservative methods. The ladies of the party were entertained at tea at the Royal Vancouver Yacht Club at Jericho Beach.

The technical sessions were continued in the evening, under the chairmanship of H. B. Muckleston, M.E.I.C., when it was announced that, owing to the illness of F. W. Groves, M.E.I.C., the paper announced on "Irrigation in Mountainous Country" could not be given. His place was taken at very short notice by K. W. Hicks, S.E.I.C., who read a paper on "The Preservation of Douglas Fir by Pressure Creosoting." After touching on the history of wood preservation, Mr. Hicks pointed out that the ten creosoting plants on the Pacific coast were now treating some 300,000,000 cubic feet per year, and a modern plant such as that visited by the members at North Vancouver was able to treat ties at the rate of seven per minute. He stated that the process there carried out did not materially reduce the strength of the timber as compared with air-seasoned lumber, and that structural timbers and ties should be treated after fabrication and boring, since untreated surfaces and holes in the sticks were always sources of incipient decay. Proper creosote treatment had been found to give practically complete security against the attacks of the teredo and other marine organisms, which are so destructive to timber in sea water on the Pacific coast. He gave illustrations of a number of structures where creosoted material, treated before fabrication, had been used successfully for scows, cribs, bridge timbers and other structural purposes, and had given excel-

View of Vancouver Harbour Taken from Vancouver Hotel.

lent results as regards durability. An active discussion followed, in which the difficulties in treating pipe staves, and the methods of avoiding changes of form and dimensions due to creosote treatment were discussed by Messrs. MacDonald, Yuill, Archibald and others.

The third technical session opened at 10.30 on the morning of Friday, June 8th, with H. B. Muckleston, M.E.I.C., in the chair, when Patrick Philip, M.E.I.C., deputy minister of public works, British Columbia, presented his paper upon " The Cariboo Road." This was profusely illustrated by lantern slides and dealt with the history and construction of this important highway project, commencing in the year 1857 when the influx of miners to the goldfields of the Cariboo began. This paper appears in this issue of The Engineering Journal, and was greatly appreciated as forming a complete record of the history and construction of this main route into the interior of British Columbia. On the conclusion of Mr. Philips' paper, the general secretary gave an informal talk on Institute affairs, outlining the problems before The Institute at the present time and the plans for future development.

In the afternoon, members attending the meeting visited the industrial plant of the Canadian Western Lumber Company, (Fraser Mills), New Westminster, this visit being rendered possible by the courtesy of Mr. J. D. McCormack, vice-president of the company. Those who had never had the opportunity of observing the operation of a large modern wood-working plant were greatly impressed with the great variety of work performed, the efficiency of the modern machinery employed, and the large scale upon which the manufacture is conducted.

In the evening, the ladies were entertained at dinner and at a theatre party, while The Institute Dinner took place at the Hotel Vancouver, over which W. Brand Young, A.M.E.I.C., chairman of the Vancouver Branch, presided. The principal speakers were Mr. Harold Brown, manager of the Union Steamship Company of British Columbia, Past-President George A. Walkem, M.E.I.C., His Worship the Mayor of Vancouver, Dean R. W. Brock, M.E.I.C., of the University of British Columbia, and Mr. Frank Sawford, past-president of the Association of Professional Engineers of British Columbia. A delightful musical programme was

Western General Professional Meeting

Vancouver, B.C., June 7th to 9th, 1928

1. J. F. Frew, M.E.I.C.
2. F. L. Macpherson, M.E.I.C.
3. Mrs. Kirby
4. Mrs. Yuill
5. Mrs. Anderson
6. Mrs. Pilkington
7. Mrs. Hodgson
8. Mrs. Wootton
9. Mrs. Cockrill
10. Mrs. Brakenridge
11. Mrs. Grant
12. Mrs. Walkem
13. W. Brand Young, A.M.E.I.C.
14. Mrs. Melville
15. Mrs. Lamarque
16. Mrs. Wheatley
17. Major H. B. Hicks, A.M.E.I.C.
18. Frank Lee, M.E.I.C.
19. E. A. Jamieson, A.M.E.I.C.
20. C. E. Cartwright, M.E.I.C.
21. A. W. G. Clark, A.M.E.I.C.
22. E. A. Cleveland, M.E.I.C.
23. Mrs. Brydone-Jack
24. J. A. Walker, A.M.E.I.C.
25. Mrs. Muirhead
26. C. Brakenridge, M.E.I.C.
27. Wm. Anderson, M.E.I.C.
28. H. W. Frith, M.E.I.C.
29. A. J. Pilkington
30. Mrs. Price
31. Miss Muckleston
32. A. S. Wootton, M.E.I.C.
33. J. P. Hodgson, M.E.I.C.
34. Geo. A. Walkem, M.E.I.C.
35. J. McHugh, A.M.E.I.C.
36. C. E. Webb, A.M.E.I.C.
37. E. C. W. Lamarque
38. S. Hodgson, A.M.E.I.C.
39. J. J. Earl
40. W. H. Powell, M.E.I.C.
41. P. J. Jennings, M.E.I.C.
42. A. C. R. Yuill, M.E.I.C.
43. Miles P. Cotton, M.E.I.C.
44. E. E. Brydone-Jack, M.E.I.C.
45. S. F. Ricketts, A.M.E.I.C.
46. Mrs. Ricketts
47. Mrs. MacPherson
48. A. E. Foreman, M.E.I.C.
49. A. C. Eddy, M.E.I.C.
50. F. P. V. Cowley, A.M.E.I.C.
51. J. N. Finlayson, M.E.I.C.
52. P. H. Buchan, A.M.E.I.C.
53. T. E. Price, A.M.E.I.C.
54. J. R. Grant, M.E.I.C.
55. A. D. Fisken, A.M.E.I.C.
56. F. W. Anderson, M.E.I.C.
57. E. E. Carpenter, M.E.I.C.
58. R. J. Durley, M.E.I.C.
59. E. A. Wheatley, A.M.E.I.C.
60. R. Martin
61. F. R. Smith, A.M.E.I.C.
62. J. C. MacDonald, M.E.I.C.

rendered during the dinner, which was admitted to be one of the most successful functions of the meeting.

At 10 a.m. on Saturday, June 9th, the fourth technical session commenced, with A. C. R. Yuill, M.E.I.C., in the chair, when P. Z. Caverhill, chief forester, Department of Lands of the province of British Columbia, presented his paper on "Forest Conservation in the West." This paper, which has already been published in the June issue of The Engineering Journal, gave rise to an active discussion, dealing with such important topics as the reforestation of areas damaged by high-lead logging, the expense and possible advantage of artificial planting as compared with natural reproduction, both in the case of Douglas fir and spruce, the experiments which are being made in studying the possibilities of natural re-seeding as compared with replanting, the advantages of selective logging, the possibilities of reforestation by leaving seed trees, the disposition of slash, and other important matters. In the author's opinion, under the conditions now existing in British Columbia, the funds available could be more advantageously spent in giving adequate fire protection than in embarking on extensive schemes of artificial reforestation.

Mr. Caverhill's paper was followed by a paper on "The Study of Transmission Line Power Arcs," by Paul Ackerman, A.M.E.I.C., which was presented by the chairman and was illustrated by a large number of slides and a moving picture film giving a clear idea of the methods adopted in carrying out the experiments described by Mr. Ackerman. This paper has already been published in the May issue of The Engineering Journal, and was recognized as being of outstanding interest, particularly to those concerned in the present development of long-distance power transmission in British Columbia.

After an informal luncheon, the members and ladies were taken on a motor drive round the city and district, stopping at the University of British Columbia, Point Grey, where they were received by Dean Brock and hospitably entertained at tea.

The meeting closed on Saturday evening with a dinner and dance held at Grouse Mountain Chalet, 3,800 feet above the sea, to which point the members travelled in a procession of automobiles, most of which succeeded in negotiating the eight miles of continuous uphill grade without any halt for water or other refreshment on the way.

Few cities are able to show the visitor a view of the extent and beauty of that obtained from Grouse mountain, and this delightful dinner-dance and drive, favoured by splendid weather, formed a fitting climax to the many enjoyable functions of this successful meeting.

Presentation of Plummer Medals

The presentation of the Plummer Medals, which, as announced at the Annual General Meeting in Montreal last February, were awarded to Professor J. W. Shipley and Mr. C. F. Goodeve, was the feature of an executive meeting of the Winnipeg Branch held in the St. Charles Hotel on June 1st, 1928.

In the absence of Mr. Goodeve, who is in London, his father, the Rev. F. W. Goodeve, received the medal for his son.

The presentation was made by R. J. Durley, M.E.I.C., the General Secretary of The Institute, and Professor J. N. Finlayson, M.E.I.C., the chairman of the Winnipeg Branch, presided at the meeting.

OBITUARY

Major Wallace C. Trotter, Affiliate E.I.C.

It is with regret that we record the death of Major Wallace Cuthbert Trotter, Affil.E.I.C., president and managing director of the Standard Clay Products, Limited, St. Johns, Que., and New Glasgow, N.S., which occurred at his home in St. Johns, Que., on June 11th, 1928.

The late Major Trotter was born at Sydney, Gloucestershire, England, on March 26th, 1851. He served with the Montreal Garrison Artillery in the Northwest Rebellion in 1885, and commanded No. 1 Battery as Captain. He was afterwards retired with the rank of Major, and was the holder of the officers' Long Service Medal.

Major Trotter was the founder of the company of which he was president over a period of forty-five years, and was actively engaged in the business of his company up to the time of his death.

On May 12th, 1887, shortly before the incorporation of the Canadian Society of Civil Engineers, he was admitted to the Society as an Associate, which grade was later changed to Affiliate, and throughout the long period of his membership he has been keenly interested in the development of The Institute.

The late Major Trotter had a host of friends amongst engineers throughout Canada by whom the news of his death will be learned with sincere regret. Lt.-Col. H. L. Trotter, D.S.O., M.E.I.C., of the firm of Trotter and Cate, consulting engineers, Montreal, is a son of the late Major Trotter.

View of Vancouver by Night from Grouse Mountain.

PERSONALS

Martin Wolff, A.M.E.I.C., who for the past two years has been on the engineering staff of the Gatineau Power Company at Ottawa, has resigned his position and is at present located in Montreal.

David Humphreys, A.M.E.I.C., hydro-electric engineer and superintendent of power station with the Newfoundland Power and Paper Company at Deer Lake, Newfoundland, and later with the International Paper Company of Newfoundland, has resigned his position.

Charles A. Wakeham, S.E.I.C., of Saint John, N.B., who graduated with the degree of B.Sc. in electrical engineering from the University of New Brunswick this spring, has accepted a position with the Northern Electric Company, Montreal, and is engaged on automatic telephone work.

James B. Nelson, A.M.E.I.C., of McGregor-McIntyre Structural Steel, Limited, Toronto, has been promoted by the company and is now in charge of draughting in the ornamental iron department. Mr. Nelson has been with this company for the past three years, prior to which he was at various times with the A. B. Ormsby Company, Limited, of Toronto; the Standard Steel Construction Company, Limited, of Welland; Canadian Allis-Chalmers Limited, Toronto, and the Trussed Concrete Steel Company, Limited.

W. S. E. Morrison, A.M.E.I.C., who for some time past has been located at the R.C.N. Barracks at Esquimalt, B.C., has been promoted to Lieutenant-Commander (E) and appointed to the new Canadian destroyer *H.M.S.C. Champlain* on the east coast of Canada. In a recent letter from Lieutenant-Commander Morrison he advised Headquarters that it is expected that the *H.M.S.C. Champlain* will arrive in Montreal some time in July, and he extends an invitation to all members of The Institute in Montreal at that time to visit the destroyer.

Viggo Anderson, Jr.E.I.C., formerly on the engineering staff of the Dominion Bridge Company at Lachine, Quebec, has accepted a position with the Southern Canada Power Company. Mr. Anderson is a graduate of the Royal Technical College of Copenhagen, Denmark, in 1923. He came to America in 1924 and spent two years in the United States on engineering work. He returned to Denmark in June 1926. In May 1927 he came to Canada, and has been employed with the Dominion Bridge Company since that time.

A. H. Pattenden, M.E.I.C., has recently resigned from the position of electrical engineer of the eastern and western plants of the Dominion Rubber Company, Limited, and has accepted the appointment of industrial engineer of the new business department of the Montreal, Light, Heat and Power Consolidated at Montreal. Mr. Pattenden joined the Dominion Rubber Company in 1918, prior to which he was engaged for a short time on research work and previously was with the Canadian Pacific Railway in charge of the electrical department at the Angus Shops.

C. Oldrieve Thomas, A.M.E.I.C., formerly with the designing and estimating department of Canadian Vickers Limited, has accepted a position with the Dominion Bridge Company. Mr. Thomas is a native of the Old Country, and since coming to America in 1904 he has had extensive experience in structural steel and other engineering work, having been connected at various times with the Canadian Westinghouse Company, Limited, the Algoma Steel Corporation, the Canada Car and Foundry Company, Fraser and Chalmers of Canada, the Montreal Light, Heat and Power Consolidated, and the Dominion Bridge Company.

G. W. Waddington, A.M.E.I.C., is located at Creighton Mine, Ontario, with the International Nickel Company. Mr. Waddington was formerly mining engineer with the Iron Mask Mine at Kamloops, B.C. He received his engineering education at the University of British Columbia, from which he graduated with the degree of B.A.Sc. in 1927, although prior to his graduation he had been engaged on engineering work for some years, having been on survey work since 1913. In 1920 he was appointed engineer for the Middlesboro Collieries Limited, at Merritt, B.C.

J. E. Thicke, S.E.I.C., of New Liskeard, Ont., is located in Pittsfield, Mass., where he is taking the students' test course with the General Electric Company. Mr. Thicke graduated with the degree of B.Sc. in electrical engineering from Queen's University this year. During the summer months of his university course he was engaged on steel transmission line construction; the first summer as chainman, the next year as assistant to the resident engineer and finally as assistant to the resident engineer and instrumentman on the construction of fourteen miles of railroad for the Abitibi Transportation and Navigation Company, Iroquois Falls, Ont.

J. P. Watson, A.M.E.I.C., formerly of the Dominion Bridge Company, Limited, is now with the Canadian Mead-Morrison Company, Limited, in Montreal. Mr. Watson was for a short time with the engineering department of the Imperial Tobacco Company, Montreal, which he left in September 1920 to accept a position in the engineering department of the Wayagamack Pulp and Paper Company, at Three Rivers. In August 1921 he was appointed to the staff of the mechanical department of the Canadian Pacific Railway, where he remained until the early part of 1924, when he went with the Dominion Bridge Company, Limited.

George F. MacRae, S.E.I.C., who has accepted a position in the underwriting department of Johnson and Ward of Montreal, in connection with which an announcement appeared in the May 1928 issue of the Journal, was formerly sales manager for the Combustion Engineering Corporation Limited for the Maritime provinces and Quebec. As noted in the previous announcement, Mr. MacRae had previously been connected with the Bell Telephone Company, from which he resigned in March 1926 to accept a position on engineering sales with the Combustion Engineering Corporation. His work in his new position will be in connection with the engineering end of financial reconstruction of industrial companies.

V. R. Currie, Jr.E.I.C., has joined the staff of the Abitibi Fibre Company, Limited, at Smooth Rock Falls, Ont. Mr. Currie is a graduate of Queen's University, having received his degree of B.Sc. in civil engineering in 1923. Following graduation Mr. Currie was engaged on land subdivision work in British Columbia and in the same year became connected with the Spanish River Pulp and Paper Company engaged on hydro-electric surveys and dam construction. In 1924 he was offered a position with the Alabama Power Company, which he accepted. His headquarters were at Birmingham, Ala., and for the first year he was engaged on general survey work. From November 1926 until recently he was resident engineer for the same company on investigations and foundations.

William A. Gilmour, A.M.E.I.C., has joined the staff of the Foundation Company of Canada Limited, and is located at Liverpool, N.S., in connection with the company's work on the Mersey river. Mr. Gilmour is a graduate of Edinburgh University at which he received the degrees of M.A.

and B.Sc. in 1911. Immediately after he graduated, he spent a year in Scotland on engineering work. He came to Canada in 1912 where he secured a position with McKenzie, Mann and Company on the construction of the Mount Royal tunnel. He remained with this company until 1917, being engaged on survey work and later as chief inspector on the construction of the tunnel. In 1917 he was appointed to the engineering staff of the Montreal Water and Power Company, later being appointed assistant superintendent in charge of construction with supervision of the pumping stations of the company. He remained in this position until his recent appointment.

A. S. Runciman, a.m.e.i.c., Receives Degree of E.E.

A. S. Runciman, a.m.e.i.c., maintenance engineer of lines with the Shawinigan Water and Power Company, Montreal, received the degree of E.E. at the recent convocation of the University of Toronto. Mr. Runciman was born at Goderich, Ont., in 1890 and graduated from the school of Applied Science, University of Toronto, in 1911. Following graduation he was engaged with the Calgary Power Company at Horse Shoe Falls, and in the following year was appointed assistant superintendent of the light and power department of the city of Prince Albert, where he remained until the end of 1914. During the following year he was with the Canadian Westinghouse Company, located at Grand'Mere, Que., in connection with the construction of the Laurentide Power Company's plant. The next year he joined the staff of the Marconi Wireless Telegraph Company of Canada and was located at the Transatlantic receiving station at Louisburg until July, when he was transferred to the company's plant at Glace Bay, N.S. The following year he was made assistant manager and in 1918 he was transferred to the company's factory, where he was engaged on experimental work. Mr. Runciman joined the Shawinigan Company in May 1920 and has been with this company since that date.

G. B. Mitchell, m.e.i.c., Transferred to Colombia, S.A.

G. B. Mitchell, m.e.i.c., western manager of the Peter Lyall and Sons Construction Company, Victoria, B.C., has been transferred by the company to Bogota, Colombia, S.A. Mr. Mitchell graduated from the Colorado School of Mines in civil engineering in 1896. In 1897 he was associated with Messrs. William Cramp and Son of Philadelphia, Pa., as draughtsman and assistant to the chief engineer. The following year he became assistant engineer with the United States Deep Waterway Commission and was located at Ogdensburg and Detroit. In August 1899 he was located at Nicaragua as assistant engineer with the Isthmian Canal Commission. One year later he became office engineer with the same commission at Washington. In March 1902 he entered private practice as a member of the firm, A. J. Norris and Company, Amsterdam, N.Y., but in September of the same year he accepted a position with the Canadian Pacific Railway Company as assistant engineer at the Angus Shops, Montreal. Two years later he was transferred by the company and placed in charge as assistant engineer of the mechanical work of the company's engineering department at Montreal. In December 1905 he accepted the position of superintendent of buildings with the New York, New Haven and Hartford Railroad at New Haven, Conn. In January 1907 he became associated with the C. E. Deakin Limited, general contractors, as vice-president of the company, with which he remained until September 1916 when he entered private practice as general contractor with headquarters in Montreal. In November 1917 he joined the staff of the Foundation Company of New York, where he was in charge of various works for the company in different parts of the United States and South America until December 1922. In May 1923 he was appointed western manager of the Peter Lyall and Sons Construction Company, with which he has remained ever since.

K. H. Smith, m.e.i.c., Joins Investment Bankers

K. H. Smith, m.e.i.c., who has joined the firm of Harley, Milner and Company, Toronto, investment bankers, graduated from the University of Toronto, Faculty of Arts, Victoria College, in 1908, from which he received the degree of B.A., and the Faculty of Applied Science in 1911.

Mr. Smith was attached to the Dominion Water Power and Reclamation Service, Department of the Interior, Canada, continuously from May 1911 to July 1926, in various capacities from junior field engineer to district chief engineer. During this time he was engaged in all phases of power development from preliminary field and office surveys and investigations to construction and operation. While still connected with the Federal Department he was chief engineer of the Nova Scotia Power Commission from its inception in August 1919 to October 1925, and was responsible for the conception, organization, construction and operation of an extensive electrical generating, transmission and distributing system in the province of Nova Scotia. His work in this connection included not only the technical matters involved, but the draughting of an enabling and administrative legislation.

K. H. SMITH, M.E.I.C.

He was consulting engineer to the New Brunswick Electric Power Commission in connection with water power legislation and the construction of transmission lines from Bathurst to Newcastle and Saint John to Moncton, these being the first long distance high voltage lines in the Maritime Provinces.

In the winter of 1925 Mr. Smith was employed by the Royal Securities Corporation of Montreal to investigate and report upon public utility projects in South America. In December of the same year he was appointed investigating engineer with the Montreal Engineering Company, Limited, the engineering department of the Royal Securities Corporation, Limited, and at the same time was retained in a consulting capacity by the Dominion Water Power and Reclamation Service. He resigned from the

Montreal Engineering Company, Limited, in April 1928, to join the firm with which he is now associated.

While with the Federal Government Mr. Smith was charged with the construction and assembling of the Canadian water power exhibit for the Panama-Pacific Exposition, at San Francisco, in 1915, and during the World Power Conference in London in 1924 he was an official delegate to the Conference.

J. P. McRae, A.M.E.I.C., Appointed General Manager of Sawyer-Massey Company

J. P. McRae, A.M.E.I.C., has resigned his position as manager of the engineering and water works department of the General Supply Company of Canada, to accept the appointment of general manager of the Sawyer-Massey Company, of Hamilton, Ont.

Mr. McRae is a graduate of McGill University, from which he received the degree of B.Sc. in mechanical engineering in 1912. His first work after graduating was in the office of J. B. McRae, M.E.I.C., consulting engineer, Ottawa, where he remained until February 1913, when he went to Moose Jaw, Saskatchewan, on the erection and operation of a Diesel engine unit for the Moose Jaw Street Railway.

He returned to Ottawa in the latter part of the year and was again engaged with J. B. McRae, M.E.I.C., on the design and construction of the High Falls dam on the Livre river. Other work on which he was engaged at this time was the proposed development at Waddington; the power development of the Electric Reduction Company at Buckingham, Que.; the Renfrew Municipal Power Development; the power development for the town of Orillia on Swift rapids on the Severn river, and a number of other investigations of proposed hydro-electric developments. Mr. McRae was also responsible for the reinforced concrete work on the bridge carrying the steel mains for the water supply of the city of Ottawa from Lemieux Island in the Ottawa river to the mainland.

On August 4th, 1915, Mr. McRae enlisted for overseas service, and served with distinction during the Great War. In February 1919 he returned to Canada and in April of that year was appointed to the staff of the Hydro-Electric Power Commission of Ontario, and was engaged on inspection of the Chippawa power units in Cleveland, Ohio.

He returned to Toronto in 1920 as assistant service manager and shop superintendent with the agency for the Cole and Oldsmobile automobiles. The following year he was shop superintendent with the Dodge Brothers' Service in Toronto. He was later technical adviser to the Purchasing Commission of Toronto on the purchase of motor equipment. In July 1923 he accepted the position of manager of the engineering and water works department of the General Supply Company of Canada at Ottawa, and has remained with this company since that date.

ELECTIONS AND TRANSFERS

At the meeting of Council held on June 15th, 1928, the following elections and transfers were effected:—

Member

BUNCKE, Harry Jacob, C.E., (Columbia Univ.), M.S., (Univ. of Maine), chief engineer, Abitibi Power & Paper Company, Ltd., Iroquois Falls, Ont.

Associate Members

BARNES, Frank Harvey, B.Sc., (McGill Univ.), designing engr. and asst. mgr., Northern Foundry & Machine Co., Sault Ste Marie, Ont.

BOURASSA, L. Wilfrid, B.A.Sc., C.E., (Ecole Polytech.), town manager, La Tuque, Que.

EYRE, Robert Thornton, plan examiner, city architect's dept., Toronto, Ont.

FLEISCHMANN, Albert Charles, technical engr., Sewers Commn., Technical Service, City of Montreal.

JACKSON, William, inspecting engr. for three prairie provinces, Dept. of Rlys. and Canals, Edmonton, Alta.

MacLEAN, Charles Salmon, B.A., B.Sc., (Univ. of N.B.), gen. mech'l. engrg., T. McAvity & Sons, Ltd., Saint John, N.B.

MERRIMAN, Horace Owen, B.A.Sc., (Univ. of Toronto), inductive interference engr., under the director of radio service, Dept. of Marine and Fisheries, Ottawa, Ont.

PAPINEAU, Gustave Joseph, B.A.Sc., C.E., (Ecole Polytech.), municipal engrg., Technical Service, City of Montreal.

Junior

DREW, Alfred William, B.Sc., (Univ. of Alta.), office asst. and dftsman. with divn. engr. of constrn., C.N.R., Edmonton, Alta.

Transferred from the Class of Associate Member to that of Member

BEGG, James McGee, B.Sc., (Glasgow Univ.), chief engr., Vancouver and Districts Joint Sewerage and Drainage Board, Vancouver, B.C.

GAMBLE, Clarke William, B.Sc., (McGill Univ.), res. engr. on bridge over Mississippi river at Cairo, for Waddell & Hardesty, Cairo, Ill.

JONES, William Henry, B.Sc., (Univ. of Man.), asst. mgr. i/c of production, Medway Oil and Storage Co., Isle of Grain, England.

LEES, Thomas, Associate, (Royal Tech. Coll., Glasgow), dist. engr., C.P.R., Calgary, Alta.

PATTENDEN, Albert Henry, elect'l engr., eastern and western plants, Can. Cons. Rubber Co., Montreal, Que.

PROCTOR, Edward Moore, B.A.Sc., (Univ. of Toronto), president, James, Proctor & Redfern, Ltd., Toronto, Ont.

Transferred from the Class of Junior to that of Associate Member

FRASER, Isaac Matheson, B.Sc., (McGill Univ.), asst. professor, mech'l engr., University of Saskatchewan, Saskatoon, Sask.

JOB, Stanley Robert, designing engr. and dftsman., L. & P. Manufacturing Company, Niagara Falls, Ont.

KEITH, William Hargreave, B.A.Sc., (Univ. of Toronto), dist. engr., municipal roads, Dept. of Public Highways, Ontario, Islington, Ont.

PAINCHAUD, Francois Benoit, B.A.Sc., (Ecole Polytech.), struct'l engr., Dept. of Public Works, Quebec, Beauport, Que.

PLUMMER, William Elfric, asst. engr., Welland Ship Canal, Humberstone, Ont.

Transferred from the Class of Student to that of Junior

VICKERSON, George Locker, B.Sc., (McGill Univ.), estimator and asst. foreman, G. R. Locker Co., Montreal, Que.

Students Admitted

KLEMPNER, Harold, undergraduate Univ. of Man., at present junior dftsman., Dominion Water Power and Reclamation Service, Winnipeg, Man.

WELSFORD, Jack A., Engrg. Cert., Acadia Univ., senior student, N.S. Technical College, Halifax, N.S.

Outstanding
in the Course of

The Royal York Hotel

The Royal York Hotel of the Canadian Pacific Railway Company, which is being erected on Front street in Toronto, immediately opposite the Union Station, will provide, in addition to the public spaces, one thousand and ten bedrooms of varying sizes and grouping. Special provision has been made in the design for the accommodation of conventions and other private and public functions, which includes the following public rooms: Main dining room, 8,270 square feet; five private dining rooms, varying in size from 700 to 2,208 square feet. The approximate aggregate accommodation of these rooms is, for dining, 2,500 persons; for banquets, 4,300 persons; for conventions, 6,400 persons. The building will occupy 10,000,000 cubic feet of space, and the exterior will be entirely in stone.

The work is being carried on under the direction of J. M. R. Fairbairn, D.SC., M.E.I.C., chief engineer of the Canadian Pacific Railway Company, with J. W. Orrock, M.E.I.C., of the Canadian Pacific Railway Company, as engineer of buildings for the company, and H. S. Bare, A.M.E.I.C., assistant engineer of the Canadian Pacific Railway Company, representing the architects. The general contractors are Messrs. Anglin-Norcross, Limited, of Montreal and Toronto, and the general steel contractors, the Dominion Bridge Company of Montreal. The architects are Messrs. Ross and MacDonald, of Montreal, with Messrs. Sproatt and Rolph, of Toronto, as associate architects.

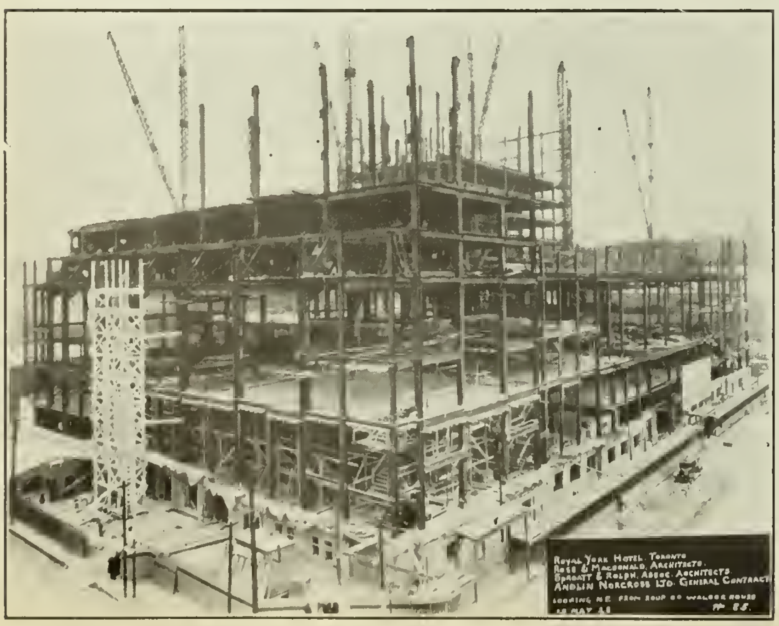
The Head Office of The

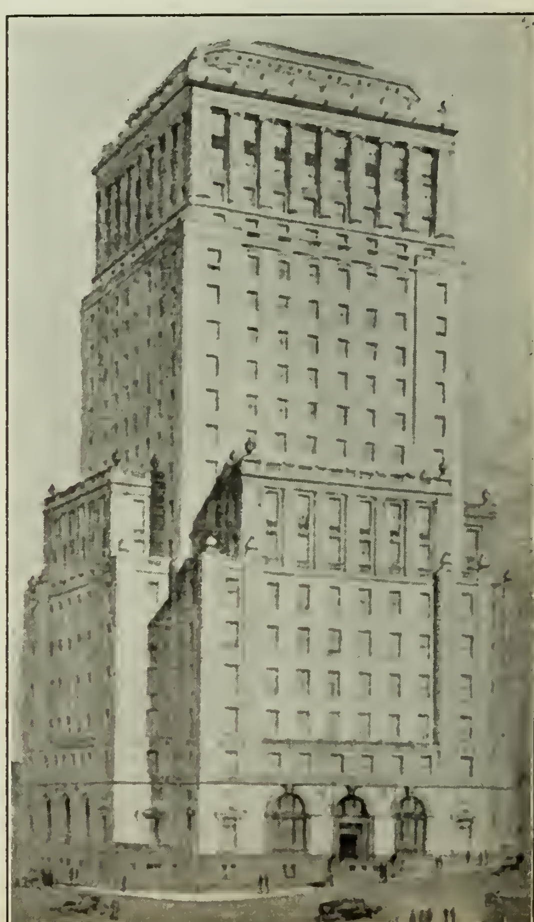
The new Bell Telephone Building at present under construction on Beaver Hall Hill in Montreal, at the northwest corner of the intersection with Lagauchetiere street, will comprise twenty storeys, exclusive of penthouse, machinery room, basement and sub-basement. The height will be approximately 315 feet above the street level, and the foundations were taken to rock. The building will be faced with limestone on all sides and will comprise approximately 5,000,000 cubic feet of space, developing 193,000 square feet of net floor area.

(*Above*) Royal York Hotel of The Canadian Pacific Railway Company, in Toronto, Ont. Sketch of building as it will appear when completed.

(*Below*) Progress photograph of Royal York Hotel taken on May 10th, 1928.

(*Right*) Head Office Building of The Bell Telephone Company of Canada, in Montreal, Que. Sketch of building as it will appear when completed.





Buildings

Construction

The Sun Life Building

The head office building of the Sun Life Assurance Company of Canada, which is at present under construction, is located opposite to Dominion square in Montreal and occupies an area 217 feet wide by 430 feet long, facing on Metcalfe, Dorchester and Mansfield streets. The existing head office building was so designed as to permit of its forming a part of the larger building which is now being constructed.

The completed building, shown on this page, is twenty-one storeys in height and has a total floor area of 1,120,000 square feet exclusive of the basements.

It will comprise approximately 22,000,000 cubic feet of space, and the building will be entirely faced with Canadian grey granite.

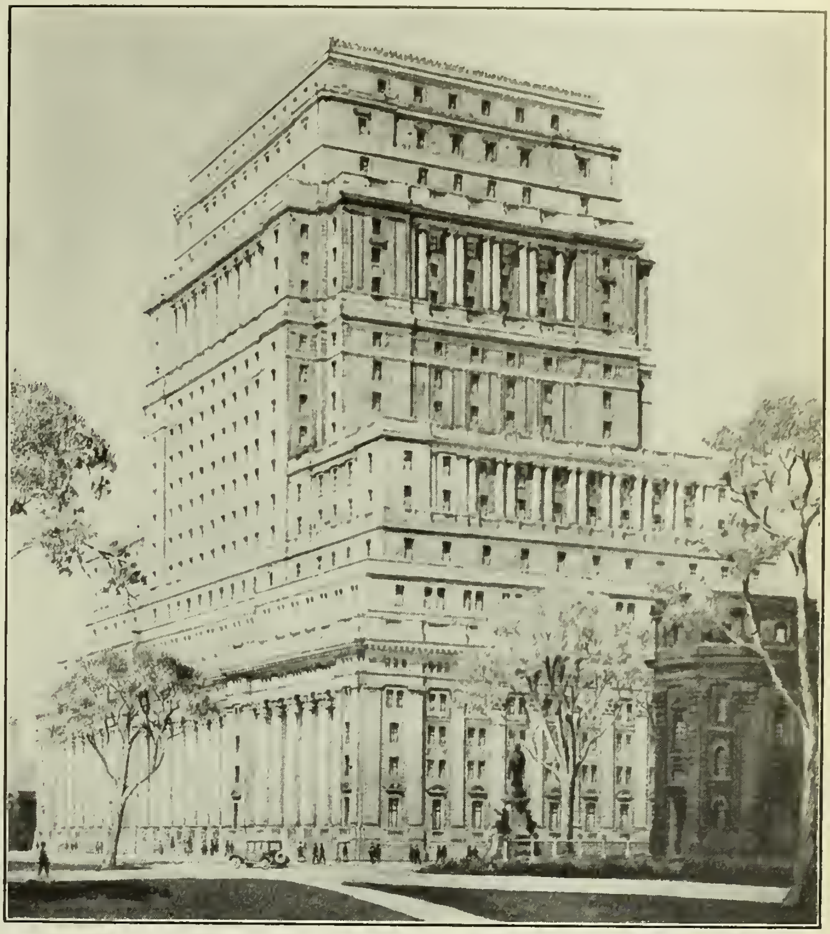
The present construction programme contemplates the completing of the building up to the eighth storey over the entire site, the easterly section of which is at present under construction, and it is intended that the work on the westerly section will be commenced during the coming winter. The steel for the entire structure, however, is now being prepared.

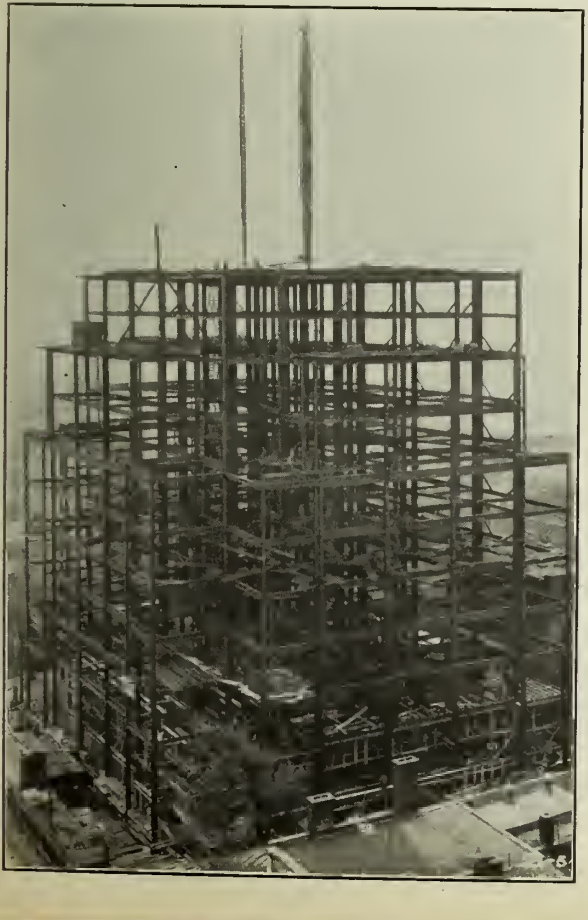
The construction of the building is in charge of A. J. C. Payne, staff architect of the Sun Life Assurance Company, and the architects are Messrs. Darling and Pearson, of Toronto, and the general contractors are Messrs. Cook and Leitch of Montreal. The structural engineers are Messrs. Harkness, Loudon and Hertzberg, of Toronto, and the mechanical engineer is E. A. Ryan, M.E.I.C. The Dominion Bridge Company are supplying the steel.

Bell Telephone Company

The building will house the entire headquarters staff of the company now located in Montreal.

The chief engineer is R. V. Macaulay, M.E.I.C., of the Bell Telephone Company, and the engineer representing the Telephone Company and the architects is T. T. Rutherford. The architects are Messrs. Barott and Blackader of Montreal, and the general contractors are the George A. Fuller Company of Canada, Limited. The structural steel is being prepared by the Dominion Bridge Company.

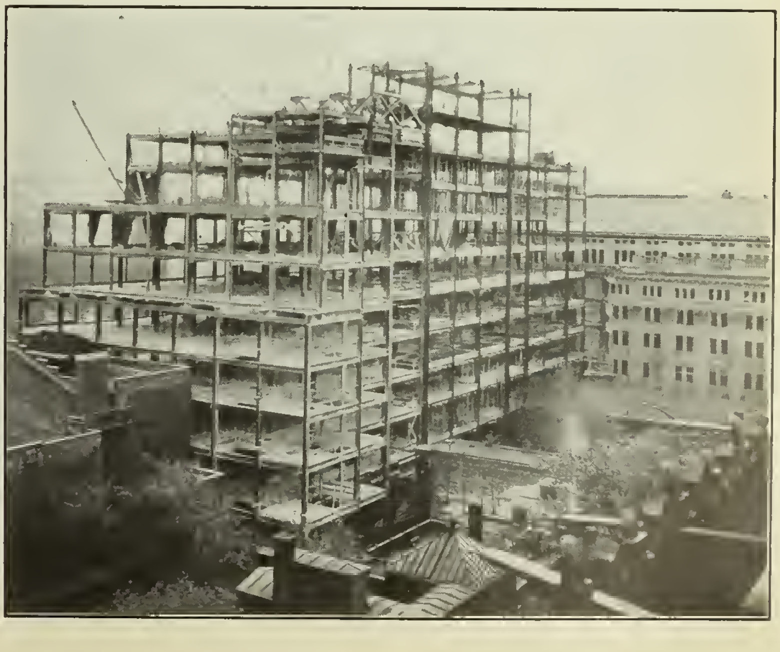




(*Above*) **Head Office Building of the Sun Life Assurance Company of Canada, in Montreal, Que. Sketch of building as it will appear when completed.**

(*Below*) **Progress photograph of Sun Life Building taken on June 1st, 1928.**

(*Left*) **Progress photograph of Bell Telephone Building taken on May 21st, 1928.**



BOOK REVIEWS

The A. C. Commutator Motor

By C. W. Olliver, D. Van Nostrand Co., New York, 1927, Buckram, 6 x 9½ in., 281 pp., diagrs., figs., plates, $7.50.

The author was educated at Eton and in Paris, completing his education in England first and finally in Paris, where, and this is the important part as regards the book, he became the pupil of Marius Latour at the Ecole Supérieure d'Electricité, Paris. Practical engineering experience was obtained first at the Thomson-Houston Company, Paris, and then as a consulting engineer in his own name. Returning to England, the author was first on the editorial staff of the "Power Engineer" and "Colliery Engineering" and is at present on the engineering staff of the London office of the Ateliers de Constructions Electriques de Charleroi, better known as the A.C.E.C., one of the largest of continental electrical manufacturers.

This is the author's second book, the first published in France and in the French language being a detailed study of the potentialities of electrical development and a power station on the Cunene river in Angola, South West Africa.

The author has written a considerable number of technical articles on electrical subjects for various technical papers such as "Power Engineer," "Colliery Engineering," "Railway Engineer," "Marine Engineer," etc., and is regular abstractor for "Science Abstracts."

The book is a plea for the use of the single-phase a.c. commutator type motor, including very large sizes.

The first five chapters deal with theory and the last four with practical applications.

Under theory he treats of commutation, of the analysis of single-phase and repulsion motors, such as the Latour motor, the Deri motor, the Wagner motor, the Schuler motor and the Fynn-Weichsel motor. Polyphase commutator motors are illustrated by the Brown-Boveri type.

The fifth chapter deals with power factor correction by means of induction-commutator type motors. Any rotary machine provided with a commutator or any induction motor used in conjunction with a commutator machine can be made to feed back wattless energy to the mains and thus compensate for low power factor.

Under "Practical Applications" he describes crane and hoisting appliances. Then follows a chapter on single-phase traction. Brown-Boveri machines are illustrated.

One picture shows a 2,960-h.p., 350-v., single-phase commutator type motor used on an express locomotive, German State Railways. The trolley voltage is 15,000. A speed of nearly 70 miles per hour can be obtained. Auxiliary ventilating fans are mounted on the frame. Control is obtained by shifting the brushes.

A description is also given of a single-phase locomotive characterized by the use of a single 3,000-h.p. motor.

Chapter eight deals with rolling mill drives and this application is chosen as typical of the advantages of large commutator machines, the more so since it introduces not only the 3-phase commutator motor as a unit, but also various combinations of induction motors and commutator machines, either in cascade on the same shaft or running as separate auxiliary units, as in the Kramer and Scherbius systems.

The last chapter deals with other applications to which the commutator type a.c. motor is suitable, such as collieries, paper mills and cetera.

The book should prove of great interest to designing engineers, as the subject matter is remarkably well presented.

W. F. McLaren, M.E.I.C.,
Chief Draughtsman,
Canadian Westinghouse Company,
Hamilton, Ont.

The Mathematics of Engineering

By Ralph E. Root, Williams & Wilkins, Baltimore, Md. Buckram, 6 x 9 in., 540 pp., figs., $7.50.

This text is rather unusual, in that it combines in one book explanations of algebraic and geometrical operations together with those of the differential and integral calculus. It is essentially a text for students and for those engineers who from time to time may have recourse to mathematical processes in which they do not possess facility for lack of continuous use.

There is in the book a slight suggestion of the formulism so prevalent in the viewpoint of students on the North American continent. The emphasis on basic operations from which other subsidiary formulæ may be developed is somewhat lacking, as indeed it seems to be in most of the present educational tendencies on this continent.

The first three chapters are devoted to developing the idea of the derivative of a function. General rules for finding derivatives of the usual functions are given.

Chapter four is a concise statement of the idea of integration together with tables of the ordinary integration formulæ.

Chapter five is devoted to a discussion of the solution of equations. It is a well put together chapter, the reason for the location of which is not clear.

Chapter six gives the various processes of integration.

Chapter seven deals with the methods of analytic geometry; and then in chapter eight the methods of the calculus are applied to derive certain information from given equations of curves.

And so the book runs from one chapter to another, not always in the logical order of the usual text, but certainly in much more interesting and exciting forms.

The following are the remaining chapters:—

Chapter IX, Application of Integration; Chapter X, Methods of Evaluating Functions; Chapter XI, Complex Quantities and Periodic Functions—this chapter is well put together; Chapter XII, Functions of Several Variables; Chapter XIII, Treatment of Empirical Data; Chapter XIV, Ordinary Differential Equations, First Order; Chapter XV, Ordinary Differential Equations, Higher Order; Chapter XVI, Ordinary Differential Equations, Several Variables; Chapter XVII, Partial Differential Equations; Chapter XVIII, Differential Equations, Additional Devices.

If one is interested in mathematical exercises, there are problems scattered throughout the book that will enable one to spend many profitable hours.

T. R. Loudon, M.E.I.C.,
Professor of Applied Mechanics,
University of Toronto.

Investigations of Fuels and Fuel Testing, 1925

Report of the Mines Branch, Ottawa, 1927, Paper, 6½ x 10 in., 184 pp., figs., tables.

This report divides itself into three main parts—the first having to do with solid fuels, the second with oils and gasolines, and the third with oil shales.

In Part I, Messrs. Gilmore, Malloch, Strong, Nicolls, Mohr and Baltzar contribute a great deal of interesting and valuable data. From the point of view of the consumer, the paper of Messrs. Malloch and Baltzar is particularly interesting. In their paper, Table V summarizes the relative value to the consumer of twenty-one possible domestic fuels available for Canadian consumption. This table is one that merits the careful study of those who wish to discuss the present fuel problem of Canada.

In view of the future importance of low temperature carbonization, Mr. Strong's paper is a valuable contribution to the literature on the subject. His present investigation is confined to the application of L.T.C. to bituminous coals. The physical examination of domestic cokes by Messrs. Gilmore, Mohr and others is of interest.

Mr. Rosewarne's researches on lubricating oils after use in motor car engines is in the nature of a progress report on a research that may prove to be most valuable.

The report is one that should be on the shelves of all those interested in the questions of fuels and fuel technology.

Lesslie R. Thomson, M.E.I.C.,
Consulting Engineer, Montreal.

CORRESPONDENCE

The Editor, Montreal, June 11th, 1928.
The Engineering Journal.
Sir:—

Referring to my paper on "Viaduct Structure at Toronto Union Station" read before the Toronto Branch on 5th of January and published in the April issue of the Journal.

In discussing the general features, I mentioned in paragraph 3, page 254, that several structures of flat slab type had been built in the United States for railway loading, but in no case, (as far as I was aware), did they exceed the Toronto structure in the size of the normal panel, viz., 26 feet by 25 feet 8¾ inches.

I am in receipt of a letter from Mr. M. Hirschthal, concrete engineer, Delaware, Lackawanna and Western Railway, pointing out that the normal panels of their Buffalo Terminal structure, (of same type), are 27 feet by 27 feet and, therefore, one foot larger than the Toronto structure.

As this point may be significant to those interested in this type of construction for railway purposes, I wish to acknowledge this correction through the Journal.

Yours very truly,
(Signed) A. R. Ketterson, A.M.E.I.C.

Recent Additions to the Library

Proceedings, Transactions, etc.

Presented by the Societies:
The American Engineering Standards Committee: Year book, 1928.

Reports, etc.

Department of Trade and Commerce, Canada:
Bureau of Statistics: Summary of Canal Traffic, 1927.
Department of the Interior, Canada:
Dominion Water Power & Reclamation Service: Water Resources Paper No. 53; Surface Water Supply of Canadian Pacific Drainage, Annual Report, 1926-27.
Department of Mines, Canada:
Mines Branch: Silica in Canada, Its Occurrence, Exploitation, and Uses.
Department of Mines, Ontario:
Annual Report, Vol. 36, Pt. 1.
Department of the Interior, United States:
Geological Survey: Water Supply Paper No. 579, Power Capacity and Production; Water Supply Paper No. 596-H, Notes on Practical Water Analysis.
Department of Commerce, United States:
Bureau of Standards: Miscell. Publ. No. 83; Standards Year Book, 1928.
Bureau of Mines: Tech. Paper No. 409, Spontaneous Heating of Coal.
Department of Scientific & Industrial Research, Great Britain:
Illumination Research: Tech. Paper No. 1, The Terminology of Illumination and Vision; No. 2, Transmission Factor of Commercial Window Glasses; No. 3, Light Distribution from Industrial Reflector Fitting No. 1; No. 4, Surface Brightness of Diffusing Glassware for Illumination; No. 5, Measurement of Mean Spherical Candle Power; No. 6, The Natural Lighting of Picture Galleries.
International Joint Commission:
Water Supply of St. Mary and Milk Rivers, 1898-1917, by R. J. Burley and B. E. Jones. In the Matter of the Measurement and Apportionment of the Waters of the St. Mary and Milk Rivers and Their Tributaries in United States and Canada; Hearing in the Matter of the Measurement and Apportionment of the Waters of the St. Mary and Milk Rivers and Their Tributaries in United States and Canada; Report on the St. Lawrence Navigation and Power Investigation; Hearings in the Matter of the Application of the St. Lawrence River Power Company; Report of the United States and Canadian Government Engineers on the Improvement of the St. Lawrence River from Montreal to Lake Ontario; St. Croix River Fishways; In the Matter of the Application of the Buffalo and Fort Erie Public Bridge Company; In the Matter of the Application of the New Brunswick Electric Power Commission; Hearings re Levels of Rainy Lake and Other Upper Water of the Lake of the Woods Watershed and Their Future Regulation and Control; In the Matter of the Application of the St. John River Power Company.
Department of Engineering Research, University of Michigan:
Machinability of Metal, by O. W. Boston; Properties of Ferrous Metals at Elevated Temperatures, by A. E. White and C. L. Clark.
Ohio State University, Columbus:
Bulletin No. 20, Thermal, Electrical and Magnetic Properties of Alloys; Bulletin No. 38, The Heat Required to Fire Ceramic Bodies; Bulletin No. 40, Dead Load Stresses in the Columns of a Tall Building.
St. Mary's Falls Canal, Michigan:
Statistical Report of Lake Commerce Passing Through Canals at Sault Ste Marie, 1927.
John Crerar Library:
Annual Report, 1927.
Kenya and Uganda Railways and Harbours:
Report of General Manager, 1927.

Second Generator Started in Paugan, Que., Power House

The second generator has been started in the new Paugan, Que., power house of Gatineau Power Company, one of the largest hydro-electric stations on the North American continent. Designed for 272,000 horsepower in eight generators of 34,000 horsepower each, the plant is located on the Gatineau river, thirty-three miles north of the city of Ottawa. Gatineau Power Company is a subsidiary of Canadian Hydro-Electric Corporation, Limited, which in turn is a subsidiary of International Paper Company.

EMPLOYMENT SERVICE BUREAU

In connection with the announcement which appeared in the June issue of The Journal regarding the reorganization of The Institute's Employment Service Bureau, all members who wish to be registered with this service are requested to secure the necessary Registration Form either from Headquarters or from their local Branch Secretary and forward it, properly completed, to Headquarters.

Situations Vacant

Electrical Designer

Electrical designer required for general wiring layout in connection with pulp and paper mill work by a firm of consulting engineers. The position is temporary at the present time but there is possibility of permanency. Reply with full particulars of experience to Box No. 3-V, The Engineering Journal.

Draughtsmen

Two draughtsmen with experience in structural and mechanical detailing are required by a mining company in northern Quebec for general industrial work. Give full details of qualifications and experience with application. Apply Box No. 4-V, The Engineering Journal.

Electrical Engineer

Industrial company in Ontario requires the services of an electrical engineer, briefly one with experience in electric railway and distribution work. Apply Box No. 7-V, The Engineering Journal.

Mechanical Draughtsmen

A manufacturing company located in Ontario has an opening for two draughtsmen with experience in mechanical work. The company intends that these men should be attached to the staff of the parent company in the United States for training prior to establishment of an engineering office in Canada. Apply with full particulars to Box No. 10-V, The Engineering Journal.

Combustion Engineer

A manufacturing company located in Ontario has an opening for a combustion engineer with experience in the design of coke and gas products. The company intends that this man should be attached to the staff of the parent company in the United States for training prior to establishment of an engineering office in Canada. Apply with full particulars to Box No. 11-V, The Engineering Journal.

Draughtsmen

A large manufacturing company requires the services of two draughtsmen with four or five years' experience. Preference will be given to those having experience with electrical equipment. Give full particulars of qualifications with application. Apply Box No. 15-V, The Engineering Journal.

Recent Graduates

The Institute's Employment Service Bureau has received during the past few weeks a large number of requests for recent graduates and undergraduates in connection with various large construction works, and for general draughting and detailing. Any members of The Institute interested in such positions should register with the Employment Service Bureau as soon as possible.

Situations Wanted

Civil Engineer

Civil engineer, A.M.E.I.C., speaking French and English, with experience in building construction, factory managing and costing, desires a position as chief engineer or manager with a lumber company or as construction or resident engineer on any general construction work. Apply Box No. 1-W, The Engineering Journal.

Civil Engineer

Civil engineer, M.E.I.C., Registered Professional Engineer of Alberta, fully qualified, thirty years experience in railway construction, reconnaissance and highway work, is available for a position. Would prefer position as city engineer, or post of trust and responsibility, in western province. Apply Box No. 3-W, The Engineering Journal.

BRANCH NEWS

Border Cities Branch

Orville Rolfson, A.M.E.I.C., Secretary-Treasurer.

The regular meeting of the Border Cities Branch was held in the Prince Edward hotel on May 11th. The chairman introduced the speaker of the evening, William Gore, M.E.I.C., of the firm of Gore, Nasmith and Storrie, consulting engineers, of Toronto.

Toronto Water Supply System

Mr. Gore remarked that the population of Toronto is 575,000 and the population, including suburbs, is 675,000, and that there is a difference of elevation of three hundred feet between some parts of the city. There are seven distinct pumping areas in the city's water supply system, and a balancing reservoir is located on the upper level.

In a general way most cities require pumping facilities for twice the average consumption of water, but in Toronto the balancing reservoir is of great value because with it smaller pumps which run more nearly to capacity can be used.

The average demand of Toronto is 73,000,000 gallons per day. The city sewage is emptied into lake Ontario, from which it draws its water. The present filtration plant, using both slow sand and mechanical filters, is located on the Island. The water is chlorinated and pumped through the tunnel under the bay to the John street pumping plant, from whence it is pumped to the city mains.

On account of phenol tastes the water is super-chlorinated on the Island and dechlorinated at the John street station by using sulphur dioxide. During the time of passing from the Island to the John street station the chlorine acts on the impurities in the water. Mr. Gore presented a chart, prepared by the Toronto Board of Health, showing that, by chlorination, sedimentation and pasteurization, the typhoid mortality had been reduced from 44 to 4 per 100,000.

Consulting engineers are working on the problem of increasing the supply of water for the city. The prevailing winds are westward, and the new pumping station and filtration plant will be located at the east side of the city. The new intake will extend 7,500 feet from the shore into 50 feet of water. Because of erosion the first half of the intake will be a tunnel in the shale and the remainder a pipe laid on the bottom of the lake.

The new filtration plant will have a capacity of 200,000,000 gallons per day, and from it the water will be pumped through a 7-foot tunnel in the shale to the existing plant at John street and to Sunnyside. Also two large mains running northerly, and then westerly, will supply another section of the city. A reservoir on St. Clair avenue will be constructed which will have a capacity of 50,000,000 gallons.

The address was illustrated by lantern slides. Also Mr. Gore showed blue prints of several features of the work.

Calgary Branch

W. H. Broughton, A.M.E.I.C., Secretary-Treasurer.
W. St. J. Miller, A.M.E.I.C., Branch News Editor.

On Saturday, June 2nd, a golf tournament was arranged between the members of the Calgary Branch and members of the Earl Grey Golf Club and was played on the latter's golf course. Some twenty-four players paired off for the first tournament that this branch of The Institute has participated in locally. A cloudy day proved an advantage, if anything, and the excellent condition of the tees and greens proved conducive to a most enjoyable afternoon. A magnificent view of the snow-capped Rocky mountains is seen from this golf course. The programme was arranged as follows:—

Thirteen holes medal play in competition for prizes of golf balls.

Best net score.
Best gross score.
Hole in one.
Hole in two.
Consolation (highest gross score).
Consolation (highest net score).

The handicap and draw committee were G. P. F. Boese, D. T. Townsend, C. C. Richards, and J. A. Spreckley.

The results of the match were: H. L. High, best net score and best gross score; hole in two, G. P. F. Boese; consolations, Lt.-Col. F. M. Steele and F. K. Beach. Incidentally, no one chanced to make a hole in one. Chairman T. Lees presented the prizes.

Major Duncan Stuart, president of the Earl Grey Golf Club, regaled the players with refreshments at his beautiful residence nearby, which contributed considerably to the ultimate success of the afternoon.

The Programme Committee met under the convenership of J. A. Spreckley, A.M.E.I.C., and a tentative selection of outings and meetings for the year has been arranged, among which are the following: Picnic to P. Burns Ranch; lectures on "Modern Power" by F. J. Robertson, A.M.E.I.C.; "Technical Education" by Dr. W. G. Carpenter; "Aviation" by W. St. J. Miller, A.M.E.I.C.; a visit to Spiller's Flour Mills; a paper on "Steam Plants," and the annual ball, etc.

Moncton Branch

V. C. Blackett, A.M.E.I.C., Secretary-Treasurer.

The annual meeting of the Moncton Branch was held in the Council Chamber at the City Hall on May 18th. G. C. Torrens, A.M.E.I.C., chairman of the branch, presided. The annual report and financial statement was presented and approved. On motion of F. O. Condon, M.E.I.C., seconded by F. B. Fripp, A.M.E.I.C., a vote of thanks was tendered the retiring chairman and members of the executive for their untiring efforts on behalf of the branch during the past year.

Following the business of the meeting, through the courtesy of Messrs. Stone and Webster, of Boston, Mass., two motion pictures were shown. The first was entitled "From Coal to Electricity" and illustrated the working of an electric power plant, and the second, "Conowingo," which featured a large hydro-electric development on the Susquehanna river, near Conowingo, Md.

Report of the Executive Committee

The Executive Committee held six meetings during the year. There were ten meetings of the branch, one of which was open to the public. At these meetings papers were read, addresses given and business transacted as follows:—

1927

Sept. 9—A meeting, open to the public, was held in the City Hall. Ian M. McLean, of the Canadian General Electric Company, Toronto, gave an address on **"The Progress Made in the Electrical Industry."** The address was illustrated with moving picture films.

Oct. 28—A supper-meeting was held in the Y.M.C.A. Prof. H. W. McKiel, M.E.I.C., of Mount Allison University, gave an entertaining and instructive address on **"The Autobiography of the Earth."**

Nov. 18—A supper-meeting was held in the Y.M.C.A. Dexter P. Cooper gave a very interesting address on **"The Passamaquoddy Tidal Development."**

Dec. 14—A supper-meeting was held in the Y.M.C.A. An instructive paper on **"The Evolution of Industrial Organization"** was read by Prof. Norman M. Guy of Mount Allison University.

1928

Jan. 11—A supper-meeting was held in the Y.M.C.A. P. L. Pratley, M.E.I.C., consulting engineer, Montreal, and councillor of The Institute, gave a very interesting detailed description of the construction of **The Montreal South Shore Bridge.**

Feb. 22—A supper-meeting was held in the Y.M.C.A. E. W. Jeffrey, sales engineer, Northern Electric Company, Halifax, gave an address on **"Illumination."**

Mar. 6—A special meeting of the branch was held for the purpose of discussing Institute affairs with the general secretary, Mr. Durley.

Mar. 30—A meeting was held in the Council Chamber of the City Hall. H. E. Bigelow, Ph.D., Dean of the Faculty of Science, Mount Allison University, gave a very interesting paper on **"Coal, Oil and Wood; Something of Their Past Performance and Future Promise."** Branch officers for 1927-28 were nominated at this meeting.

Apr. 4—A joint meeting of Moncton Branch and the Engineering Society of Mount Allison University was held at Sackville. H. J. Crudge, A.M.E.I.C., building engineer, Canadian National Railways, Moncton, gave a very instructive address on **"Construction Methods."** The address was illustrated with slides and motion picture films.

Apr. 23—A joint supper-meeting of Moncton Branch and the Gyro Club of Moncton was held in the Palm room of the Brunswick hotel. H. P. Webb, M.Sc.F., professor of forestry, University of New Brunswick, read a paper on **"Forestry and Its Relation to the Canadian Forests."**

The following is a statement of our membership at the present time:—

MEMBERSHIP

	Resident	Non-Resident	Total
Members	8	3	11
Associate Members	21	8	29
Juniors	4	—	4
Students	6	3	9
	39	14	53

GENERAL

The meetings during the year have been well attended. The branch was fortunate in securing a number of outstanding speakers, and the chairman of the Papers Committee, Prof. F. L. West, M.E.I.C., is to be congratulated on the uniform excellence of the papers presented.

It has been customary each year for the branch to hold at least one open meeting to which the public have been invited. Special care has been taken that the subjects of the addresses should be interesting as well as educational, and slides and motion pictures have always been included in the programme. The attendance on the part of the public, however, has been disappointing. Apparently the average person cannot get away from the idea that it is not possible for a technical address to be entertaining as well as instructive.

In an endeavor to co-operate with the provincial government in the annual "Save the Forest" campaign, a joint meeting was arranged during Canadian Forest Week with the Gyro Club of Moncton. The speaker was H. P. Webb, M.Sc.F., professor of forestry, University of New Brunswick, and his address was later published in full in the local papers.

The thanks of the executive are due Prof. F. L. West, M.E.I.C., chairman of the Papers Committee, Messrs. J. G. Dryden, A.M.E.I.C., and J. A. H. Whitford, JR.E.I.C., of the Entertainment Committee, and the ladies and gentlemen who very kindly furnished the musical entertainment for our meetings.

FINANCIAL STATEMENT

(For the fiscal year June 1, 1927, to May 31, 1928.)

Receipts

Cash in bank, June 1, 1927	$ 38.19	
Rebates on dues	81.00	
Branch News	29.35	
Bank interest	2.64	
Supper-meetings	113.00	
Miscellaneous	1.10	
		$265.28

Expenditures

Expenses, branch meetings	$140.20	
Printing and advertising	29.89	
Telegraph and telephone	5.07	
Postage	5.50	
Express charges	5.67	
Miscellaneous	10.13	
Cash on hand and in bank	68.82	
		$265.28

Assets

Balloptican lantern	$ 45.00	
Attache case	10.00	
Rubber stamp	0.50	
Cash in bank	68.08	
Cash on hand	0.74	
		$124.32

Liabilities

None

G. C. TORRENS, A.M.E.I.C.,
Chairman.

V. C. BLACKETT, A.M.E.I.C.,
Secretary-Treasurer.

Audited and found correct.

JAMES PULLAR, A.M.E.I.C.,
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Auditors.

Montreal Branch

C. K. McLeod, A.M.E.I.C., Secretary-Treasurer.
W. McG. Gardner, A.M.E.I.C., Branch News Editor.

STATUS AND OPINION OF ENGINEERING GRADUATES

An analytical study of the "Occupations and Opinions of McGill Graduates in Applied Science," as expressed in reply to a questionnaire, formed the subject of an address to the branch on April 5th last, by Dean H. M. MacKay, M.E.I.C. The paper, of interest to all engineers and to The Institute in particular, when delivered in the Dean's inimitable manner, attracted marked attention.

In opening his remarks, the Dean pointed out that in view of the general discussion in recent years relating to the training of young engineers, engineering schools had deemed it advisable to carry out some investigation on their own account. That such an investigation is justified by financial considerations is apparent from a survey covering the average cost of producing a graduate engineer. This usually amounts to around $4,000, of which $2,000 is provided by the funds of the school, $1,000 by the graduate and the remainder represents interest on the cost of land, buildings and equipment.

The investigation at McGill University included a questionnaire to all graduates preceding the class of 1924. On some 30 per cent of the recipients responding, the most important features of these replies were carefully summarized.

On the subject of activity of graduates since their graduation, the study revealed some interesting tendencies. Mechanicals lead by a small margin in executive work; metallurgists in superintendence, and miners in management. Civils do more than their share of designing and estimating, while chemicals lead in research. Electricals are to the fore in consulting work and mechanicals reach the happy stage of ownership to a greater extent than their fellows.

As the years elapse after graduating, there was a gradual shifting of the centre of gravity from activities mainly technical to those which are mainly executive or administrative. More than 80 per cent of the graduates in the classes 1920-24 were engaged in work mainly technical, while 49 per cent only of the graduates previous to 1900 were so engaged, leaving more than 50 per cent engaged in executive, administrative or other work mainly non-technical. In the United States, due to greater industrial activity, this figure approaches 70 per cent. While the drift from technical to executive work is entirely satisfactory, the gateway seems likely to be mainly through technical employment.

Sixty-three per cent of civils and forty-five per cent of mechanicals remain in the field into which they were graduated, but on the other hand, only 28 per cent of chemists and miners are constant to their first choice, though both display versatility in entering other fields.

However, some 14 per cent of the work of graduates lay away from engineering altogether. The ownership percentage was small and less than that prevailing among American graduates, nevertheless our clerical percentage was also lower than theirs.

In view of the trend away from the course followed at college, it is evident that Canadian schools must continue to train along broad lines.

A number of interesting conclusions were drawn from the careful analysis of the income figures submitted as derived from earnings. For instance, graduates who enlisted for overseas service have been set back on the average about five years in this respect. University teachers and government employees are the two groups of graduates who earn least eventually, though both start off pretty well.

While these income statistics are rather erratic, due to the smaller representation of Canadian graduates, they are closely parallel to corresponding figures gathered in the United States. Their medium graduate, the man neither more nor less deserving or fortunate than his fellows, begins at nearly the same rate as in this country. Though he seems to advance a little more rapidly for the first five years or so, in the end he hardly holds his own with the Canadian graduate.

A remarkable feature of the study was the indication that, though the initial income following graduation was much higher than twenty years ago, in actual relative purchasing power the new graduate was not much better off than his predecessor.

On correlating income with academic standing, it appeared that after twenty years of graduation, the good and the medium were receiving approximately the same income, with the "low" man considerably behind.

Considerable difference of opinion prevailed in answer to questions on the quality of the engineering training obtained and the product turned out. On the whole, however, both were credited with being good.

The answers relating to the elements that should be included in the course and stressed as being most useful and important to engineers, have been of service in strengthening the curriculum. The majority of the graduates seemed to believe that while it is true that such subjects as foreign languages, accounting, industrial management, psychology, history and political science might be useful, the limited time available renders it difficult to present them in such a way that they would be both interesting and fruitful of result.

Both the general trend of opinion indicated and the individual suggestions and criticisms were proving most useful in adjusting the courses to meet present day circumstances.

In the interesting discussion which ensued, led by D. C. Tennant, M.E.I.C., R. J. Durley, M.E.I.C., P. F. Sise, M.E.I.C., R. A. Ross, D.Sc., M.E.I.C., and Geo. R. MacLeod, M.E.I.C., all stressed the importance of training the young engineer in the fundamentals of his profession.

A. S. Wall, M.E.I.C., moved the vote of thanks which was presented by D. C. Tennant, M.E.I.C., the presiding chairman.

66-K.V. CABLES OF MONTREAL LIGHT, HEAT AND POWER CONSOLIDATED

The recently installed 66-k.v. underground cables of the Montreal Light, Heat and Power Consolidated, representing as it does an almost phenomenal development in cable construction, formed the subject of a most timely address, when on April 19th the branch received a paper on that subject, splendidly illustrated with both slides and picture films, by Humphreys Milliken, M.E.I.C.

This high voltage underground installation came as a result of the economic need of feeding the company's new Vallee Street substation, situated in the heart of Montreal's underground distribution system, with a 66,000-volt system.

Forming part of a protective ring around the city, these 66-k.v. cables, in addition to carrying the load of Vallee Street station, may be called upon to carry the load of one or more adjacent stations in case the ring is temporarily open-circuited.

The present cable system covering the distance from Vallee station to the overhead lines is approximately 4,000 feet long and consists of six single conductor cables constituting two 3-phase circuits. These have been installed in a line of ten ducts, two ducts wide by five high. The duct system has been so arranged that it may receive a third feeder, connected in multiple with either of the two installed circuits.

The conduits are 4½ fibre with sleeve joints.

To provide for unavoidable seepage in the ducts and manholes, some of which are below sewer level, it was necessary to install sump pumps, automatically controlled by a float valve.

Specially large manholes have been constructed at the ends of the line to accommodate three-pole double-throw oil switches, required for connecting the future third feeder in multiple with either of the present circuits.

The cable, a single-conductor 750,000 C.M. copper strand, laid around a spiral steel spring, forming a hollow core, is insulated with a 30/32-inch thickness of paper enclosed in a 9/64-inch lead sheath and manufactured entirely in Canada.

The Simmons joints applied to this line have as their essential feature the application of one wide and long sheet of insulating paper, cut by machine to fit the steps of the joint at the moment of application and bonded by automatic ground shields at the ends formed by long pieces of thin tapering tinfoil applied to the paper in the factory.

The cable was pulled in with a power winch, the maximum tension required to start the cable from rest being 2,780 pounds, and that to keep it in motion 2,020 pounds. The pulling speed averaged from 15 to 20 feet a minute, with an average pull of 308 feet straightaway.

Heavy grease was used for lubricating the cable during the pulling, and in spite of an outdoor temperature of from 16°F. to 42°F. no difficulty was experienced.

This success was largely due to the care taken in ensuring the best working conditions in the manhole. For this reason a shack 10 by 12 feet was built, which could be removed from one manhole to another as the work progressed.

As a further precaution to prevent moisture entering the joints the air in the manhole was dried by passing it through a calcium chloride dryer and warmed against condensation by electric heaters placed in both shack and manhole.

On the completion of the work the two circuits were connected in series, and a short circuit current of approximately 250 amperes, 60-cycle, 3-phase, was put through the two circuits for a period of twenty-eight consecutive days.

The temperature in the adjacent empty ducts was read by a thermocouple, and that of the cables by resistance during the heat run. From these results it has been calculated that the maximum safe operating current will be about 350 amperes at 60°C. with ambient temperature of 20°C.

The heat run served also to test the operation of the sylphon reservoirs and as a result additional precautions have been taken to ensure the operation of an alarm signal should any such reservoir become empty of oil.

All cable sheaths are grounded on either side of each joint and both the cable and joints in the manholes wrapped with three wide asbestos listing saturated after installation with a solution of sodium silicate.

The cable terminals rated at 110-k.v. are oil filled. They have been protected against electrostatic stresses at the base by concentric tubes of micarta terminating in a correctly flaring copper ground shield. Two arresters have been installed to protect the cables against lightning.

Following a successful test with a six-tube Kenotron set, when the cables withstood 219,000 volts d.c. for fifteen minutes, the circuit was put into service on November 13th, 1927, and has been operated successfully ever since, with no troubles in cable or joints.

In the discussion which followed, N. L. Morgan, A.M.E.I.C., gave credit to the Montreal Light, Heat and Power Consolidated for being the pioneers in this development in Canada, and commented on the effect of sheath losses on the current carrying capacity of single conductor cables operating 3-phase with their sheaths bonded.

G. E. Templeman, M.E.I.C., referred to the research and investigation now being conducted on these high voltage underground cables and the problems introduced by their adoption outside of the high cost. W. S. Vipond, M.E.I.C., reported a 220-k.v. underground cable as being considered in New York.

Following the presentation of the vote of thanks by Prof. C. V. Christie, M.E.I.C., presiding chairman, as moved by G. E. Templeman, M.E.I.C., the meeting enjoyed a reel of microscopic studies on minute sea life beautifully illustrated.

Peterborough Branch

S. O. Shields, Jr.E.I.C., Secretary-Treasurer.

At the regular meeting of the branch held Thursday, April 26th, 1928, H. R. Sills, JR.E.I.C., a member of the a.c. design engineering department of the Canadian General Electric Company, Peterborough, gave a paper on the "Starting Characteristics of Synchronous Motors."

THE STARTING CHARACTERISTICS OF SYNCHRONOUS MOTORS

As an introduction the author gave something of the evolution of the induction motor characteristics of self-starting synchronous motors from the rudimentary squirrel cage winding used in early designs of alternators to give them self-starting properties to the modern starting winding which is an integral part of the machine, of as great importance as its synchronous characteristics.

The changes in the design of the pole pieces to accommodate an effective pole face winding, the effect of ratio of pole face to pole pitch, the ratio of stator to rotor ampere turns, and the air gap dimensions, were discussed in some detail. The effect of the resistance and reactance of the pole face winding on the starting characteristics was demonstrated with slides, and the speaker gave a fairly comprehensive discussion of the various phases of full voltage and reduced voltage starting, and showed that motors with special

Visit of Peterborough Branch to Lakefield, Ont.

Plant of Canada Cement Company, Lakefield, Ont.

high reactance windings could be designed to give the same starting characteristics as standard motors starting on 80 per cent voltage by means of a compensator, and further that full voltage starting was one of the best as well as the most economical methods of starting synchronous machines.

The effect of short circuiting the field winding on the inrush kv.a. and torque and the effect of resistance in the field circuit were discussed, followed by the theory and practice of compound windings for full voltage starting.

The speaker then referred to the mechanical design of pole face windings, covering something of their evolution and the reasons for adopting the present design. The end rings are placed against the side of the pole, and the bars are entirely embedded in the iron of the pole, so that the heating of the pole face winding is totally absorbed in the pole body and thus the bars cannot heat sufficiently to burn out. This construction makes the heating constant of the rotor of the same order as those of the stator, and hence the machine as a whole is protected by the overload protective devices.

The bars are silver soldered to the rings and so can operate at high temperatures without trouble. The method of connecting the ring segments between poles and the effect of omitting these connections were then described.

In closing, the author mentioned that the pole motors under discussion included motors that were susceptible to starting as squirrel cage induction machines, and called attention to the demand for a type of synchronous motor that fulfilled the functions of the wound rotor induction motor. A short description was then given of the starting characteristics of the synchronous induction motor; the standard synchronous motor with a magnetic clutch, and the so-called super-synchronous motor in which, when starting, the stator revolves until the motor is synchronized and then is braked to a standstill. Bringing the rotor up to speed in this manner makes use of the pull out torque of the motor to start the load.

The address was well illustrated by slides, both photographs and diagrams, many of which had been made by the author.

An interesting discussion followed the address, particularly amongst the electrical members of the branch, and a hearty vote of thanks was accorded to Mr. Sills for his paper.

Annual Meeting

The annual meeting of the Peterborough Branch was held at the Paragon Tea Rooms on the evening of May 10th, 1928. This took the form of a "ladies' night," commencing with a supper at 6.30 p.m., followed by the business portion of the meeting and concluding with a social hour for amusement and entertainment.

Chairman A. E. Caddy, M.E.I.C., was master of ceremonies, and since by strange coincidence his birthday fell on the date of the annual meeting, a birthday cake was introduced with all due ceremony during the first part of the evening. The toast to the ladies by Secretary W. E. Ross, A.M.E.I.C., and R. L. Dobbin, M.E.I.C., proved brief but humorously interesting, after which a half-hour was taken up with business, including the presentation of reports and the election of the executive committee as follows: G. H. Burchill, M.E.I.C., W. M. Cruthers, A.M.E.I.C., R. C. Flitton, A.M.E.I.C., A. B. Gates, A.M.E.I.C., J. A. G. Goulet, M.E.I.C., B. Ottewell, A.M.E.I.C., R. H. Parsons, M.E.I.C., E. R. Shirley, M.E.I.C.

The retiring chairman, Mr. Caddy, briefly addressed the meeting, giving all credit to the committee rather than to himself for the success of the past year. He thanked the branch for the honour of having been its chairman, made complimentary reference to the new executive committee and expressed the hope that the branch might enjoy a prosperous future.

Following the business meeting, moving pictures, written, filmed and edited by members of the branch, were shown, while the remainder of the evening was spent playing auction bridge.

As a result of the Annual Executive Meeting, May 28, 1928, the following is the list of officers for the season 1928-29:—

Chairman	W. M. Cruthers, A.M.E.I.C.
Secretary	S. O. Shields, Jr.E.I.C.
Treasurer	A. B. Gates, A.M.E.I.C.
	G. H. Burchill, Jr.E.I.C.
	J. A. G. Goulet, M.E.I.C.
	R. C. Flitton, A.M.E.I.C.
	E. R. Shirley, M.E.I.C.
Ex-officio	R. L. Dobbin, M.E.I.C.
	A. E. Caddy, M.E.I.C.
	W. E. Ross, A.M.E.I.C.

Visit to Cement Plant at Lakefield

The annual picnic of the branch was arranged for Saturday, June 9th, and comprised a drive to Lakefield, an inspection trip through the plant of the Canada Cement Company, followed by sports and dinner at the Lakefield hotel. The outing was well organized by a number of sub-committees and a total of fifty-four members and friends took advantage of the trip.

Mr. E. W. Bailey, superintendent of the Lakefield plant of the Canada Cement Company, and his assistants conducted the tour through the works which have recently been completed and have an output of 3,500 barrels per day.

The party first proceeded on two electric locomotives to the limestone shale quarry about half a mile away and inspected the operation of the electric shovel. Power for this railway is furnished by a 200-kw., 600-volt synchronous motor-generator set. Returning to the plant the several guides followed the direction in which the materials pass through the plant, describing the various processes involved.

The shale from the quarry is dumped from the cars into a 36- by 60-inch Allis Chalmers, single-roll crusher, belt driven by a 150-h.p. motor, falling thence into a Fraser and Chalmers "Pennsylvania" crusher driven by a 175-h.p. motor.

From this point the material travels by a long inclined belt conveyor into bins, then into the rock dryers to storage tanks.

The six ball mills and six tube mills were next inspected, the former driven through belt and spur gears, the latter by a 285-h.p. wound rotor induction motors through herringbone gears.

Meantime the coal is carried by conveyor from yard storage to the dryers and pulverizers, and thence to the kilns. There are six kilns, approximately 10 feet in diameter by 250 feet in length, rotated at about 40 revolutions per hour and fed with the ground shale at the upper end, being fired with powdered coal at the lower end. The resultant cement clinkers pass through the coolers and then by chain conveyor to the grinders. Here the material is ground twice before passing through "Hummer" electric screens to the storage silos, of which there are sixteen, each with a capacity of 21,000 barrels.

There are three 3-bag Bates packers which automatically fill and weigh 87½-pound paper bags, the cement being forced through one corner which is subsequently self-sealing.

In the chemical laboratories samples of the raw materials and finished product are taken and tested every two hours so that a close check is kept on quality.

The party next proceeded to the company's new power house on the Otonabee river close by, which furnishes power to the entire mill. This contains a 2,600-kv.a. vertical generator with direct connected exciter, motor-generator exciter set, switchboards, etc. This completed the tour of the mill and the members separated for tennis, softball, etc., rejoining for dinner at 6.30 p.m. After inhaling quantities of cement dust and indulging in more or less strenuous sports, all were most appreciative of the excellent fare provided by Mr. Strickland, mine host of the Lakefield Inn.

Mr. E. W. Bailey and his associates were entertained as guests and were heartily thanked by W. M. Cruthers, A.M.E.I.C., chairman, on behalf of the members, for the interesting trip through the plant.

Quebec Branch

Philippe Méthé, A.M.E.I.C., Secretary-Treasurer.

The St. Lawrence Waterways

A most successful meeting was held on May 7th, when the Lieutenant-Governor of the province of Quebec, Hon. N. Pérodeau, the Prime Minister, the Hon. Alexandre Taschereau, and the Hon. A. Galipeault, minister of public works and labour, attended the regular monthly luncheon of the Quebec Branch, at the Chateau Frontenac, together with a large number of members of the Quebec Board of Trade and of the Rotary and Kiwanis Clubs, who had been invited by the branch to listen to a talk of the utmost importance to the province and the country at large.

The interest aroused by the subject, which was presented by such an authority as O. O. Lefebvre, M.E.I.C., chief engineer of the Quebec Streams Commission, and a member of the Joint Board of Engineers appointed in 1924 to report on the problem of canalizing the St. Lawrence river and of developing its water powers, was well evidenced by the fact that this gathering included over 200 persons.

Beginning with a few general remarks on the geographical features of the St. Lawrence river, the economics and allied aspects of the problem, the very interesting and lucid lecture, delivered in French by Mr. Lefebvre, on the St. Lawrence Waterways may be briefly summarized as follows:—

Is it feasible to improve the St. Lawrence for deep navigation alone? Which is the best way to perform these improvements, and what will be the probable cost?

Is it feasible to improve the St. Lawrence for power alone? Which is the best way and the probable cost?

Is it possible to improve the St. Lawrence for both navigation and power? Which is the best way and the probable cost?

To answer these questions the Board had to study the whole problem of canalizing the St. Lawrence.

For navigation purposes, the river may be divided into three sections:—

First, from the gulf of St. Lawrence to Montreal, 1,000 miles. In this section a depth of 30 feet has been made available by spending $32,000,000, and this depth is being increased to 35 feet.

The second section extends from Montreal to Port Colborne, at the foot of lake Erie, a distance of 368 miles; the difference in level of 552 feet, due to falls and rapids. is at present overcome by lateral canals with locks 14 feet deep. Lachine canal surmounts the 45 feet of the Lachine rapids, between Montreal and lake St. Louis.

The second obstacle in this section is between the head of lake St. Louis and lake St. Francis, a distance of 16 miles with a difference in level of 83 feet, overcome by the Soulanges canal.

The third obstacle is the rapids between Prescott and Cornwall, a total drop of 92 feet in about 50 miles, overcome by canals with locks at Cornwall, Farran's Point, Morrisburg and Cardinal.

The fourth obstacle is the drop of 326 feet between lake Erie and lake Ontario, overcome by the Welland canal. The new Welland canal will be completed in 1930 at a cost of $115,000,000. The depth will be 27½ feet and the locks will be 30 feet deep. The old Welland canal has cost about $40,000,000, and $51,000,000 have been spent in other canals.

The third section is that comprising the Great Lakes system above the foot of lake Erie, navigable for boats drawing 20 feet, due to dredging the channels between the different lakes.

The problem is as follows:—

From the Great Lakes to the gulf of St. Lawrence maritime transportation necessitates two transshipments; first at Port Colborne, and second at Montreal. It is hoped that the St. Lawrence deep waterway would eliminate these two transfers by allowing ocean vessels to reach the Great Lakes. It is generally admitted that the first transshipment can easily be eliminated, but many experts are in doubt about the second.

Between Montreal and the Great Lakes 5,000,000 h.p. can be developed, 2,000,000 h.p. in the International section, and 3,000,000 entirely in the province of Quebec.

Improving the St. Lawrence river for navigation alone is very simple, and the flow would not be affected at all. The problem of developing the water powers is more complicated, as it involves interference with the flow of the river, which must be maintained uniform and regular.

The cost of improved navigation in the section of Lachine rapids is estimated as $53,000,000, and between lakes St. Louis and St. Francis, in the Soulanges section, $33,000,000.

In the International section, the cost of navigation improvements would amount to $79,000,000, and that of harnessing 2,000,000 h.p. available, $213,000,000.

American engineers favour the single-stage development as less expensive, but Canadian engineers insist on having a two-stage development, one at Morrisburg and the second at Cornwall, as affording a better control of the flow.

The total cost of developing all of the water powers would be $533,000,000, or approximately $100.00 per horsepower. The total cost of the improvement for navigation and power combined would be $650,000,000, so that $58,000,000 would thus be saved. To this must be added the $115,000,000 of the new Welland canal.

Mr. Lefebvre emphasized the necessity of maintaining the uniform flow of the St. Lawrence. Very little can be done to further regulate the flow of the Great Lakes, which are 90,000 square miles in area. One inch of water over such an area represents 80,000 cubic feet per second for one month, about one-third of the low water flow of the St. Lawrence.

It has been proposed to have the water power development in the Canadian section bear the cost of the navigation improvements in that section; the province of Quebec cannot agree to such a proposition, as the whole of Canada would benefit by the improvements, but the burden would rest on the shoulders of the consumers of power, for the great majority of whom would be located in the province of Quebec.

The luncheon was presided over by A. B. Normandin, A.M.E.I.C., chairman of the branch, and the vote of thanks presented by Dr. A. R. Décary, M.E.I.C., honorary chairman of the branch.

Sault Ste. Marie Branch

A. H. Russell, A.M.E.I.C., Secretary-Treasurer.

The regular meeting of the Sault Ste Marie Branch was held on Friday, May 25th, at 8 p.m., in the Y.W.C.A. rooms, with W. S. Wilson, A.M.E.I.C., chairman.

Mr. D. C. Wright, technical engineer of the Electric Controller and Manufacturing Company, of Cleveland. gave a splendid address on "Advantages Derived from Enclosed and Fully Protected Types of Motor Starting Apparatus."

Commencing with the earliest use of a.c. motors, the speaker gave an interesting paper on the history and development of control apparatus for a.c. motors. The control apparatus originally was of the manual type which frequently gave more trouble than the motors. Later, semi-automatic and complete automatic controllers operated from master switches were developed which still gave more or less trouble, due to the use of more delicate parts.

More attention was then given to providing suitable control rooms to protect the apparatus against dust, fumes, etc. Such rooms are sometimes expensive, requiring extra wiring and conduit work, but are justified wherever they can be provided. In places where it is impossible to provide such rooms the enclosed type of controller is used. The latter type was first introduced about ten years ago and has been well developed for all purposes. They are now in very extensive use, providing greater safety to operation and simplicity of control through simply pressing a button.

These compensators are operated from a master switch, and have automatic features for acceleration and protection against overload and starting. They are mounted in heavy cast iron or sheet steel tanks with tight fitting covers and all operating parts immersed in oil. Different attachments and connections can be made to give the desired flexibility for all purposes for which motors may be required, including provision for quick stopping of motors, when it may be necessary in case of accident, etc.

A more detailed discussion was given of recent developments to controllers to adapt them to use with synchronous motors. By the addition of a field control panel various refinements can be worked out to suit all conditions of starting acceleration and pull-in torque and a more recent development has been worked out whereby automatic power factor correction can be secured by varying the field strength where the synchronous motor is over-size or larger than is necessary to perform the required mechanical work.

A considerable number of lantern slides were shown of the various types and installations of control apparatus, etc.

Saskatchewan Branch

R. W. E. Loucks, A.M.E.I.C., Secretary-Treasurer.

Concrete Control

At the May meeting of the Saskatchewan Branch Mr. L. J. Street, vice-president of the National Testing Laboratories, Limited, of Winnipeg, Man., addressed the members on the subject of "Concrete Control." Mr. Street supplemented his remarks by charts illustrating the fineness-modulus, water ratio and compressive strength of tested samples.

Mr. Street stated that for years concrete has been proportioned on a purely volumetric basis. Time of mixing and curing of concrete apparently were not appreciated to the full. Yield of aggregate, bulking due to moisture, percentage of fine and coarse aggregate, fineness-modulus, etc., were either unknown, or viewed as heights of knowledge considered impossible or unnecessary to climb. The allowable quantity of mixing water to a sack of cement was not specified and no restrictions imposed as to any extra water necessitated by reason of excess sand in the mix, lower fineness-modulus of aggregate, or personal whim of the contractor, who might happen to be of the "soup mix" type.

About seven years ago Professor Duff A. Abrams, M.E.I.C., working in the Structural Materials Research Laboratory of the Lewis Institute in Chicago, discovered in his thousands of tests an ordered relation between strength of concrete and the ratio of the water to the cement in the concrete, a relation that persisted through all kinds of aggregate and all kinds of mixes, provided the resultant concrete was what could be called workable, that is, of a consistency that would readily slide from mixers, fill forms and penetrate rod meshes, all without segregation or visible water. There followed soon after suggestions by other investigators for the proper grading of the aggregate, all of which was tied up to the water content in the final determination of the mix.

A year or so ago, however, from various sources it began to be apparent that the rational adaptation of the water-cement ratio was just the one which is discussed by Ahlers, McMillan and Yound, that is, that strength is a function of water-cement ratio and economy a function of aggregate grading and proportioning, and that the two are quite separate. There followed, therefore, the radical proposal that instead of requiring the contractor to proportion his concrete by some arbitrary measure of cement and aggregate, that the engineer merely specify the water content to guarantee the desired strength, and let the contractor put in as much stone as he could actually work with, in such proportions as to insure this workable mixture. Theory indicated, what some experience has since demonstrated, that the resulting concrete would be uniform and strong, which the engineer wanted, and economical, which both the contractor and engineer wanted.

The water-cement ratio theory is that, for given materials and conditions of manipulation, the strength of concrete is determined by the ratio of the volume of mixing water to the volume of cement so long as workable mixtures are obtained. It is common knowledge that, as long as other conditions are maintained constant, the strength of concrete is increased by (1) mixing the concrete drier, (2) increasing the cement content, or (3) using coarser aggregate.

For concrete made under average conditions and cured in the presence of moisture, the compressive strength may be expressed by the equation:—

$$S = \frac{14{,}000}{9x}$$

where S = the compressive strength at 28 days, in lbs. per square inch, and
x (an exponent) = water-ratio, (by volume).

The constant 9 will usually suit our local Portland cement but may vary with the product of different mills. It is necessary therefore to plot a water-cement ratio curve to suit the particular cement being used and evolve a suitable constant.

The practice has so long prevailed of securing increased workability or wet mixes by simply adding water, which practically costs nothing, without putting in additional cement, which would cost money, that a very firm stand will require to be taken to correct these conditions.

Time of mixing, while not of the same direct importance as water content, still has a bearing on the strength of the concrete which cannot be ignored. Tests show that thorough mixing makes a stronger and more uniform concrete and it also increases the plasticity, which means a more workable mixture and less labour in placing. Mixing for two minutes after all the materials are in the mixer should be the minimum, and mixing concrete for five minutes will give a further increase in strength. The revolutions per minute of the mixer drum should also be checked and should not exceed twenty revolutions per minute.

The speaker then referred to a number of precautions to be taken, particularly in curing and in the choice of water to be used, and concluded by saying that concrete made with Portland cement has been used over a period of one hundred years.

High-Pressure Gas Research at the Imperial College, London

The useful work on gaseous combustion at high pressures, which has been carried on under the direction of Professor W. A. Bone, F.R.S., in the department of chemical technology of the Imperial College of Science and Technology, London, is well known. Such work necessitates, among other things, the collection of not a little special, and often of specially designed, apparatus and, frequently, the development, as the result of hard experience, of a new experimental technique. In a word, in new investigations of this kind, the education of the worker is as important as the organization of the work. After seven years, then, the college is in a specially favorable position to offer facilities for training post graduate students in a branch of technology, which is becoming of increasing importance, in connection with new developments in the chemical industry. The position is being still further improved by the provision of two new high-pressure gas research laboratories, one of which is divided into four sections by steel partitions for the accommodation of high pressure explosion bomb installations and two pressure catalytic tube units. The other will be equipped with apparatus for preparing, storing and compressing gases, for determining compressibilities and for testing and calibrating standard gauges. Outside the building there will be an experimental gas generator and gas holders of various capacities from 3,000 cub. ft. downwards. The other equipment will include two compressors, one working up to 200 and the other up to 1,000 atmospheres pressure, a wide range of bombs capable of withstanding pressures of 100, 1,000, 2,000 and 20,000 atmospheres respectively, and catalytic tube units for pressures up to 500 atmospheres at 500 deg. C. It is hoped that most of this equipment will be ready for operation by the end of March 1928. This will enable a limited number of post-graduate research students to undergo a two-years course of systematic training, under the personal direction of Professor Bone and his assistants. As the number of vacancies is limited, early application should be made to Professor Bone at the Imperial College of Science and Technology, London, S.W. 7.—*Engineering*.

Tungsten Reactions in Gas-Filled Lamps

The temperature at which a tungsten filament can be operated in a vacuum is in practice settled by the state of evaporation of the metal which forms a black deposit on the bulb. The loss of metal is reduced by filling the bulb with an inert gas. In ordinary low-watt lamps the inert gas used is argon containing from 10 per cent to 20 per cent of nitrogen; on economic grounds large lamps, of 500 watts and more, are filled with nitrogen only, though they are run at temperatures of 2,850 deg. K. In such lamps a dark brown deposit settles on the bulb very slowly, yet more rapidly than in argon-nitrogen mixtures. That this brown deposit is a tungsten nitride had long been suspected, but had not actually been proved even by Langmuir in his studies of tungsten lamps. When the problem was recently taken up by Messrs. Colin J. Smithells and H. P. Rooksby in the research laboratories of the General Electric Company, Limited, at Wembley, they had to burn a four-litre lamp for 1,000 hours to collect about 10 milligrammes of the brown deposit. Ignited in air this deposit burnt to a greenish yellow oxide. X-ray examination of the deposit, of tungsten metal itself, and of its three oxides, (WO_3 yellow, W_2O deep blue and WO_2 chocolate brown), did not indicate any oxygen compound. Oxidation of the deposit with potassium permanganate in a spectrum tube showed the presence of nitrogen, and the volume relations suggested a nitride WN_2. This formula was confirmed by further experiments; the density of the nitride was of the order 5. In their recent communication on this subject to the Chemical Society, Messrs. Smithells and Rooksby also referred to the action of water vapour, which is difficult to exclude entirely. The reaction between the hot tungsten and the vapour giving oxide and hydrogen is reversible. The hotter parts of the filament, as Dr. Smithells has previously shown, are oxidized, the oxide is reduced again, at lower temperature by the hydrogen, to metal which is re-deposited on the cooler portions of the filament. One would then expect that the brown deposit should also contain oxygen which, however, was not found. There is, however, reason to assume that water vapour does reach the glass walls; but it seems to be reduced again by the atomic hydrogen. That would help to explain how one part of water vapour in 10,000 can burn out a tungsten filament in less than an hour.—*Engineering*.

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Preliminary Notice

of Applications for Admission and for Transfer

June 20th, 1928.

The By-laws now 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 election 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 1928.

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 or 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.

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.

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

FIEGEHEN—EDWARD GEORGE, of 8016 Western Avenue, Montreal West, Que., Born at London, England, Jan. 7th, 1875; Educ., Bedford Modern School, technical classes at Bedford, Leeds Univ. and McGill Univ. at intervals during 1895-1913; apptce., 1892-94, Grafton & Co., Bedford, and 1894-98, Bedford Engrg. Co.; 1898-1900, dftsman., and 1900-07, i/c of production, Bedford Engrg. Co.; 1907-09, leading dftsman., Thos. Smith & Sons, Ltd., Rodley, Eng.; 1909-11, i/c of crane dept., estimating, etc., Royce, Ltd., Manchester, Eng.; 1911-13, 2nd mech'l engr., Dominion Bridge Co., Montreal; 1913-27, (with exception of 1914-17, when Major in command of Field Co., R.E., in Gallipoli, Egypt and Palestine), senior partner, Bedford Engrg. Co., Bedford, Eng.; at present in mech'l dept., Dominion Bridge Company, Lachine, Que.

References: G. H. Duggan, F. P. Shearwood, P. L. Pratley, F. Newell, A. Peden, D. C. Tennant, R. H. Findlay.

JESSEY—DAVID WILLIAM, of Calgary, Alta., Born at Elmira, N.Y., July 17th, 1904; Educ., elect'l engr., Prov. Inst. of Tech., 1924; 1924 to date, with Calgary Power Company as floorman at Seebe, Alta.; July 1925, operator; Dec. 1926, promoted to sub-station operator of Calgary sub-station, i/c operation of Calgary sub-station supplying electricity to City of Calgary.

References: F. J. Robertson, G. H. Thompson, W. H. Broughton, J. H. Ross, H. J. McLean.

KERSON—MORRIS WILLIAM, 266 Addington Avenue, Montreal, Que., Born at Reval, Republic of Estonia, Aug. 1st, 1890; Educ., High School and I.C.S.; 1915-19, Can. Exp. Force; 1919-20, extension course. D.S.C.R.; 1920-21, dftsman and engr. i/c of constrn., T. Pringle & Son, Ltd.; 1921-22, engr. i/c of constrn., E. G. M. Cape & Co.; 1922, asst. to supt., Canadian Benedict Stone, Ltd. (Mount Royal Hotel); 1922, supt. i/c of constrn., school bldg., St. Lambert, for J. A. Grant & Co., Ltd.; 1922 to date, gen'l struct'l designer and dftsman., also engr. i/c of constrn. on various jobs, for T. Pringle & Son, Ltd., Montreal.

References: J. S. Costigan, G. M. Wynn, A. H. Milne, L. H. D. Sutherland, J. A. Grant, F. T. Gnaedinger, B. E. Norrish, R. Bickerdike, Jr.

LEGATE—ROBERT MOORHEAD DE CONLAY, of Burlington, Ont., Born at Sydney, N.S.W., Australia, Oct. 25th, 1899; Educ., B.Sc. (E.E.) 1924, M.Sc. (E.E.) 1928, Univ. of New Brunswick; 1918-19, gen. helper, C.P.R. shops, Montreal; 1919-20, gen. helper, G.T.R. shops, Montreal; 1920, electr'n, small power house install'n, Vaughan Electric Co., Saint John, N.B.; 1921, rodman and concrete inspr. on Musquash development for C. H. & P. H. Mitchell Co., of Toronto; 1923 (8 mos.), asst. engr., Civic Power Commission, City of Saint John, N.B.; 1924-25, power house dftsman., Shawinigan Water & Power Co., Shawinigan Falls; 1925 to March 1928, asst. elect'l engr., Rio de Janeiro Tramway Light & Power Co., Brazil, i/c of design, etc.; not employed at present.

References: E. O. Turner, A. F. Baird, S. R. Weston, J. Stephens.

McFADYEN—ANDREW JAMES, of Winnipeg, Man., Born at Balsover, Ont., Sept. 15th, 1882; Educ., B.A.Sc., Univ. of Toronto, 1928; 1911, bridge and bldg. dept., C.N.R.; 1912-13, detailer in structural steel with Dom. Bridge Co., Montreal; 1913-14, detailer and checker with Eastern Can. Steel and Iron Works, St. Malo, Que.; 1914-15, checker with Carnegie Steel Co., Baltimore, Md.; 1915-16, detailer and checker in bridge dept., Dom. Bridge Co., Montreal; 1916-18, engr. on erection of Int. Nickel Plant, Port Colborne, Ont., for Dom. Bridge Co.; 1918-22, ch. dftsman., Dom. Bridge Co., Winnipeg; 1923-26, in designing office, Dom. Bridge Co., Winnipeg, 1924-26 doing actual designing.

References: D. C. Tennant, F. P. Shearwood, H. M. White, A. J. Dostert, J. M. Morton, H. C. D. Briercliffe.

McMAHON—JOHN LEONARD, of Winnipeg, Man.; Born at Winnipeg, April 26th, 1904; Educ., B.Sc., Univ. of Manitoba, 1928; May to Sept. 1925, rodman, C.P.R.; May to Sept. 1926, dftsman., C.P.R.; at present, dftsman., C.N.R.

References: J. N. Finlayson, R. W. Moffatt, W. Snelson, S. H. Frame.

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

BLACK—WILLIAM DUNCAN, of Hamilton, Ont., Born at Toronto, Ont., May 8th, 1892; Educ., B.A.Sc., Univ. of Toronto, 1909; 1910, res. engr., Kentucky River High Bridge, for Gustav Lindenthal; 1911 to date, with the Otis-Fensom Elevator Co., Ltd., as follows: 1911-17, manager of Quebec and Maritimes; 1918, engr. i/c of munition production; 1918-21, manager of constrn.; 1921-25, works mgr.; 1926 to date, general mgr., and at present vice-president and managing director.

References: J. M. R. Fairbairn, R. A. Ross, Harold Rolph, F. B. Brown, W. A. Bucke, W. L. McFaul, T. H. Hogg, H. A. Lumsden.

GIBBS—CHARLES RICHARD, of 19 N. Jefferson Street, Carthage, N.Y., Born at Carthage, N.Y., Jan. 27th, 1893; Educ., B.Sc., McGill Univ., 1916; 1917 to date, with Ryther & Pringle Co., Carthage, N.Y., designing and building pulp and paper mills, hydraulic power plants, etc., for many large companies; at present sales engr. and mechanical supervisor, in full charge of specifying and selling Ryther equipment.

References: S. R. Newton, H. V. Haight, P. A. Trost, J. E. A. Warner, E. S. Winslow.

FOR TRANSFER FROM THE CLASS OF STUDENT TO A HIGHER GRADE

BENJAMIN—ABRAHAM, of Outremont, Que., Born at Glace Bay, N.S., Dec. 23rd, 1900; Educ., B.Sc., McGill, 1924; professional electrician for 5 yrs. up to 1924; 1924 (6 mos.), dftsman. with Dr. L. A. Herdt and Mr. E. G. Burr; 1925 to date, engr. with the Elect'l Comm. of Montreal.

References: G. E. Templeman, C. V. Christie, G. A. Wallace, deG. Beaubien, E. G. Burr, L. A. Kenyon.

BREHAUT—HARRY BAKER, of Edmonton, Alta., Born at Souris, P.E.I., May 20th, 1896; Educ., B.Sc., Univ. of Sask., 1927; apptce., Dom. Coal Co.; 1912-16, field dftsman. and rodman, Halifax Ocean Terminals Rly.; 1916-17, dftsman., Nova Scotia Steel & Coal Co.; 1917-20, i/c of mechanical and marine designs; 1920, senior dftsman., Eastern Car Co.; 1920-23, dftsman., C.N.R., Saskatoon; summers 1924-26 and 1927, instr'man, C.N.R.; Feb. 1928, appointed res. engr., Hudson's Bay Rly., and April 1928 to date, res. engr. on C.N.R. constrn., Edmonton, Alta.

References: C. J. Mackenzie, A. M. Macgillivray.

HARBERT—EDWARD THOMAS, of Montreal, Que., Born at Toronto, Ont., May 22nd, 1901; Educ., B.Sc., McGill Univ., 1923; 1923 to date, with Canadian Ingersoll-Rand Co., Ltd., as follows: 1923-25, dftsman., Sherbrooke; 1925-28, sales and engrg., and May 1928 to date, engr. to sales dept. at Montreal, all on pulp and paper mill machinery.

References: H. V. Haight, S. R. Newton, G. P. Cole, H. C. Nourse, E. S. Winslow.

HENDERSON—IAN GORDON, of Montreal, Que., Born at Mimico, Ont., Sept. 26th, 1902; Educ., B.Sc., McGill Univ., 1926; 1925 (summer), leveller with Thurso and Nation Valley Ry.; 1926 (June to Dec.), structural dftsman. with Can. Bridge Co.; Feb. to July 1927, field engr. for Anticosti Corp.; 1927 to date, field engr. and structural dftsman. for Dom. Bridge Co., Montreal.

References: H. M. MacKay, E. Brown, A. Peden, J. Weir, W. P. Murray, R. E. Jamieson.

KURTZ—HAROLD JOHN, of El Centro, Colombia, S.A., Born at Burlington, Ont., Aug. 3rd, 1900; Educ., B.Sc., Queen's Univ., 1926; summers 1916 to 1921, labouring, timekeeping, foreman, Can. Engrg. and Contracting Co., Hamilton; summer 1922, foreman S. Oakes, contractor, Burlington, Ont.; 1923 (summer), concrete road inspector, Town of Burlington; summers 1924 and 1925, associate J. H. Kurtz & Son, sidewalks, watermains, sewers, etc.; June and July 1926, instrumentman Welland Ship Canal; Sept. 1926 to Mch. 1928, engrg. corps, N.Y. Central Railroad, land surveying, track layout, dfting.; at present, dftsman. Tropical Oil Co., El Centro, Colombia, S.A.

References: J. J. MacKay, J. E. Sears, D. S. Ellis, W. L. Malcolm, A. MacPhail, W. P. Wilgar, G. Beecroft.

ROBERTS—FREDERIC MORLEY, 1074 Glenwood Boulevard, Schenectady, N.Y., Born at Grappenhall, Cheshire, Eng., May 26th, 1901; Educ., B.Sc., Queen's Univ., 1924; summer 1922, instr'man, Can. Nat. Parks Divn., Dept. of the Interior; 1923, elect'l apprentice, Algoma Central Ry., Sault Ste Marie, Ont.; 1924-25, testing dept., General Electric Co., Schenectady, N.Y.; 1925-27, design of slow speed synchronous machinery, engrg. dept., and from Jan. 1927 to date, industrial engrg. dept. of same company, as asst. to engr. on pulp and paper mill electrification, also cement mill electrification.

References: D. M. Jemmett, A. B. Gates, W. E. Ross, D. S. Ellis, L. T. Rutledge.

STEPHENSON—JOHN GORDON, of Kirkland Lake, Ont., Born at Rise, Yorkshire, Eng., May 31st, 1901; Educ., Junior Matric., 1918, Elect'l Engrg. course, I.C.S., 1918-20, elect'l mtce., Wallace Shipyards, Ltd., North Vancouver; 1920-22, apptce. in Test Dept., and 1923-25, asst. to industrial engr., Peterborough Works, Can. Gen. Elec. Co., Ltd.; 1925 to date, chief electr'n, i/c of design, etc., of all electr'l work, Teck Hughes Gold Mines, Ltd., Kirkland Lake, Ont.

References: W. E. Ross, W. M. Cruthers, L. DeW. Magie, A. B. Gates, E. R. Shirley.

STEWART—WILLIAM LEWIS REFORD, of Sherbrooke, Que., Born at Toronto, Ont., Oct. 6th, 1900; Educ., Diploma of Graduation, R.M.C., 1920; summer 1919, instr'man, Toronto Hbr. Comm.; 1920, asst. to res. engr. on constrn. work for Lockwood Greene & Co.; 1921-22, with Abitibi Power & Paper Co. and Morrow & Beatty, Ltd., as asst. res. engr.; 1923, engr. on bldg. constrn. work for Robert Reford Steamships Co.; 1924, field engr., Newton Construction Co., Ltd.; 1925 (Jan.-June), office engr. and estimator at Montreal office, and from June 1925 to March 1927, manager of Sherbrooke office for same firm; March 1927 to date, managing director, Stewart Construction Co., Ltd., Sherbrooke, Que.

References: J. E. Beatty, G. D. MacKinnon, W. B. Crombie, J. A. Beatty, H. J. Lamb, R. P. Raynsford.

VAN KOUGHNET—EDWARD MATTHEW, of Montreal, Que., Born at Buffalo, N.Y., Feb. 16th, 1902; Educ., Diploma of Graduation, R.M.C., 1922; 1922-23, 3rd year, elect'l, McGill Univ.; summer 1922, C.P.R.; 1923-24, Steel Company of Canada; June 1926 to Feb. 1928, Shawinigan Engineering Company, i/c of field party, inspection of transmission lines, etc.; 1928, Brazilian Traction Co., Toronto, and at present with Canadian & General Finance Co., Ltd., Toronto, estimates on transmission lines, design and cost, hydrology.

References: E. J. C. Schmidlin, L. F. Grant, J. A. McCrory, C. R. Lindsey, H. Dessaulles, H. L. Dowling.

VERNOT—GEORGE E., of Montreal, Que., Born at Montreal, Feb. 27th, 1901; Educ., B.Sc., McGill Univ., 1926; since graduation in engrg. dept., Fraser Brace Company, Montreal.

References: J. B. D'Aeth, L. N. Jenssen, R. E. Heartz, F. S. Small, T. W. W. Parker, C. S. Bennett, T. M. Morrow.

WHITELEY—FREDERICK BRYON, of Flamand, Que., Born at Georgetown, Brit. Guiana, Feb. 10th, 1901; Educ., 4 yrs. Rothesay Collegiate and railroad engrg., I.C.S.; Oct. 1921-Apl. 1924, chainman and rodman, Temiskaming & Northern Ont. Rly.; May to Nov. 1924, mine surveyor, Lorrain Cons. Mines, South Lorrain, Ont.; Nov. 1924 to Apl. 1925, leveller, Northern Development Br.; June to Aug. 1925, topographical surveys, working in Red Lake Dist.; Sept. 1925 to date, with Wayagamack Pulp & Paper Co., Three Rivers, as follows: Sept. to Nov. 1925, transitman; Nov. 1925 to date, ch. of party limit line, dam location, watershed surveys and road location.

References: A. A. Wickenden, M. S. Sutherland, S. B. Clement, E. W. Neelands, W. J. Bishop, J. A. Freeland, W. E. Hall.

THE

ENGINEERING JOURNAL

THE JOURNAL OF
THE ENGINEERING INSTITUTE
OF CANADA

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The St. Lawrence River Project

A Review of Existing Conditions and a Discussion of Proposed Improvements

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Paper read before the Quebec Branch of The Engineering Institute of Canada, on May 7th, 1928 (1)

Previous Surveys

The linking up of the important territory bordering the Great Lakes with the Atlantic ocean by a ship canal has been a subject of discussion during the past thirty years in Canada and the United States. A commission of engineers was appointed in 1899 by the Government of the United States to study this question, and this commission submitted a report in 1900.

Three routes were considered. The route favoured at that time was that of lake Erie to lake Ontario by a canal on the American side, then navigation to Oswego, N.Y., and a deep ship canal from Oswego to the Hudson river.*

No action was taken following this report.

In 1904, the Canadian Government, with the object of facilitating the grain movement from the head of the Great Lakes to Montreal, had a study made of a ship canal scheme by way of the Ottawa river and French river. This is the Georgian Bay canal project.

In 1920, the Government of the United States and the Canadian Government submitted to the International Joint Commission the study of a project which aimed to make the St. Lawrence navigable by deep draught ships. This Commission submitted the technical aspects of the scheme to two engineers, Lieut.-Col. W. P. Wooten, of the United States, and W. A. Bowden, at the time chief engineer of the Department of Railways and Canals. The report of these two engineers is known as the "Wooten-Bowden Report."

In 1921, this Commission made a report which was rather favourable to the undertaking, but it recommended that the problem be submitted to an enlarged board of engineers, and in 1924 the two governments appointed such a board which consisted of six members:—

American Section:—

- Major-General Edgar Jadwin, then assistant chief engineer of the United States Army War Department, Washington.
- Colonel William Kelly, at the time chief engineer of the "Federal Power Commission," Washington.
- Lieutenant-Colonel G. B. Pillsbury, at the time engineer in charge of hydrographic surveys on the Great Lakes.

Canadian Section:—

- D. W. McLachlan, M.E.I.C., engineer in charge of the St. Lawrence in the Department of Railways and Canals.
- Brigadier-General C. H. Mitchell, M.E.I.C., dean of the Faculty of Applied Science, University of Toronto, and consulting engineer.
- O. O. Lefebvre, M.E.I.C., chief engineer of the Quebec Streams Commission.

The two governments submitted to these engineers a certain number of questions regarding the possibility of improving the St. Lawrence as a deep waterway. This commission presented a report in 1927. This is the report which serves as a basis for most of the discussions on the subject.

It should be pointed out, at the outset, that these engineers did not recommend the carrying out of the scheme. They answered certain questions of a wholly technical character which had been submitted to them. The Board stated unanimously that the project was feasible with all guarantees of security. They recommended that, in order to achieve a given result, the best plan to adopt was this or

(1) This paper also formed the basis of Mr. Lefebvre's address to the members of the Montreal Branch of The Engineering Institute of Canada, on the occasion of their excursion on the St Lawrence river from Montreal to Prescott, June 1st and 2nd, 1928.

*(See Deep Waterways Board Report, 1900.)

that one, for such and such a reason, but they did not state that the said plan should be undertaken. It has been wrongly stated in certain quarters that this Commission reported favourably to the scheme.

Actual Conditions

For the purposes of navigation, the St. Lawrence may be divided into three sections: that of the Gulf of St. Lawrence up to Montreal,—a distance of about 1,000 miles, and navigable by ocean-going ships with 30 feet of draught. This navigation has been made possible by dredgings, more particularly above Quebec, which have cost Canada in the neighbourhood of $32,000,000. The work of deepening the river is being continued with the object of increasing the available depth to 35 feet. The harbour of Quebec, whose importance is increasing rapidly, and into which ocean liners of the greatest tonnage may find a berth, is situated in this section. The season of navigation covers, on an average, a period of about seven and a half months,—from April 15th to the beginning of December.

The second section, from Montreal to the foot of lake Erie at Port Colborne, covers a distance of 368 miles. Within this stretch there is a rise of 552 feet,—a rise which is overcome by canals and locks opposite the falls and rapids. The depth of the canals accommodates boats with 14 feet of draught.

The First Obstacle:—The Lachine rapids between Montreal and lake St. Louis, in which there is a fall of 45 feet, are overcome by the Lachine canal, which is 8½ miles in length and has five locks.

The Second Obstacle:—Between the head of lake St. Louis and the foot of lake Francis, a distance of 16 miles, where Coteau, Cedars and Cascades rapids are located. The difference in level between the two lakes is 83 feet and the distance is navigated through the Soulanges canal, which is 14 miles in length and has four locks.

The Third Obstacle:—At Cornwall the river becomes an international waterway. The rapids of the Long Sault, which are overcome by a lateral canal 11 miles in length, with six locks, commence near Cornwall. The fall in the Long Sault rapids is 48 feet. Then there is another lock at Farrens Point, and the length of the canal is 1½ miles.

At Morrisburg, (at Rapide Plat), there is a canal 3 2/3 miles in length with two locks, and finally, between Iroquois and the head of the section of the rapids, at Cardinal, a few miles below Prescott, there is a canal with three locks. From the head of Galop rapids, 110 miles from Montreal, where the control section of lake Ontario is located, there is open navigation for a distance of 225 miles. The Niagara river and Niagara falls are between lake Ontario and lake Erie, where the difference in levels is 326 feet, and is overcome by the Welland ship canal, which is 26¾ miles in length and has twenty-five locks.

The third section is that of the Great Lakes where a depth of 20 feet has been made possible by deepening certain of the channels connecting these lakes, such as the Detroit river between lake St. Clair and lake Erie, a distance of 28⅛ miles; lake St. Clair, 14 miles in length; the St. Clair river between lake Huron and lake St. Clair, a distance of 39 miles; and finally, St. Mary's river between lake Superior and lake Huron, a distance of 64¾ miles. Lake Superior is 600 feet above sea-level, whereas lake Huron and lake Michigan are at 580 feet. The difference of 20 feet is to be found in the slope of St. Mary's river and in the rapid or falls of 18 feet at Sault Ste. Marie. This rapid is overcome by locks, four on the American side and one on the Canadian side. Two of the American locks have a depth of 24½ feet over the sills, and the Canadian lock has a depth of 18 feet.

Therefore, the existing system provides ocean navigation with a draught of 30 feet and more as far as Montreal; navigation at 14 feet from Montreal to Port Colborne, at the foot of lake Erie; and navigation at 20 feet on the Great Lakes as far as the head of lake Superior.

Cost of Canals

The canals mentioned in the second section, (from Montreal to lake Erie), are all located in Canadian territory. They were constructed and are maintained by the government of Canada, and our country made a capital outlay of $69,000,000 for their construction. You are aware that a new Welland canal is under construction, and that it is estimated it will be completed in 1930. It will provide a depth of 27½ feet in the reaches, and a depth of 30 feet in the locks. In 1930, it will be possible for the largest lake boats to enter lake Ontario and to navigate as far as Prescott, 115 miles from Montreal. The cost of the new Welland canal is estimated at $115,000,000.

Improvements in the Great Lakes

If all the canals in the second section have been constructed by Canada, at Canada's expense, it is but fair to say that the improvements in the rivers connecting the Great Lakes were carried out almost exclusively by the United States government, at a cost of about $46,000,000. The improvements include the locks at Sault Ste. Marie. The channels thus improved are not all located in American territory; the Livingstone channel, in the Detroit river, is largely in Canadian territory; the Amherstburg channel in the same section of the Detroit river is wholly in Canadian territory,—the first is used by downbound vessels and the second by upbound vessels. Canadian boats use them on the same basis as American boats, just as the latter make use of our canals. The government of Canada has spent about $6,000,000 for the lock at Sault Ste. Marie.

The present system of navigation requires a transfer of export cargoes at two points; first at the foot of lake Erie, then at Montreal. It is believed that there is an advantage in doing away with this transshipping from one vessel to another if the St. Lawrence were deepened and improved to accommodate vessels of greater draught. This undertaking is what is generally called " The St. Lawrence Deep Waterway."

St. Lawrence Deep Waterway

The problem submitted to the engineers was that of determining if such a project could be carried out; the best plan of carrying it out, and the probable cost of same.

In view of the fact that the falls and rapids on the St. Lawrence have a potentiality of approximately 5,000,000 h.p., of which 3,000,000 h.p. are in the Canadian section and 2,000,000 h.p. are in the International section, and that it is desirable to utilize this power for the industrial development of the two countries, would it be possible to improve the St. Lawrence for the production of that power? The investigation had reference to the following questions: What would be the cost of improving the river for navigation alone, and what would be the cost of improving the river for power alone? What would be the cost of a combined plan of improvement? Would it be advantageous to carry out the combined projects?

The St. Lawrence has, as you know, a drainage basin of about 375,000 square miles at Montreal. It has a flow which is extraordinarily regular. In fact, it is the best regulated river in the world. At the outlet of lake Ontario, the maximum flow registered was 320,000 second-feet, and the minimum flow 180,000 second-feet. The ratio between the extreme maximum and the extreme minimum was less than 2 to 1. On the St. Maurice river, for instance, the ratio is 25 to 1; on the Ottawa river the ratio is 10 to 1.

Navigation Alone

One of the problems to be solved was an improvement of the river above Montreal, and as far as the head of the Great Lakes, for navigation alone.

The problem looking to the improvement of navigation alone is easy enough, since in every case, with the exception of one short section, the depth is secured by means of lateral canals with locks, at an estimated cost of $167,200,000. The exception mentioned is in the reach just above the head of the Long Sault rapids, where it is cheaper to use the river for a certain distance, which would require the construction of a low dam.

All these works for navigation alone do not affect the flow of the river in any way, and do not involve any engineering difficulties whatever.

Water Power

This is not the case when the improvement of the river for power is considered. The concentration of the available heads at given points requires extensive changes in the sections and rather complicated compensating works, if the necessary safeguards against damage claim and disasters are to be provided.

Ice constitutes one of the most difficult problems in the St. Lawrence and creates a situation which calls for very careful study if a definite and effective solution is desired. For instance, the sections of the rapids do not cover with ice. This stretch of open water subjected to the cold air forms frazil which is carried along by the current and gathers in the parts of the river where the surface is smoother, and piles up at the surface if the velocity of the current does not exceed 2¼ feet per second, or which is carried under the ice if the current exceeds 2½ feet per second. This process of ice-formation goes on throughout the whole winter.

The Lachine rapids and the foot of lake St. Louis are responsible for the Laprairie basin and the harbour of Montreal being filled with ice, frazil, (which the French call "glace en sorbet," "sherbet ice"). This ice forms an obstruction and raises the water in the harbour from 10 to 12 feet higher than the summer level. This phenomenon is due solely to the obstruction caused by the ice.

Lake St. Louis, where the sheet of water is smooth, is covered with ice, but the rapids of Coteau and the Cedars always remain open, and the same phenomenon of the production of ice and frazil is repeated, with the result that the surface of lake St. Louis, which should be practically level, rises at the head of the lake as much as 7, 8 and even 10 feet above the normal summer level, so that at a certain time a portion of the water of the St. Lawrence flows into the Ottawa river at Vaudreuil through the lake of Two-Mountains, whereas normally it is the Ottawa river which flows into the St. Lawrence by that channel.

The same ice phenomenon occurs in the international section of the river between Prescott and Cornwall. The ice piles up at the foot of the Long Sault rapids and often causes very damaging floods at Cornwall in the middle of winter. From Prescott to Kingston, the river covers with ice in a normal way. Lake Ontario does not freeze, neither do the other lakes, with the exception of lake St. Clair, which in area might be compared with lake St. John at the head of the Saguenay river.

To ensure the operation during the winter months of hydro-electric power stations erected on the St. Lawrence river, it is essential that the upper reach be covered with a sufficient ice cover to prevent the frazil from reaching the power house. To achieve this object, the section of the river in the rapids must be enlarged to a point where the velocity of the current will not be more than 2¼ feet per second, or, at all events, that the surface water exposed to the air and producing frazil will be reduced to a point where the frazil that is formed may be stored in the deep part of the head-race without retarding the regular flow of the river.

The concentration in generating plants can only be attained by means of dams built across the river, or by the diversion of the waters into lateral head-races excavated for this purpose. At all events, the plan found to be the cheapest was that which uses the river by taking all factors into account; necessary deepening in the rapids, in order to secure a current which would practically eliminate the formation of frazil, and ensuring a regular and uniform flow of water to the various power houses. In summer the enlargements of certain sections are necessary in order to avoid backwater and head losses.

Cost of the Combined Improvements

It has been found that navigation between lake Ontario, at Kingston, and Montreal, for a depth of 25 feet with locks at 30 feet, may be secured at a cost of $167,000,000. It has also been established that in order to improve the river for power alone in the same section the cost would total $533,000,000 for a power house capacity of 5,000,000 h.p. By combining the two improvements, the cost would be $650,000,000, so that an economy of $50,000,000 would be realized. If one adds the cost of the Welland canal, $115,000,000, the cost of deepening the rivers connecting the Great Lakes, and that of the compensating works, estimated at $44,000,000, one reaches a grand total of $799,000,000. Once again, this estimate provides for hydro-electric plants with a capacity of 5,000,000 h.p. Of this quantity of power 2,000,000 h.p. in round figures are situated in the international section from Cornwall upstream, and are to be divided equally between the two countries. The balance, 3,000,000 h.p., is available in the essentially Canadian section of the river, which is wholly in the province of Quebec, namely, 2,000,000 h.p. in the Soulanges section, and 1,000,000 h.p. in the Lachine section. It goes without saying that the installation of the power generating units may be made when the power may be disposed of and our industrial progress demands it.

No Export of Power

It is well understood, and it is a policy approved by the greatest majority,—that is about the only point on which everybody is in agreement,—that the power that will be generated from our section of the St. Lawrence must be utilized at home and will not be exported to the United States. Moreover, the author believes that American opinion accepts this situation with good grace, and that our friends in the United States are not counting on receiving from the St. Lawrence any other electrical power than that which rightfully belongs to them. They desire the improvement of navigation; they want to make it possible for vessels of the Great Lakes to reach Montreal or Quebec, or even enter the gulf, and they believe that ocean steamers will travel up to the head of the Great Lakes; to Chicago, Duluth, Fort William.

Estimates

The estimates prepared by the engineers have caused some criticism. Comparisons have been made. The estimate of $252,000,000 made by Messrs. Wooten-Bowden in 1921 has been compared with the estimate of $650,000,000 mentioned in the last report, and this has led to the statement: " What was to cost $252,000,000 in 1921 is estimated at $650,000,000 in 1927."

In the first place, a comparison is made between two plans which are not comparable because they do not cover the same items. The estimate of 1921 only covers the section between the foot of lake Ontario and Montreal. In addition, the estimate only deals with the development of 1,464,000 h.p. in the International section. It does not include any power development in the purely Canadian section. If the two estimates are placed on the same basis, it will be found that they are not very far apart.

It is generally stated that the engineer's estimates are insufficient. The author is in a position to tell you that the estimates embodied in the report which was submitted last year were prepared with the greatest care. Nothing was overlooked in the way of determining the exact nature of the foundation, the ground which would require excavation, and finally all the factors which would have any bearing on the cost of the works. Strangely enough, it is whispered in certain quarters that the estimates are too high. That is, the unit prices we have used have been stated to be too high.

Maintenance of a Uniform Flow

In considering the problem of the development of the St. Lawrence and its improvement, both for navigation and for power, there are certain guiding principles which must be kept in mind. For instance, the uniform flow of the St. Lawrence must be maintained at all costs; it must be guaranteed. The level of the St. Lawrence river at Montreal is seasonably regular and free from sudden fluctuations because the discharge from lake Ontario is seasonally regular and uniform. On the other hand, the volume of water utilized by hydro-power plants is, with rare exceptions, very variable. It varies directly with the quantity of power supplied to the customers.

The power plants which will be installed on the St Lawrence will be subject to the same conditions. Whatever the power factor may be, it is essential that the flow of the river must not change with the load,—which amounts to this: the maximum to be allowed for the power generating plants must correspond to the power which an average available flow can produce. In this way, when the water is not required at the plant, it will not be stored in a pond formed by a dam or a lake, but it must be allowed to flow out by means of sluice-gates outside of the plant, in a dam constructed for this purpose. It is an exceedingly important principle if one is to retain for our river its navigable character.

All the commissions of engineers were unanimous in laying down this principle, which must be applied not only in the international section but also in the Soulanges section and in the Lachine section.

It is the method to be followed in order to ensure a uniform flow that caused the two sections of the Board to differ with respect to the plan for the international rapids section. The Americans favoured what is known as the " single-stage development," a concentration at one point of all the fall between Prescott and the foot of the Long Sault rapids at Cornwall, by means of a dam located at either the head or at the foot of Barnhart island, but the power plant would in both cases be located at the foot of Barnhart island. This means that the flow from lake Ontario would be controlled by a dam connected to a power station having a capacity in excess of 2,000,000 h.p. The flow in such a plant may vary to a very considerable degree. As the stretch of water above the dam is lake Ontario, which has an area of 7,500 square miles, the flow may be retarded with little effect on the level of this sheet of water, but the effect might be positively disastrous to that section of the river below the dam.

The Canadian section of the Board insisted that the control of the flow from lake Ontario be not connected with a power plant having a capacity of several million h.p. The ideal plan would be the construction of a control dam for flow only, but as this plan would involve the loss of a certain quantity of power which may become very valuable, and which has an important value to-day, it was agreed by the Canadian section to connect this dam with a hydro-electric plant of much lesser proportions, and which can be operated as a basic plant with a uniform load 24 hours a day. It is readily conceivable that this plant may be connected with a system in which the variations in load will be absorbed by other units in the system. For this reason concentration at two points, " the two-stage development," was favoured.

The control dam for lake Ontario would be at Crysler island, a few miles below the town of Morrisburg. The head available would be 24 feet. The other concentration would be at Barnhart island, at the same point favoured by the American section, where the head would be about 60 feet. The dam at the head of Barnhart island will be equipped with a long spillway, and if the volume of water in the plant be reduced, the pond between the two power houses, which is limited to the area of the river, will rise very rapidly, and in a very short while the water will flow over the spillway.

This plan ensures the uniformity of the discharge from lake Ontario, which is the essential thing, not only in the interest of good navigation at Montreal, but also to safeguard the value of the water power in the Canadian section of the river. It is quite true that this plan would involve an outlay of $34,000,000 more than the sum required to carry out the single-stage plan, but the security of the level in the port of Montreal and of the level below Montreal is worth much more than this slight difference. Moreover, control by means of two dams makes provision for greater security against accidents, the chances of which are very remote, but nevertheless quite possible.

" The Joint Board of Engineers, 1924," lays down the following:—

> *Paragraph 109. Fundamental Principles.*—The plans have been prepared in accordance with the recognized principle that the interests of navigation on the St. Lawrence are paramount. A full observance of this principle does not interfere with the beneficial use of the flow of the river for power generation. On the contrary, the improvement of the rapids sections of the river for the joint benefit of navigation and power affords, as a rule, much better navigation than could be secured by the improvement now economically justifiable in the interest of navigation alone.
>
> *Paragraph 116.*—The various power houses have the capacity for the development of the maximum flow which the Board considers as utilizable in the future. The interests of navigation require that the flow down the St. Lawrence be maintained at a high degree of uniformity, and prevent the maximum use of water for power by fluctuating the hourly flow to meet the fluctuating power demand. An installed capacity well in excess of the minimum flow of the river has been provided, however, since the increasing value of power will justify its eventual development from the flow available during high-water periods only.
>
> *Paragraph 218.*—The improvement of the St.

Lawrence river could affect the water levels at and below Montreal to the extent only that the works might be so operated as to modify the rate of discharge of water down the river. The programme for the regulation of lake Ontario recommended by the Board is so drawn as to afford mean discharges during the critical months of September, October and November at least equal to the discharges that occur in nature; and discharges in the half of April, when the river has its maximum flood levels, no greater than those that would occur with equal frequency without regulation. There remains the possibility of the introduction of fluctuations in the discharge of the river through the fluctuations in the discharges through the power plants to meet their changing loads.

Paragraph 219.—Any necessary uniformity of discharge past the various power structures can be secured by opening sluice gates as the power load and power house discharge diminishes. Power can be profitably generated at the various plants recommended by the Board without causing any greater hourly and daily fluctuations in the water levels at Montreal than now occur from natural causes, and suitable government supervision, both over the plants in the international section and over those in the province of Quebec, can assure this result.

Paragraph 234.—Question 5: "To what extent may water levels in the St. Lawrence river at and below Montreal, as well as the river and lake levels generally, be affected by the execution of the project?"

Answer: The irresponsible operation of the power works proposed by the Board, or indeed of any power works, however designed, that develop fully the power resources of any section of the river, would affect injuriously the water levels in the St. Lawrence river at and below Montreal; but it is feasible to operate these works under government supervision in such manner that they will neither lower the summer levels in the lower river nor raise the winter and spring levels. With such control the improvements proposed will have no injurious effect whatever on the water levels of the St. Lawrence at and below Montreal.

Regulation and Control of Discharge from the Lakes

The possibility of regulating the discharge of the Great Lakes with the view of improving it, if possible, has been the subject of a thorough study. This study has shown that no improvement can be carried out which would warrant the extraordinary expenditure it would involve.

Certain interests in the Great Lakes have proposed that the level of the Great Lakes be controlled with the object of maintaining a given minimum. Now, the Great Lakes are the basins which feed the St. Lawrence, which regulate its flow. When the supply of water is very great, the levels of the lakes rise and the lakes retain a large portion of the supply. On the other hand, when the supply is small, the St. Lawrence is fed from the storage in the lakes, the levels of which then recede. If it be planned to install control works that would prevent the level of the lakes from receding during a certain period, this would prevent the lakes from performing their function, that of feeding the St. Lawrence. This is a project which must be opposed every time it is put forward. A calculation based on the conditions that obtained in the month of September, 1925, proves that in order to prevent the level of the lakes from dropping during that month, the discharge would have had to be reduced by 142,000 cubic feet per second. Now, what would be the effect of such a reduction at Montreal? The lake Ontario level would have dropped about two feet, and in the harbour of Montreal the drop would have been greater, since the level of the harbour under normal conditions drops one foot when the discharge is decreased by 23,000 cubic feet per second.

Diversions

Another interesting point is the effect of the diversion of water at Chicago on the level of the lakes and the level of the river. This diversion caused a lowering of about six inches in the level of lakes Huron, Michigan, Erie and Ontario. The level of lake Ontario was restored by the construction of a dam between two islands, at Galop rapids,—which is known as the "Gut" dam. The water diversion at Chicago results in a lowering of the level at Montreal by 4½ inches. This effect does not increase. It is definite and will not increase if the volume of water diverted is not increased. It will decrease if the volume of the diverted water decreases.

The lowering of the level may be remedied by means of compensating works. At the outlet of lakes Michigan and Huron, these compensating works would take the form of submerged weirs in the St. Clair river, which would spread over a great distance the additional slope it is desired to secure. At the outlet of lake Erie in the Niagara river, compensating works that would restore the level of lake Erie could be carried out. The estimated cost of all these compensating works is $3,100,000.

There is one thing, however, which the Chicago diversion causes, and for which there is no remedy. This is the loss of power represented by 8,500 second-feet on the available head. This loss amounts to 161,000 h.p. in the section of the river between Prescott and Montreal. With respect to the loss which this volume of water represents at Niagara falls, Canada may be compensated for same by a distribution of the amount of water authorized to be diverted from the falls. At the present time the volume of water diverted at Niagara falls under the terms of a treaty between the two countries is 56,000 cubic feet per second, of which 20,000 are on the United States side and 36,000 on the Canadian side. There is a proposal to increase this volume to 80,000 cubic feet per second, if it can be proven that such a diversion will not affect the grandeur or mar the beauty of Niagara falls.

There are several water diversions throughout the whole St. Lawrence system, most of them for the purpose of generating power. At the outlet of lake Superior, at Sault Ste. Marie, 50,000 cubic feet per second are diverted, of which 30,000 are on the American side and 20,000 on the Canadian side.

To compensate for this diversion on lake Superior, a dam which serves to control the discharge from the lake was constructed in St. Mary's river. This dam is under the control of the International Joint Commission. This diversion does not affect the levels below.

The most important water diversion outside of Chicago is that at Massena. Between the St. Lawrence river at the head of Long Sault island and Massena, N.Y., on the Grasse river, there is a drop of 42 feet. The river at Massena is three miles from the St. Lawrence. A feeder canal was excavated, whereby 23,000 cubic feet per second are diverted for the generation of 86,000 h.p., used for the manufacture of aluminum. This water again finds its way into the St. Lawrence by the Grasse river and in no way affects the level of the river below.

Grain Carrying Charges

The effect of this improvement on the transportation charges is a matter of discussion. Certain enthusiastic supporters of the project speak optimistically of a reduction of $0.10 per bushel in the grain carrying rates. There are others who assert that there will be no change whatever in the freight rates. During the past few years the cost of grain transportation from Fort William to Port Colborne has been, on an average, $0.03 per bushel. This rate will not be lowered as a result of the proposed improvement.

The distance between Fort William and Port Colborne is 850 miles, and requires a lockage lift of 18 to 20 feet at Sault Ste. Marie. The average time required for this lockage in 1925 was 1 hour and 9 minutes, inclusive of the delay incidental to the entry into the canal and the exit therefrom.(2) If one deducts the delay, the lockage itself took an average of 52 minutes. This demonstrates the importance of the vertical distance.

From Port Colborne to Montreal the distance is 368 miles, but the vertical drop which must be overcome by canals and locks is 540 feet. This vertical distance is equivalent to an horizontal distance of about 300 miles for the average freighters on the Great Lakes. Under present conditions the cost of grain transportation, including the transshipment charges between Port Colborne and Montreal, works out at about $0.06 per bushel. This is the only section of the river where a reduction in transportation costs is anticipated. What will this reduction amount to? The most competent authorities have stated that this reduction may reach a maximum of $0.03. It can only apply to grain tonnage which will be carried mainly by this improved route. On the basis of the cost of wheat, this reduction would equal $1.00 per ton. As the capacity of the projected canal is 24,000,000 tons per year, the maximum amount that could be saved on this basis would be $24,000,000. (Last year, cargoes totalling 7,200,000 tons passed through the Welland canal, so that the economy effected would, therefore, be $7,000,000.) Twenty-four million dollars is the maximum which may be hoped for. Can this maximum be realized? There is reason to doubt whether it will be. Traffic on the Great Lakes in 1926 totalled 121,000,000 tons, divided between four main commodities, namely:—

> Iron ore, from the mines on lake Superior to the harbours on lake Erie, 63,000,000 tons;
> Coal, traffic from the east to the west, return traffic, 31,000,000 tons;
> Crushed stone, 14,000,000 tons;
> Grain, 12,000,000 tons.

These products are carried as bulk cargoes. The balance of the traffic is largely made up of package freight which only represents a very small portion of the total traffic. Iron ore will not be transported by way of the improved canals. It is used in the blast-furnaces in the Pittsburgh district and in the ports on lake Erie. Coal is shipped to us from the ports on lake Ontario. It is doubtful whether the improvement contemplated will have the least effect on the freight charges for this kind of merchandise. Crushed stone and gravel constitute a very important local traffic which, however, will not extend beyond the Great Lakes. Grain is the only article which may increase the traffic on the Great Lakes, and this traffic will probably show a very large increase.

What the package freight to be developed on the St. Lawrence route will amount to is problematical. On the other hand, it must be borne in mind that the fixed charges, interest and maintenance of the canals, will be several million dollars greater than they are to-day. There are no toll charges on the canals, which are free to navigation.

There is another aspect of the deep waterway project to which attention must be called, and that is the necessity of separating the cost of navigation from the cost of power development. The canals of Canada have been declared to be public works, which have been carried out for the greatest advantage of the country, and their cost is paid by the whole country. Water power must be paid in the final analysis by the consumer of electric current. Now, the government is being advised from certain quarters to deviate from this principle, and the following proposal is put forward:—

The St. Lawrence deep waterway may be carried out without entailing any cost to the country, in addition to those expenditures we are committed to, such as the Welland canal. Here is the proposal:—As an offset to our expenditures for the Welland canal and the deepening of the St. Lawrence below Montreal, the United States would be asked to undertake at their own expense the works projected in the International section of the river for the improvement of navigation and the development of power, Canada would take her share of the completed works, including half of the power. As regards the national or Canadian section of the river, the section situated wholly in the province of Quebec, it is submitted that the producers of hydro-electric power, private interests probably, but the principle would be the same in the case of a government organization, would be prepared to provide the country with improved navigation free of charge, in exchange for the privilege of developing the water power, and here you have a completed deep waterway project without any further cost to the federal treasury.

It is, nevertheless, interesting to ponder for a minute and ask oneself who is going to assume the function of the federal treasury, because, after all is said, this improved navigation, whose cost is estimated at from $86,000,000 to $90,000,000, must be paid for by somebody. The canals cannot provide any revenue, as they are free. The only source from which these producers or private interests could derive revenue would be the sale of power. Consequently, it is self-evident that the cost of navigation, which would be added to the normal cost of their power development, would be paid by the consumer of electric current. This mode of procedure would be extremely unfair to the province of Quebec which would be called upon to pay in final analysis the cost of an improved navigation that is designed to benefit and is demanded by interests outside the limits of the province.

This proposal is embodied in the report of the National Advisory Committee. It is stated in this report:—

> "We believe that if a reasonable time were permitted in which to enable the resultant power to be economically absorbed, the development of this national section would be undertaken by private agencies able and willing to finance the entire work, including the necessary canalization, in return for the right to develop the power."

Messrs. Beaudry Leman, A.M.E.I.C., and the Hon. Adelard Turgeon declined to assent to such a proposal, and it is to be hoped that the federal government will not entertain it.

What we require in the province of Quebec is cheap power that will bring large industries in our midst and keep our population at home. The system that is proposed is not designed to give us this result.

The following is the meaning of this proposal in figures:—The cost of the works for deep navigation in the Canadian section is estimated at $86,000,000. About 3,000,000 h.p. can be developed at Soulanges and Lachine at a

(2) See paragraph 139, Appendix "B."

cost of $296,000,000. Now, then, the fixed charges on this capital expenditure of $86,000,000 will amount to at least $7,000,000. Spread over 3,000,000 h.p. it means that there must be added $2.50 per h.p. to the sale price of the power. This is the minimum increase. But 3,000,000 h.p. can only be fully marketed after a long period of years. It is very likely that improved navigation will have to be provided before the 3,000,000 h.p. can be marketed. It is even possible that the additional charge will have to be spread over one million h.p. In that case $7.00 per h.p. would have to be added to the normal selling price in order to cover the costs of navigation. Such a principle will never find acceptance in Ontario, and it is to be hoped that Quebec will not lend it support.

Conclusion

(1) The St. Lawrence can be improved for navigation alone at a cost of $167,000,000 between lake Ontario and Montreal, and at a cost of $44,000,000 in the Great Lakes section, for navigation at 25 feet. This is the deep waterway project proper.

(2) The St. Lawrence can be improved for power alone by retaining the present canals, at a cost of about $533,000,000,—whether there be canalization or not, this water power will be developed some day.

The two proposals are distinct.

(3) It is essential that a uniform flow be maintained down the river and every development scheme must be made to provide for the maintenance of this uniformity.

(4) We must scrutinize the plans which may be proposed with respect to the development of the international section of the river, as well as the plans which may be proposed in regard to the control of the flow from the Great Lakes.

(5) The cost of canalization must be separated from that incidental to the hydro-electric development,—improved navigation should be paid by the country at large, and not by the consumers of power.

Arc Welded Structures

Progress in the Art of Arc Welding and its Application to Structural Engineering

Gilbert D. Fish,
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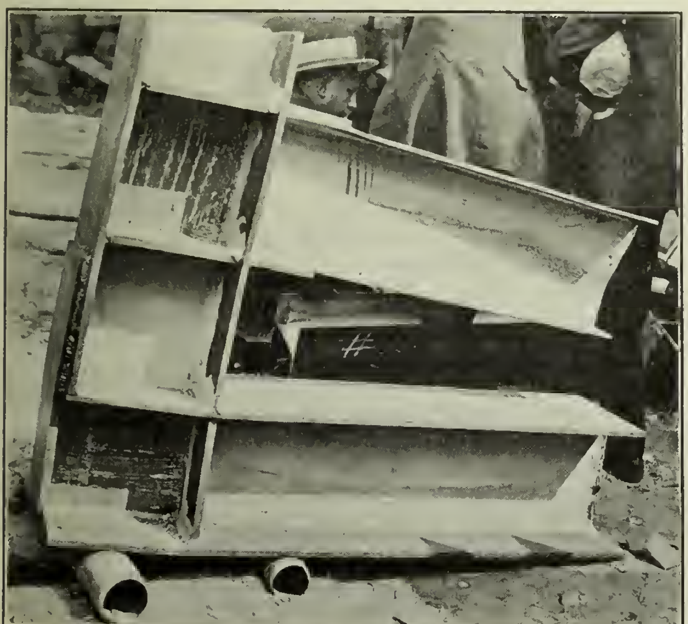
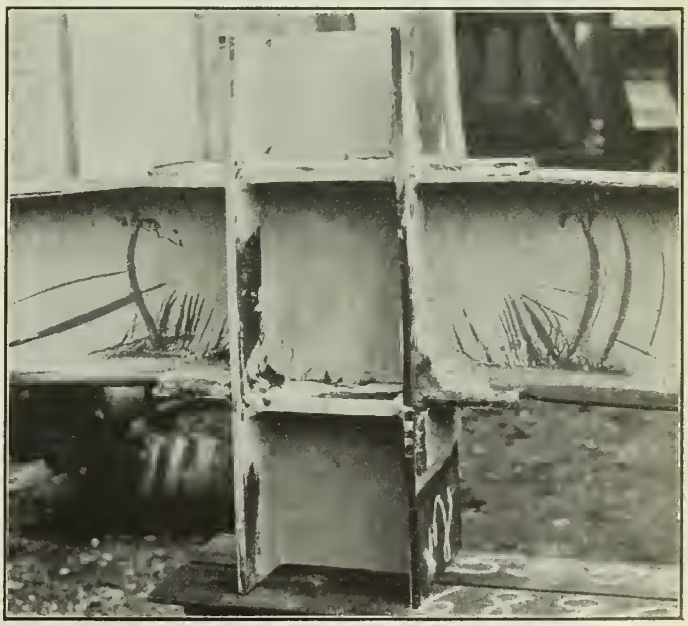
Paper presented before the Montreal Branch of The Engineering Institute of Canada, October 6th, 1927

The integrity of arc welded connections correctly designed and executed under proper control has been established. Wherever structural steel parts are to be joined permanently together, the electric arc process is suitable for the purpose.

The analysis of welded joints, although still in the research stage, is inherently more definite than that of riveted or bolted ones, because of the continuity of metal through the junctions. We know enough about the properties of welded joints at this time to design and detail welded structures economically according to definite standards, and the testing and research now in progress are enabling us from month to month to refine our designing methods and reduce excessive safety factors.

Welded joints will prove more permanent under severe conditions of moving loads and stress reversals than riveted ones, owing to their immovability. Doubt is frequently expressed as to the fatigue and shock resistance of weld





Figures Nos. 1 and 2.—Welded Cantilever Joint Used in Test at Carnegie Institute of Technology in Pittsburgh.

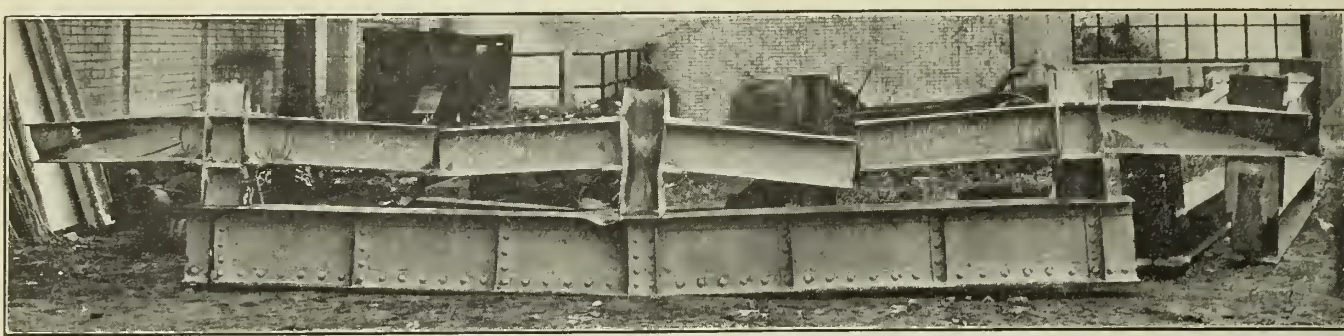


Figure No. 3.—Result of Test of a Riveted Girder.

metal, laboratory tests having shown that the cast steel forming a weld is somewhat inferior to rolled steel in respect to these factors. What counts is that the properly designed welded joint, in which no part suffers strains beyond the elastic limit, has a joint resistance to impact and fatigue far superior to the non-continuous riveted joint in which rivets are stretched and connection angles twisted by sudden and frequently repeated deflections of one or more of the connected members.

Continuity or fixedness of welded joints brings into use the elastic, or " rigid " frame, with its economy of material, elimination of play at joints, minimum deflection and vibration, and reduced cracking of fireproofing material and plaster if used. The elaboration of design calculations for the elastic frame places an extra burden on the designing engineer, but the elimination of rivet holes greatly reduces the work of the detailer and steel shop draughtsman.

The change from riveted to welded construction, now in its early stages but taking place at increasing speed, calls for changes in the instruction of professional engineering students and for study on the part of practising engineers. There is need for a text book covering welded construction in its present state, and steps are being taken to meet this need.

The reasons for preferring welding to riveting in structural work are its comparative economy, its availability for some purposes not served by riveting, its properties whereby the bending and tensile strength of the members joined may be fully developed, its reduction of dead weight and bulk of steel required, and its silence.

Figure No. 4.—Result of Test of Welded Plate Girder (with Plates and Angles).

The Westinghouse tests at the Carnegie Institute of Technology in Pittsburgh in July 1926 proved that arc welded structural joints could be made stronger than any possible riveted joints. Figures Nos. 1 and 2 show cantilever joints which developed the ultimate bending resistance of the cantilever arms, a performance not to be matched by riveted joints regardless of number, size or arrangement of rivets and connecting parts.

These and similar tests paved the way for the first use of fully continuous beams and girders in steel building construction, which occurred in the Sharon building. This statement is made with due respect to the prior use of cantilever beam construction in riveted buildings and the familiar continuous plate girder of turn-tables and deck bridges.

Figures Nos. 3 to 5 show results of testing a riveted plate girder, a welded plate girder made of duplicate parts, and a welded girder of the same depth made of plates only. The welded girder made of plates and angles developed 9 per cent greater ultimate resistance under concentrated centre load than the riveted girder, due probably to the welds connecting the flange angles directly to each other at their heels. The girder made of plates only weighed the same as the riveted girder but developed 55 per cent greater ultimate resistance due to its greater section modulus and its stiffer compression flange.

Figure No. 6 shows the Sharon building of the Westinghouse Company. Figures Nos. 7 and 8 are views of the massive plate girders carrying five tiers of that building across the 45-foot crane runway. Figure No. 9 illustrates a typical interior column joint, with two 15-inch beams and two 20-inch girders fixed by welding to the column so that full continuity is developed in both directions; absence of continuity as in riveted construction would have necessitated 18-inch instead of 15-inch beams and 24-inch instead of 20-inch girders. Welded construction saved 100 tons of steel in this 800-ton structure.

Figure No. 10 is a view of the welded building at Derry, Pa., which was constructed of 135 tons of fabricated steel and 200 tons of plain material shipped directly from mill to job. The purlins were made fully continuous by the welding, but the rafters could not be made continuous because they were at different elevations. The welded design required 10 per cent less steel than the riveted design on which comparative bids were taken, and the cost to the owner was approximately 10 per cent less than the bid of the same contractor on the riveted design.

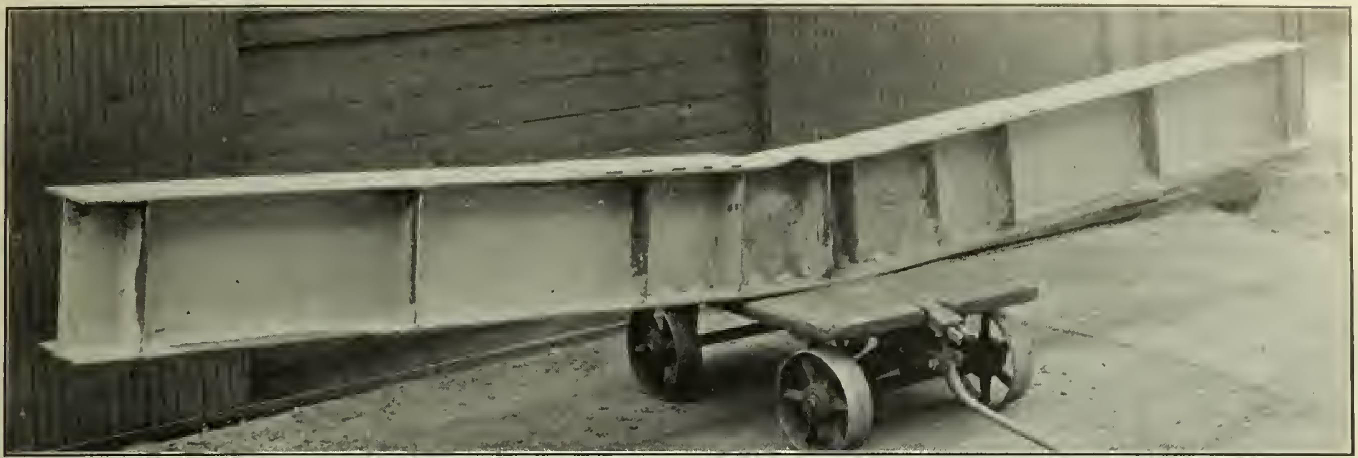


Figure No. 5.—Result of Test of Welded Girder (with Plates only.)

Arc Welding in Railroad Work

The principal uses for arc welding in railroad work are:—

(1) Miscellaneous shop work on locomotives and cars, especially repairs and building up worn parts such as wheels.

(2) Maintenance of way, particularly building up worn frogs and switch rails.

(3) Construction of miscellaneous steel structures such as signal bridges, switch towers, catenary supporting bridges on electric lines, transmission towers, water towers and tanks.

(4) Construction of buildings such as machine shops, tool houses, train sheds and stations.

(5) Constructing steel bridges, trestles, viaducts and turntables.

(6) Reconstruction and reinforcement of bridges to carry increased train loads or to restore original strength after deterioration.

(7) Construction of locomotives and cars.

Arc welding for repair purposes has been going on in railroad shops for some years. It is the author's belief that all railroads have arc welding equipment, and its use for building up worn wheels, repairing cracked cylinders and fireboxes, fastening boiler tubes to tube sheets, and repairing broken parts of locomotives and shop machinery is too well established to require detailed discussion here. The use of arc welding in locomotive boiler construction is being developed. Many welded tanks are in use by railroads.

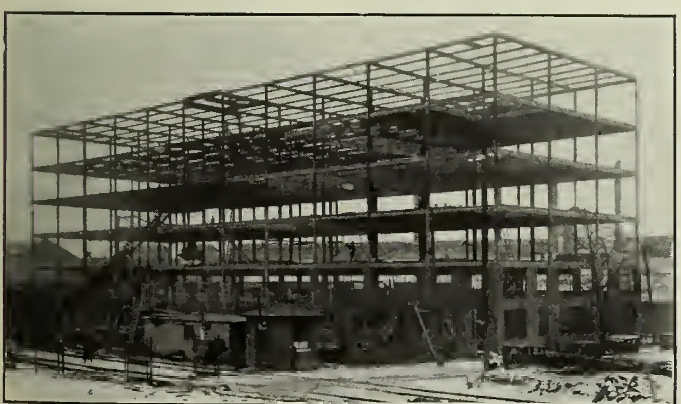


Figure No. 6.—Sharon Building of the Westinghouse Company.

Extensive use of the arc is being made for building up manganese steel frogs in railroad yards. The joining of rails by welding is very common where track is embedded in concrete or pavement, and the arc method is generally employed for this purpose. The C. B. & Q. Railroad has built half a dozen small arc welded buildings; as welded buildings have already been discussed sufficiently for the purposes of this paper, further reference to them will not be made except to point out that railroads are suitably organized to construct welded buildings of unfabricated steel, using their own labour and sometimes drawing on the steel scrap pile.

Light steel structures such as signal bridges and towers are an attractive field for welding. Many parts of such frames, when designed for riveting, are made of angles with legs 2½ inches wide to take ¾-inch rivets and ⅜-inch thick to withstand weathering, where angles of the same

Figure No. 7.—View of the Plate Girders of the Sharon Building.

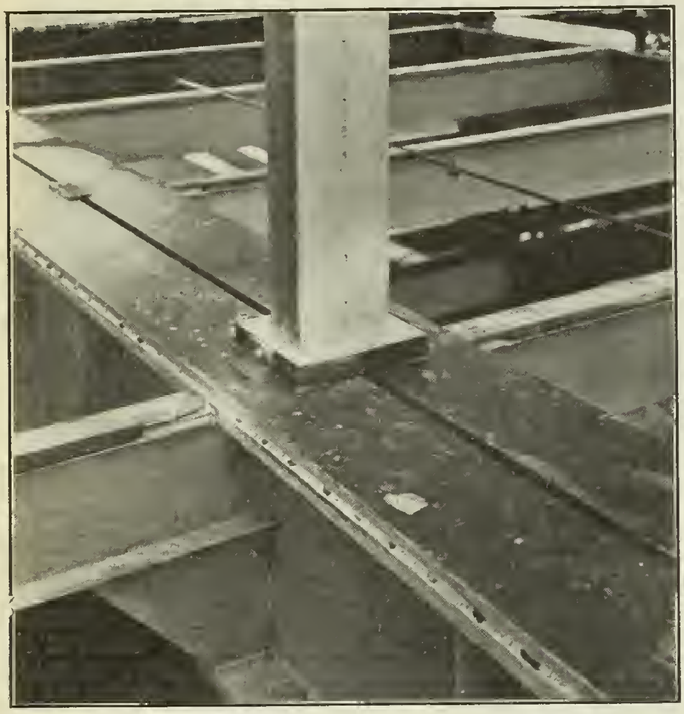


Figure No. 8.—Welded Plate Girders of the Sharon Building.

thickness but with narrower legs or narrow bars ⅜-inch thick would serve the purpose if welded.

Again, the tension value of a small angle or lattice bar connected by rivets in one leg only is very small in relation to its weight, and welded connections for such members save a large percentage of weight. Further, the fabrication cost is relatively high in these light frames when riveted, whereas such structures if welded can be built on the floor of a shop with the use of jigs and entirely without punching.

The author has recently designed for welding a four-track signal bridge which required 25,000 pounds of steel according to the railroad standard for riveted construction; the design for welding required less than 10,000 pounds, although standard working stresses were figured and the ⅜-inch minimum thickness rule was observed; part of the difference was due to many parts of the riveted design being unnecessarily heavy in order to match corresponding parts of the eight-track bridge, but most of the saving in the welded design was due to the economy of material inherent in welded design. Struts and braces carrying slight loads can often be made lighter when connected by welding, because of the superior fixation of the ends. Main compression members of bents and trusses may be reduced by subdividing panels with cross braces welded in place; this procedure being economical in many cases where it would not pay to introduce extra fabricated pieces. Gussets are almost entirely eliminated from truss and bent construction in this class of work. Avoidance of gussets and reduction in cross-section of members reduce both dead load and wind load stresses and in the case of overhead structures on railroads have the additional advantage of improving visibility. Cost of maintenance is somewhat reduced due to saving in the painting item, the surface of metal being less and the absence of rivet heads lowering the labour cost of brush painting and doing away with the points of worst corrosion.

The Pullman Company has effected savings of 50 per cent in cost of electric transmission towers by substituting arc welding for riveting. The Mississippi Valley Structural Steel Company is manufacturing roof trusses by arc welding on the floor of one of its shops and reports cost savings. Within the last month the author has brought together an oil company and a steel shop on a project for shop manufacture of standardized small buildings for erection at scattered points, the building frame to be shop welded in panels and bolted together in the field.

The Westinghouse Company is welding all frames and bases for its transformers built at the Sharon works, and the savings realized at that plant due to replacement of riveting are estimated at $20,000 a month, with further economies in view due to improved designs and extension of automatic welding. Generally, in light steel construction with considerable repetition of pattern, where most of the work can be done in the shop with the aid of jigs, the replacement of riveting by welding can be made to save about half the cost of riveted construction, with increased stiffness of the structures and without any disadvantages.

Reconstruction of Railway Bridges

The most interesting application of arc welding in railroad work are the construction and reconstruction of bridges and viaducts. Few bridges built during the last century were designed for such heavy loads as they now carry; furthermore, most bridges become weakened by corrosion. At present, nearly all railroad bridges except those built within the last few years are overloaded, in many cases 50 per cent beyond standard specifications for new bridges. The more serious cases cannot be remedied by riveted reinforcement, because the cost of such operations would exceed the cost of new bridges and because major alterations would close the bridges to traffic. Less serious cases may be reinforced by riveting, usually at very high expense and rarely without impeding traffic.

Even minor reinforcements usually weaken some of the members temporarily and require interruptions of traffic or reduced speed of trains. On multi-track bridges the floor systems may be reinforced by introducing additional

Figure No. 9.—A Typical Interior Column Joint of the Sharon Building.

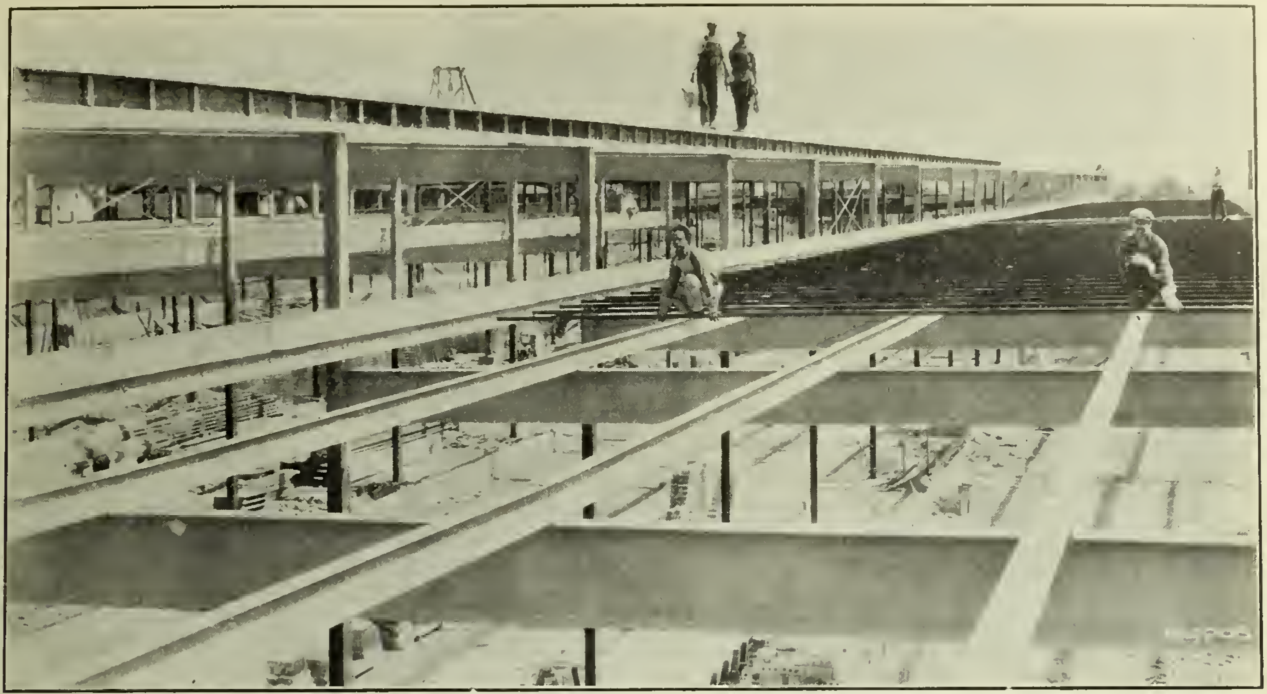


Figure No. 10.—Welded Steel-work of Building at Derry, Pa.

stringers and by riveting extra cover plates to the floor beams, one track at a time being closed to traffic. Where flange angles are badly corroded or cracked, they cannot be restored by riveted reinforcement but must be replaced.

The situation as described to the author by a number of railroad bridge engineers is a serious economic problem for the railroad companies, which are faced with the necessity to replace a majority of their bridges within a limited number of years unless they turn to welding as a means of reinforcing the old structures.

The American Bridge Company recently completed extensive arc welded reinforcement of the Great Western bridge across the Missouri river at Leavenworth. This operation, which saved a large part of the expense which would have been involved according to the original plans, was the first application of arc welding for major alteration of a railroad bridge, at least in this country. Several months earlier the Neeld Construction Company of Pittsburgh reinforced and double-decked the long highway bridge over the Susquehanna river at Havre de Grace, using arc welding exclusively for field connections.

New Bridge Construction

For new bridge construction, welding permits great economy of material for several reasons. Stringers are made continuous, with consequent saving averaging about 20 per cent in weight of stringers. Flexural members other than rolled beams, whether acting as stringers, floor beams, top lateral cross-beams, or main girders in plate girder spans, require less material if designed for welded assembly than otherwise, because the best type of welded plate girder uses plate material only and has a greater section modulus than a plate and angle girder of the same weight and depth.

Tension members of trusses are designed without deductions for rivet holes, such deductions in riveted designs frequently amounting to 15 per cent. The small amount of labour required to weld in place a light brace provides opportunity to reduce the unsupported lengths of long compression members and therefore to reduce their weights. The largest item of material saving is the elimination of most of the connection material, which amounts to 30 per cent of the total weight of steel in many riveted bridges. The lightness of the welded bridge means smaller dead load stresses than for the riveted one, and this is in itself an additional basis for weight saving.

Figure No. 11 shows a welded bridge designed to carry a spur of the Boston and Maine Railroad across a canal into the plant of the Westinghouse Electric and Manufacturing Co., at Chicopee Falls, Mass. The design has been

Figure No. 11.—A Welded Bridge Designed to Carry a Spur of the Boston and Maine Railroad across a Canal into the Plant of the Westinghouse Company, at Chicopee Falls, Mass.

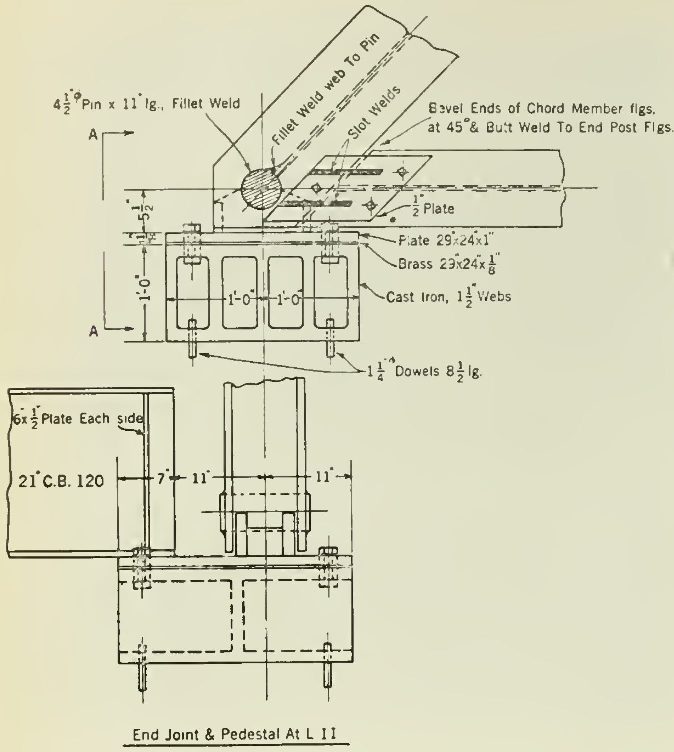


Figure No. 12.—Detail of End Joint and Pedestal of Welded Bridge at Chicopee Falls.

approved by the railroad and proposals for construction are expected this week. This is a single track through span with extreme skew, each truss being 135 feet long. The live loading is Cooper's E-50.

The bridge was first designed for riveting, with Cooper's E-60 loading, this design requiring 140 tons of steel. For E-50, the riveted design would require about 120 tons. The welded design calls for 80 tons, saving one-third in material. The weight saving is due to omitting most of the connection material, utilizing gross section of tension members, 30 per cent reduction of dead load stresses, use of extra brace members to reduce length ratios of compression members, and continuity of stringers. The centre line dimensions were made the same as for the riveted design, but rolled sections of the H-column type have been substituted for built up sections throughout.

It is believed that this is the first welded railroad bridge. Details of the design may therefore be interesting to structural engineers and steel men. Figure No. 12 shows an end joint detail. A 4½-inch pin is set in a hole drilled through the end post H-section and welded in place; both flanges and the web bear on the pin. The pin pedestal is made of two 1½-inch plates having semi-circular notches to carry the full vertical truss reaction transmitted by the pin, with two 1-inch plates welded between the pin plates

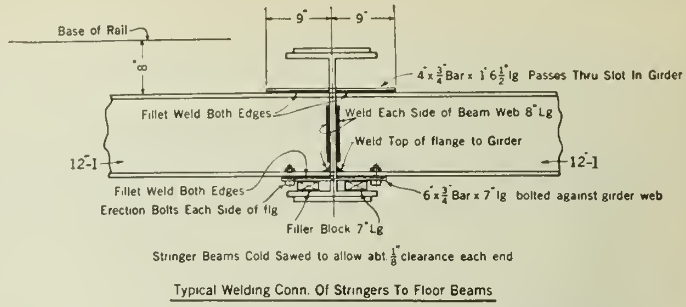


Figure No. 13.—Plan of Typical Stringer-to-Floor-Beam Connection for Chicopee Falls Bridge.

to brace them. All four plates are welded to the 1-inch sole plates.

The sole plates have slotted holes where the anchors go through, and ⅛-inch brass is used between sole plate and cast iron pedestal to permit sliding with temperature change. The pedestal, which is partly embedded in concrete abutment, is made of cast iron to resist rust, the top of the abutment being only a few inches above the water line. The bottom chord tension is developed mainly by butt welding the chord flanges to the flanges of the end post; the ends of the chord flanges are bevelled 45 degrees to facilitate butt welding. The additional tension carried by the web of the chord member is transferred across the joint by the strap plates; these are welded not only along the horizontal edges but also through the slots, which are ½ inch square in section. These plates are bolted to the members for erection purposes.

Figure No. 13 shows a typical stringer-to-floor-beam connection. The continuity is developed by a tension plate passing through a slot in the beam web and welded along its edges to the top flanges of the stringers, and by butt plates below which also serve as erection seats. The web weld is for vertical reaction. If full continuity were not developed it would be unsafe to carry the end reaction by means of a weld between the stringer web and the supporting beam, because the deflection of the stringer under live load would be likely to crack the weld. A safer procedure, in any case where it might be impracticable to develop continuity, would be to use side framing angles with welds at the outer edges, thus providing a flexible element which would accommodate the stringer deflection by yielding slightly in torsion at each application of live load. In riveted work the upper rivets connecting framing angles to supporting beam usually stretch, thus relieving considerably the torsional fatigue in the angles but throwing most of the load upon the lower rivets.

The steady replacement of the rivet by electric arc welding is a great economic movement which cannot be checked by skepticism as to the dependability of the process. The results can be definitely controlled, and failures are as definitely preventable as they are in other engineering operations.

Recent Developments in the Combustion of Fuels

A General Summary of Present Methods of Combustion with Particular Reference to Western Canadian Coals

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Paper read before the Winnipeg and Lethbridge Branches of The Engineering Institute of Canada, October 27th and October 29th, 1927, respectively.

The question may well be asked by those who have been studying the stock market this last year, "Why is it so important to develop combustion methods, is not hydro-electric power much cheaper?" It is true that during the last twenty-five or thirty years there has been a rapid increase in the use of hydro-electric power, but unfortunately our cheap water power sites are not unlimited. There are, no doubt, many places where owing to natural advantages the actual construction costs of storages and power plants are low, but the cost of getting the power to the customer is in many cases prohibitive. The result is that while the average cost of hydro-power is steadily climbing the cost of coal-power is steadily decreasing, so that in a few years, except in a few fortunate localities, we must look to fuels as the source of electric energy.

According to a statement recently made public by a geological survey of the United States Department of Interior at Washington, the total electric energy produced by public utility plants in the United States in 1926 was 73,791,000,000 kw. hrs., of this 47.5 billion kw. hrs., or 64.5 per cent, was generated by the use of fuels and the rest by water power. Of the 47.5 billion, 90 per cent was obtained from coal and 10 per cent from oil, gas or wood. The average rates of consumption were as follows:—

Coal..................1.94 lbs. per kw. hr.
Oil.....................243 kw. hr. per barrel
Gas...................22 cu. ft. per kw. hr.

while the best fuel rates were:—

Coal...................0.9 lbs. per kw. hr.
Oil.....................450 kw. hr. per barrel
Gas...................13 cu. ft. per kw. hr.

As these latter are roughly one-half the average rates, the consumption of fuel by electric public utility power plants would have been reduced one-half if all electricity had been produced at the best fuel rates and this would have conserved more than twenty million tons of coal in the year, representing a value of approximately $75,000,000.

These figures do not take into consideration the industrial boiler plants where at least a similar saving is possible. Also for every plant burning 500 tons per day there are hundreds of small plants burning from 5 to 20 tons per day. It must not be forgotten, however, that dollar efficiency and not fuel efficiency is the most important factor, and in a great many of the smaller plants it requires careful investigation to show that large expenditures will pay dividends. In making improvements to boiler room equipment considerable saving in labour can sometimes be shown as well as fuel savings, while in other cases labour is already down to a minimum, so that fuel savings only can be taken into consideration.

Some people claim that owing to the fuel reserves being limited, they should be conserved at all costs, while others more interested in the fuel industry are more concerned, say, in coal production at the present time than they are in the necessities of future generations. It is probably true that both these schools of thought are somewhat radical and the general belief is that although waste is regrettable at any time, yet no industry can prosper unless it can show dividends for every dollar expended.

In general there are three methods of firing coal:—(1), hand-firing; (2), automatic stokers; (3), pulverized fuel.

It is only recently that much serious thought has been given to the improvement of hand-firing methods. This type of firing applies to houses, apartment and business blocks, and small industrial plants. Too often the average householder would rather pay $25.00 or thereabouts more per winter than bother about improving his conditions. Also in the smaller industrial plant the executive, in trying to keep down expenses, will not pay the necessary salaries to get competent men. The boiler plant is considered a dirty, messy place, a good place to stay away from, and all the thought he gives to it is when he growls at the monthly coal bill. His men soon get to know this and, not having any incentive to do better, become as lax as their employer.

Another trouble is with the building designers, who forget all about the boiler room until the last minute and then put it down in some corner which is no good for anything else, and too often no good for boilers either. These conditions, of course, do not always apply, but it should be remembered that in any concern, especially in this locality, the boiler room is one of the most, if not the most, important parts of the industry, because no other department can function until it does.

In spite of all these drawbacks, however, big improvements have been made. H.R.T. boilers are being set higher, with furnaces big enough to burn the gases before they reach the relatively cool drums. Some engineers still cling to the old idea of using triangular piers, half way between the bridge wall and the rear wall, to mix the gases still further. Before furnace volumes became adequate this method was very effective, but with modern settings an attempt is made to complete combustion before the gases pass the bridge wall, and in this way eliminate the costly settings made necessary by the almost blow torch action of the piers.

Another big improvement is the use of forced air with proper means of regulation and boiler room instruments, such as CO_2 meters, draught gauges, flow meters, etc. The firemen thus given some encouragement are taking more interest in their work, the effect being as much psychological as anything else. The use of forced draught under proper control means not only higher efficiency, the ability to burn a greater variety of coals and higher combustion rates, but also in some cases it means a considerable reduction in banking losses. In a number of cities in the United States this is found to be true in connection with heating of school buildings. Being able to get up steam in a much shorter time means a saving of several hours of labour after the building has been closed for any period.

These conditions do not always hold true, and it is therefore very difficult to make a general statement as to the particular type of equipment to be used. Each case must be figured out on its own merits, bearing in mind all conditions, including coals available, their cost, particular load conditions, etc.

The question is often asked regarding the advisability of sprinkling coal or using steam jets to aid combustion. From a purely thermal standpoint this means a direct loss, but other factors come into play which in some cases result in a net gain. The most reasonable explanation of this seems to be that the moisture or steam, meeting the excessive temperatures of the fuel bed, is broken up into its original constituents of hydrogen and oxygen and this nascent oxygen seems to be much more efficient in combining with carbon than ordinary air. If this explanation is true it would appear that it would be very effective with coal of ordinary moisture, but it does not seem reasonable to add water to lignites which already contain from 15 to 35 per cent water.

Stokers

Due to natural improvement in design and also the severe competition of pulverized fuel, the tendency has been towards higher ratings and increased efficiencies. This has resulted in compulsory changes in furnace as well as stoker design. Several new stokers for small boilers have been introduced and those already well known have been changed as a result of more experience, and also to meet local conditions.

In the case of the underfeed multiple retort type, in order to reduce the combustible loss in the ash pit, clinker grinders are becoming standard equipment for large installations where high ratings are required. By this means a larger effective grate area can be secured, thus increasing the boiler rating for a given combustion rate and coal. For any given coal each stoker has its own maximum efficient combustion rate, i.e., the number of pounds of coal which can be burned per square foot of grate area per hour to give the maximum efficiency.

High combustion rates and high efficiencies mean higher furnace temperature, and it is this furnace temperature which has complicated matters. Stoker parts must be well protected and provision made to prevent slag formation at the sides where the walls and stoker meet. This is true with both underfeed as well as chain grate stokers. Carborundum bricks and hollow blocks seem to be overcoming this difficulty to a large extent although some companies still report high maintenance. The biggest difficulty seems to be along the side walls, due to the necessity of removing clinkers. Carborundum is extremely hard and somewhat brittle so that a sudden jar such as is sometimes necessary to remove clinker will crack the blocks. Resetting is required at irregular intervals, varying from three months to two years, depending on the coals used and ratings developed.

With chain grate stokers we have an added complication due to the necessity of arches. Very extensive study has been given to this phase of stoker work and important developments have taken place. This is especially true with regard to the burning of anthracite fines, coke breeze and high moisture lignites. Arches are necessary not only to obtain quick ignition but also to maintain ignition and assist in eliminating the stratification of gases. Owing to combustion taking place in several successive stages this stratification becomes a serious menace to high efficiency unless great care is taken. The percentage of CO_2, CO, and O_2, varies quite considerably over the length of the grate and the various gases attempt, if possible, to find their way up through the boiler passes without mixing. Designers use one arch, two arches and sometimes three arches to effect proper mixture and reduce the combustible loss in the ash pit. In some cases, also, a steam or air jet is used through the front arch causing turbulence at the furnace throat, although this is not in very general use.

Although attempts are usually made to obtain a balanced draught or a small negative pressure in the furnace it is sometimes found necessary, especially with coke breeze, to maintain a slight positive pressure. This plays havoc not only with the arches and furnace walls, but also with any parts of the stoker exposed in the furnace. This means that unless the stoker is very well designed and constructed, maintenance costs are very high.

Air Preheater and Water Walls

Two other developments which have influenced stoker work are airheaters and water walls, and it is very difficult to treat these two entirely separately, as the use of the one has a more or less distinct bearing on the other.

Due to the changes in turbine design, including back pressure and bleeder types, also the gradual changes in power plant heat balance, it is often found inadvisable to use water economizers. This brings up the question of utilizing the heat in the chimney gases, because, although the percentage of excess air can be greatly reduced by increasing the CO_2 content, there is still an appreciable flue gas loss. The air preheater was the natural outcome of this situation.

As a result of tests made with air preheaters and Westinghouse multiple retort stokers at Colfax station by Mr. G. W. E. Clark, the following notes were made:—

(1) The fuel bed was much more uniform with preheated air and no holes or disturbances of any kind appeared to break up the uniformity of operation.

(2) The fuel ignited more readily.

(3) The fuel bed burned much more uniformly throughout its depth.

(4) There was less combustible ejected from the underfeed section to the clinker grinder pit.

(5) Less carbon was contained in the refuse discharge into the ash pit.

(6) The refuse in the clinker grinder pit ground out with less trouble, due to the character of the clinker.

(7) No clinker trouble of a serious nature was encountered at any time. The clinker itself was harder and more easily handled.

The three main types of airheaters are the rotary, tubular, and plate. In the rotary type the transfer of heat is obtained by passing the hot flue gases and the air alternately through portions of the equipment. The tubular type is similar to the standard water economizer, except that the heat is transferred to air instead of water. In the plate type the gas and air passages are separated by thin plates which are either bolted or welded together, care being taken to direct the flow of gas and air so as to obtain the greatest transfer of heat and the minimum draught loss.

Advantages are claimed for each type by the various manufacturers but it is not within the scope of this paper to comment on them. Suffice it to say that there are, no doubt, facts to bear out the various statements made and the purchaser should study the claims made very carefully before deciding on the type best suited for his particular conditions.

It is, however, of decided interest to note the effects of preheated air on stokers and furnaces. When the air necessary for combustion is admitted either through the fuel bed or over the fire at a temperature from 200 to 400 degrees in excess of ordinary boiler room temperatures an entirely different set of conditions is encountered. Clearances must be changed to take care of greater expansion. Air passages must be revised owing to the decreased density of the air and provision made to prevent burning out of the stoker parts.

Unfortunately the important moving parts of the stoker are inside the furnace and should anything happen to them it means shutting down the unit, in most cases, to make repairs. Again, preheated air usually means more rapid combustion and therefore higher temperatures. The limits of firebrick and tile are fairly definite and when these are approached troubles begin. Increased slagging on the side walls and on other portions of the furnace are a serious menace to the engineer's peace of mind, and although some companies report the use of air preheated to a temperature of nearly 500 degrees without excessive maintenance this does not seem to be general.

Air cooled arches and furnace walls were tried and this method is still being used with great success up to a certain point of boiler rating and efficiency. A great many engineers realized, however, that this was only a temporary breathing spell in overcoming the trouble, and this brings us to the water or steam cooled walls.

Steam cooled walls are simply radiant heat superheaters placed in the furnace walls with some sort of protection from the direct rays of the flame. It must not be forgotten that the specific heat of steam is approximately one-half that of water, so that there is a grave danger that the steam in the tubes cannot carry away sufficient heat to prevent them from burning.

Generally speaking water walls are composed of vertical tubes placed in the furnace walls and connected into the main boiler circulation. These tubes are also protected to prevent burning and many ingenious devices are used. One method is to shrink pre-cast iron blocks on the tubes, the idea being that the cast iron will absorb the radiant heat and conduct it through the metal to the water. Another method is to surround the tubes with firebrick tile, the advantage claimed being sufficient refractory properties to aid combustion at low ratings. A third type is known as the bifurcated water wall. In this type two tubes are welded together at each end so as to have a common connection to the header. A fourth type is known as the fin tube wall, which consists of tubes with a steel fin electrically welded on each side and diametrically opposite each other. These fins, which are ¼-inch thick and 1 7/16-inch wide, extend the whole length of that part of the tube which is exposed to the heat of the furnace. The tubes are spaced on 7-inch centers and form a continuous water cooled metal surface.

In all cases the tubes are bent out through the furnace wall at the top and bottom and expanded into headers which are connected to the boiler drums by suitable circulating tubes. Great care has been taken in the design of the headers and in the provision of necessary fittings so that this part of the heating surface may be as accessible and as easy to keep clean as the boiler itself.

A great deal of discussion has taken place with regard to the credit for increased steaming capacity which should be given to water-cooled furnace walls. When dealing with this aspect of the question it must be remembered that the steaming capacity of a boiler depends not so much on the amount of heating surface as on the amount of heat generated efficiently in the furnace. Provided that a boiler is properly designed and the tubes kept clean, both inside and outside, its capacity to deliver steam is unlimited within ordinary ranges as long as the proper amount of heat is applied. It is true that at high ratings the exit flue gas temperatures will be higher, but this can be taken care of with either water or air economizers.

The main advantages of water-cooled walls in connection with stoker firing are,—first, they eliminate furnace wall maintenance so that combustion is not limited in this respect; second, they relieve the boiler proper of a great deal of its work, so that draught loss and exit temperatures should be lower.

Pulverized Coal

The idea of burning coal in a pulverized form is not new, but it is only within the last ten, or possibly fifteen, years that it has been developed to any extent in stationary plant work. Previous to that time it had been used in the cement and steel industry, and although considerable success had been achieved it was realized that the problems were not the same as those which would be encountered in the ordinary power plant. The idea was also applied to locomotive work and there is still quite a number of locomotives equipped in this manner and doing good work in Brazil and also in Japan.

The early history of the development of pulverized fuel in power plants is a very interesting study, but time will not permit any comments at this time except to say that great credit is due to the men who had faith in the principles involved and who, in spite of discouragements and criticism, overcame the difficulties and finally succeeded in bringing about its present high standard of efficiency.

There are two distinct methods of burning coal in a pulverized form, namely, the indirect or storage system and the direct or unit system. In the first the coal is pulverized in ball or roller mills and stored in bins convenient to the furnace. From there it is fed through proper mixing chambers where it is mixed with from 10 to 20 per cent of the necessary air for combustion, thence to the burners and into the furnace.

The main advantages of this system are,—first, owing to the type of mill used, power consumption and maintenance costs are lower and, generally speaking, a more uniform fineness is obtained; second, the pulverizing can be done during off-peak periods and, if advisable, at some considerable distance from the boiler room; third, owing to the positive control of the feed and air regulation, a better mixing of the air and coal is possible so that in spite of fluctuating loads a very flat efficiency curve is possible. The big disadvantage is increased first cost.

With the direct system each boiler is a unit in itself. The coal is pulverized in a ball, tube or hammer mill placed directly in front of the boiler. In most cases the primary air, or about 20 per cent of the total air required, goes through the mill with the coal and the mixture blown directly through the burners into the furnace. Some companies admit as high as 90 per cent of the total air into the mill, but this method does not seem to be in very general use.

The disadvantage is a slightly lower overall efficiency and the need of more careful operation with fluctuating loads and changes in size, moisture content and types of coal. The reason for the lower efficiency is that the output from the mill will vary, due to a change in the size of coal, moisture content, or a slight variation in the feed, which means that the mixture of air and coal for maximum efficiency is difficult to maintain. This same variation will be caused by fluctuating boiler ratings.

Designers, realizing the advantages of the two methods, are now endeavouring to work out a simplified storage system with all the advantages and none of the disadvantages of both. The idea is to use, say, for instance, a roller mill and cyclone separator for each unit discharging the pulverized coal into a small bin in front of the boiler, from which a positive feed of air and coal under proper control is admitted to the furnace, and in this way it is hoped to reduce the cost of the storage system without any sacrifice in efficiency.

Burners

Burners are of two types, namely, vertical and horizontal. There is also the inclined type of burner, but it is really a modification of the vertical.

With the vertical type of firing the coal and primary air are fed through an arch into the top of the furnace. Ignition takes place a short distance from the burner tip and the flame sweeps down within a short distance from the bottom of the furnace where it turns upwards and through the boiler passes. Secondary air is admitted through openings in the furnace front and meets the downcoming stream of coal. The result is a long slow burning flame requiring a larger furnace but one which takes full advantage of radiant heat transfer.

With horizontal firing the coal and primary air meet the secondary air either in the burner or at the burner tip. The burner is constructed so as to give a turbulent motion to the mixture, resulting in much more rapid combustion and therefore smaller furnaces.

With the large public utility plants vertical firing still seems to be the most popular, although even here there is a tendency towards the horizontal type. Most of the industrial plants use the horizontal type with either the storage or unit system. The development of the horizontal burner is probably the result of engineers beginning to realize more fully the importance of intensive mixing. They have come to realize that the rate of combustion is determined by the rapidity with which oxygen and carbon are brought together and not by the speed with which they combine after being brought together. The particles of powdered coal, although small in size when compared with the oxygen molecules, are still very large. A very large number of the oxygen molecules must be brought in contact with the coal particles before the latter are completely burned. The surface area of the particles is rather small, so that only a small number of oxygen molecules can be brought in contact at a time. The products of combustion must be continually removed from the surface in order that contact with fresh oxygen molecules can be made. Intensive mixing helps to do this.

Furnace Design

The early installations used ordinary solid wall brick furnaces, the same as were used for stoker work at that time. The main difficulties encountered were the slagging of the ash and rapid erosion of the firebrick lining. The ash fused and accumulated in a molten condition at the bottom of the furnace and was very difficult to remove, resulting in much hard labour and frequent boiler outage.

The trouble was not so much with the high furnace temperatures but rather that the hot molten ash was sprayed on the refractory walls and ran down in a molten condition, eroding the brick on its path to the bottom of the furnace. This washing away of the brick was particularly rapid if the flames were allowed to impinge on it, and in order to overcome this, furnaces were made much larger than was necessary for good combustion. The advantage of turbulence was recognized but could not be made use of, so that the process of combustion was slow, the heat liberation seldom being more than 25,000 B.t.u. per cubic foot per hour.

The manufacturers of refractories co-operated in an attempt to overcome this trouble, but unfortunately the combustion of coal ash varies so much that it was found difficult to obtain a refractory material that would resist each variation in the ash composition. Hollow furnace walls were then tried and considerable success was attained. These walls are still being used under certain conditions, but as the size of steam generating units became larger and the furnace walls had to be built very high and wide, the designer became faced with the problem of making the walls mechanically strong so that they would not collapse before they were worn out by the erosion of molten ash. Expansion and contraction of such large walls was another difficulty and it was difficult to take care of this weakness.

Water-Cooled Furnaces

The steam or water-cooled furnaces as described earlier in this paper were next developed. At first only the bottom portion of the furnace was water-cooled. This created a cooling zone so that the particles of molten ash were cooled below the fusing temperature before they reached the floor. The ash, although at a very high temperature, does not contain a great amount of heat, so that in most cases a single row of tubes is sufficient for this purpose. Next, portions of the side walls and rear walls were added and as no serious difficulty was encountered it soon became apparent that the right way to build a furnace for burning powdered coal was, if possible, to build the boiler around it. Such metallic walls would be both strong and durable and being exposed to the direct radiant heat of the flame would relieve the boiler proper of much of its work. Particularly would it relieve the tubes in the first row of the excessive heat to which they are exposed in refractory furnaces.

In water-cooled furnaces the rate of heat liberation may be very much higher because the walls will not be damaged by high temperatures or even flame impingement. All the combustion space may be effectively utilized and burners, etc., may be so designed as to make use of intense turbulence of gases, thus resulting in thorough mixing and rapid combustion. As a result of this heat, liberation of 40,000 B.t.u. per cubic foot per hour is quite common, with nearly complete combustion, thus permitting the use of a smaller furnace.

When the water-cooled wall was first introduced it was met by a great deal of criticism from engineers all over the country, but up to the present time at least these criticisms have not been justified by actual experience. In a statement made by the Thomas E. Murray Company of New York, more than eighteen months ago, in connection with their experience with water walls at Hell Gate station, the following was said:—

> "It is necessary for us to clean the bottom tubes of our boilers at least once every three to four weeks, or we would lose tubes very rapidly. On the other hand, the side wall tubes are practically in the same condition today as the day they were installed. We have never had to replace a tube in the side walls and some of these boilers have been running for over two years. We consider that the side walls are very much less subject to trouble due to impure water than the ordinary tubes found in a water-tube boiler."

Another criticism was, that owing to so much heat being absorbed by these walls, the furnace temperature would be reduced to such an extent as to affect combustion seriously, especially at low ratings.

It has been proven, however, that the furnace walls only affect the radiation of a relatively thin envelope of the furnace volume and that the interior of the furnace is affected but little, if any, by wall conditions. When a mixture of coal and primary air is introduced into the furnace it must first be heated up before combustion starts. This heating is done in stages; first, any moisture in the coal must be vaporized. This process is heat absorbing, i.e., either the furnace walls or the burning flame must furnish the heat, and although some of it is furnished by the surrounding walls the greater part comes from the flames of burning coal and gases. Next comes distillation, which starts at about 400°F. when gases and volatile vapors are given off, forming smoke. The smoky gases from the coal contain carbon particles which continue to absorb radiant heat until the mixture reaches ignition temperature, and combustion of the gases begins.

The above will explain why it is that we have so much smoke in lighting up a pulverized fuel installation with a cold furnace. However, once ignition takes place the temperature above that point is of minor importance because it does not affect materially the bringing together of oxygen and carbon.

It is frequently observed that rapid combustion is accompanied by high temperatures and the conclusion is sometimes drawn that the rapid combustion is caused by the high temperatures. The true sequence, however, is intense mixing causes rapid combustion and rapid combustion causes the high temperatures. It will be seen from this that water walls will not affect combustion to any extent, but they do mean that combustion can be made independent of furnace limitations. With the usual rates of combustion found in steam boiler practice there is very little danger that water-cooled furnace walls will cause incomplete combustion by excessive cooling of the flame. The temperature of the flame is always high enough for anything to burn that is burnable as long as a supply of air is sufficient and mixed properly with coal particles.

The use of preheated air will greatly hasten the ignition of the coal after it has entered the furnace, because by this means a considerable portion of the heat necessary is supplied from without the furnace. Air preheated to 700°F. has been used in connection with pulverized fuel burning and water-cooled walls with great success.

In order to appreciate more fully the extent to which pulverized fuel units have been developed, it might be interesting to note the general dimensions of some of the larger plants:—

New Unit at Lakeside Plant

The new unit at Lakeside has the following heating surfaces:—

Water heating surface in furnace	1,544 sq. ft.
Water heating surface of boiler	28,532 "
Total water heating surface	30,076 "
Superheating surface	930 "
Reheating surface	933 "
Total heating surface in furnace	3,407 "
Air preheating surface	40,320 "

Steam is generated at 1,200 pounds pressure and a final temperature of 720°F. It is fired with pulverized fuel and has a capacity of 240,000 pounds per hour.

Kip's Bay Station

The arrangement of the heating surfaces in each unit is as follows:—

Furnace surface

Water heating surface in side walls	1,336 sq. ft.
Water heating surface in side walls between boiler tube banks	666 "
Water heating surface in front walls	942 "
Water heating surface in arches	500 "
Water screen	688 "
Total surface in furnace	4,132 sq. ft.
Boiler surface	10,802 "
Total water heating surface	14,802 sq. ft.
Superheating surface	None
Economizer	10,802 "
Air preheater	46,800 "
Total surface	71,682 sq. ft.

Steam pressure is 275 pounds, with no superheat. Vertical firing of pulverized fuel is used, the combustion space is 19,000 cubic feet, and the normal capacity of each unit is 340,000 pounds per hour.

Calumet Station

The heating surfaces are as follows:—

Water heating surface

Rear bank of tubes	3,637 sq. ft.
Side walls	1,710 "
Roof	254 "
Bottom bank of tubes	1,375 "
Total water heating surface	6,976 sq. ft.
Superheating surface ... approx.	3,000 "
Economizer	5,250 "
Air heating surface	25,200 "
Steam pressure	360 lb. gauge
Effective combustion space	5,000 cu. ft.
Normal capacity of unit	125,000 lbs. per hr.
Peak capacity of unit	150,000 " " "

Low Temperature Carbonization

This question has been causing a very great deal of attention on all sides for the last few years. Unfortunately extravagant statements have been made regarding the results obtained by its overenthusiastic friends. The impression should not be taken from this statement that low temperature carbonization has no future. It is generally believed by competent engineers that the time is coming when it will be considered little short of a crime to burn as fuel in the ordinary way those valuable by-products which can be obtained from coal, but, as stated previously in this paper, no industry can prosper unless it can show dividends for every dollar expended.

We hear a great deal regarding the value of by-products, but it must not be forgotten that the value of any article is not what the producer places on it but rather what the consumer can afford to pay, or is willing to pay. It is perfectly true that the by-products in question are valuable under certain conditions and in certain places, but it is foolish to talk of obtaining by-products of a certain value from a ton of coal when their actual market value is only a fraction of this amount and the net result of the whole operation is a loss.

The main difference today between a scientist and an engineer is that a scientist discovers new processes with little regard to their commercial value, while an engineer must apply these discoveries in a practical way to everyday problems. At present some two hundred processes of low temperature carbonization have been listed, while it is doubtful if 10 per cent have been operated on anything approaching the commercial scale. Of these 10 per cent a large number are successful under a definite set of conditions, but if attempted under different circumstances the result would be a failure from a financial standpoint.

There are two main types of low pressure carbonization processes: first, one in which the resulting char is similar in size to coal and is to be used as smokeless fuel in domestic furnaces as well as in power plants; second, one in which the resulting char is applicable to power plant work in a pulverized form.

With the first method probably the most common type of furnace used is the rotary kiln, somewhat similar to the ordinary cement kiln. It is externally heated, and the coal being fed into the upper end of the retort is forced to the lower end by means of the rotary motion and the inclination of the retort. The retort is externally heated and the main difficulty seems to be that the drum, owing to its size, is greatly weakened by the heat to which it is exposed.

A second furnace is the concentric drum type of retort in which an inner and an outer drum are used. The coal is fed in at the bottom of the inner retort, is forced upwards by vanes acting like a screw conveyor. Having reached the top it discharges into the outer drum and because of the rotary motion and declination of the drum flows towards the lower end where it is discharged. During its path upward in the inner drum, the coal is exposed to moderate heat only, which tends to destroy some of its coking properties, so that when followed by the higher heat treatment in the outer drum it is not only distilled but is formed into hard dense lumps.

There are also the vertical stationary types of retort and the horizontal stationary type, and these are also being developed on a commercial scale.

In the second general method of carbonization the coal is first pulverized and fed into the top of a stationary vertical retort. During its fall by gravity it is exposed to sufficient heat to dry it, destroy its coking properties and heat it to approximately 500°F. From this retort it passes into a second similar retort where the carbonization process takes place. The by-products are taken off and the resulting char, still in the form of dust, is fed directly into furnaces and burned in a manner similar to pulverized coal.

Time will not permit a detailed description of the various processes, but in spite of the difficulties to which it is exposed by its own overenthusiastic friends, low temperature carbonization is making rapid strides and it would appear safe to prophesy that in the very near future, as stated previously, it will be considered, if not criminal at least uneconomical, to burn raw coal in large power plants.

Wood Refuse Burning

A development which has taken place in recent years which is of very great interest, although not applicable to all power plant work, is the burning of wood refuse. Where this refuse is dry the problem is a simple one, and there are already in the United States several plants burning a combination of sawdust and other wood refuse in the pulverized fuel type of furnace, either alone or in conjunction with coal. The sawdust burns in suspension while the larger lumps pile up on the water screen where combustion is completed.

In the paper mill industry there is an entirely different set of conditions. The bark and wood splinters come from the barking drums with a high moisture content which amounts to 50 or 60 per cent, even after passing through the bark presses. Not only is this costly to discard, but it must be remembered that one pound of bone dry wood refuse contains nearly 8,000 B.t.u., so that its efficient use is a very important problem.

It has long been realized that not only is the evaporation of this moisture content done at the expense of the heat content of the wood, but also the fact of it being done in the furnace complicates the combustion of other fuels. Many attempts have been made to reduce the moisture content and a process developed in Sweden is now being introduced in this country with considerable success.

The equipment consists of an inner and an outer perforated vertical circular tower with a housing outside of both. The wood refuse is fed in at the top by means of a revolving chute and passes down between the two perforated towers to the bottom where it is discharged and conveyed to the furnace. Waste stack gases are blown into the inner drum at the bottom, pass through the descending bark and out through the stack. If the entering gases are too hot an arrangement is provided by which a portion of the cooler gases, after having passed through the bark, are drawn back to dilute those entering and keep it at the proper temperature. As this process is automatic the operation of the equipment is simple.

At the present time there are two installations on this continent, one of which has been in operation for some months. Although it is admitted that certain refinements are still necessary the results obtained so far appear to have more than justified the necessary installation costs.

Summary

In summarizing, the question comes up of how much interest these developments are to us in the use of our western Canadian coals.

At ordinary combustion efficiencies it requires about 7 per cent of the total heat in Souris coal to evaporate the moisture in it. Besides this direct loss, the moisture complicates furnace conditions so that additional losses appear Any process, therefore, which will remove a portion of the moisture content efficiently outside the furnace will mean a considerable saving in the burning of the coal. There are several methods in the process of development at the present time and considerable success is claimed in each case by those interested. Time alone will prove whether or not these statements are justified, but at present we must consider the proposition from the standpoint of the coal as mined.

With small boilers the only apparent successful method for high ratings is with the use of well designed hand-fired grates and some method of forced draught under proper control.

With medium sized boilers considerable success can be obtained with single retort underfeed stokers, provided continuous ratings of not more than 125 per cent are required. With forced draught chain grate stokers and possibly air heaters 200 per cent continuous rating can be obtained with good efficiency. If higher ratings are necessary or larger boilers are used, pulverized fuel burning is the only method at present practicable.

With the indirect system the difficulty is with storing the undried pulverized coal for any length of time, but if the moisture content is reduced to any considerable extent, no serious difficulty should result.

With the unit system, if properly designed, the biggest difficulty will be the reduced capacity of the mill with undried coal, and this can be easily overcome by the use of larger mills.

Slagging of the lower boiler tubes has been experienced. This has been partly overcome by means of what is called a slag screen. In this method the bottom row of boiler tubes is divided into two rows with increased clearances and the tubes staggered. This has not completely overcome the trouble, so that some means of removing the slag must be used to prevent frequent boiler outage.

Alberta Coals

With the bituminous coals of Alberta all standard types of combustion equipment have been found successful, except that in the case of the highly coking coals the combustible loss in the ash pit is high with chain grate stokers.

With the lignites, the ratings possible are limited somewhat by the combustion rates of the various types of stokers. With pulverized coal equipment no trouble should be encountered in properly designed plants.

With all western coals low temperature carbonization is possible, but it would seem that it can be successful only on a large scale; also careful tests and serious investigation should be made of the amount and properties of the resulting products together with their market value in competition with similar products from other sources.

Discussion of Paper on the Removal of Carbon Sulphur Compounds from Coal Gas by Oil Washing by K. L. Dawson, A.M.E.I.C.[1]

K. L. Dawson, A.M.E.I.C.[2]

The author, in presenting the paper, remarked that in manufacturing coal gas at Halifax the obvious source of the supply of coal would be the well known fields of Nova Scotia, and the Cape Breton mines would be the first to be considered. It was not generally known that the gas-making properties of Cape Breton coal, with regard to the yield of gas per ton, are second to none. On the other hand, some coals from Cape Breton contained a proportion of sulphur, which was not at all desirable when using the coal with the ordinary small gas plant equipment. The sulphur in the original coal manifested itself in the gas in two main forms, in combination with hydrogen alone as sulphuretted hydrogen, and in combination with carbon or with carbon and hydrogen in various carbon-sulphur compounds.

Sulphuretted hydrogen could be removed readily from the gas; it is simply a matter of having sufficient equipment, but in the ordinary course of gas plant procedure, the carbon-sulphur compounds were not touched at all, because from a coal containing less than one per cent sulphur the quantity of carbon-sulphur compounds in the finished gas would have practically no deleterious effect. Most gas plants, particularly in the United States, could obtain coal containing less than one per cent of sulphur, but at Halifax, where native coal containing uniformly and consistently less than two per cent, was not commercially available, the problem of sulphur removal had to be faced.

In the paper he had tried to place on record what had been done towards solving the problem because it would indicate what remained to be accomplished.

He had described the apparatus used for washing the gas and had given the facts concerning the type of oil used.

Certain changes had been found to occur in the molecular weight of the oil following continual use of it and there were indications that the absorptive capacity for the carbon-sulphur compounds decreased with the increase in the molecular weight of the oil.

The paper contained data in connection with the carbon-sulphur compounds which had not been published elsewhere so far as he knew, and which could not be found in standard tables of physical constants.

With regard to the reasons for removing some of the fixed sulphur, he desired to point out that in Halifax the Board of Commissioners of Public Utilities had ruled that 35 grains per 100 cubic feet of gas should not be exceeded. This conclusion was reached after the Board had examined the available data on the subject, and after they had considered the rulings of other similar bodies. They had prescribed a penalty, based on the quantity of gas sold, which at present is equivalent to a fine of $600 per month for every month in which 35 grains is exceeded three times or 45 grains is exceeded once, the tests to be made daily. Thus there was an immediate monetary incentive to deal with the question of its removal in addition to such future benefits as would accrue as increased good-will and sales from a low sulphur gas.

The paper also considered the solutions of sulphur in the oil and in the gas, a chemical problem which he found he must handle mathematically. He had not been able to find a method of determining with sufficient accuracy the small quantities of carbon bisulphide or thiophene which would be left in the oil after that oil had been re-distilled or re-heated to drive off the sulphur which it had accumulated when it was in contact with the gas. Such a method would require exceptional accuracy, but was necessary in order to show whether the formulæ or conclusions worked out in the paper applied with the accuracy demanded by a chemist. From the standpoint of the mechanical engineer operating such equipment as they had in Halifax, they applied with sufficient accuracy to enable the engineer to determine practically what his plant would do under given circumstances.

He had carried out some experiments to show how the theory applied, and to indicate its correctness. For example, figure No. 13 gave the results of various tests of washing gas. The line drawn among the points showing observed results agreed with the projected theory. Remembering that there are at least nine variables in the operation of this oil scrubbing equipment, only one of which could be anchored in their plant at Halifax, while the others were varying, it would be seen that it was necessary to depend on the average of many tests to show the accuracy of the projected theory. The results indicated by scrubbing theory were summed up in figure No. 14.

The influence of temperature on the transfer of the sulphur-compounds was studied and data were given to show that the theory had been supported by actual evidence.

The paper covered the operation of the plant while washing at the rate of about 300,000 cubic feet of gas per day, so that the work was done on a commercial, not a laboratory scale.

It was interesting to note that about 30 B.t.u. were removed from each cubic foot of gas during the washing process. These were found in the crude benzol collected as a by-product. Also, the sulphur taken out of the gas appeared in the crude benzol, and unless the crude benzol was rectified or purified of course the sulphur remained in it.

In general the records of the operation of the oil scrubbing equipment at Halifax showed definitely that it removed carbon-sulphur compounds from the gas and that the efficiency of removal fluctuated widely.

The reason for this fluctuating efficiency of removal was obscured by the number of variables which influence the transfer of sulphur from the gas to the oil, but he believed that further investigation of the operation of the heating column, for the purpose of obtaining greater uniformity in the rate of flow of the oil through it, and more uniform temperature conditions, would bring improvement.

The theory set forth in the paper had served to establish that in connection with the transfer of sulphur from the gas to the oil the sulphur must be considered as existing in at least two forms, which for convenience and with reason have been considered as CS_2 and C_4H_4S; and that the efficiency of transfer, as defined, was the real measure of the efficiency of the scrubbing units; further, that the efficiency of transfer was uniformly high, probably well over 90 per cent under ordinary conditions of operation; and that the solutions of the sulphur compounds in both the gas and the

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(1) This paper was presented at the Annual General Meeting of The Institute, Montreal, February 16th, 1928, and published in The Engineering Journal, April 1928.

(2) Superintendent, Gas Department, Nova Scotia Tramways and Power Company, Limited, Halifax, N.S.

oil obeyed closely, if not exactly, the elementary laws for dilute solutions. By means of it, equations had been derived which could be used to predict what the performance of the process would be under given conditions.

Unless the values of R, which had been used for both CS_2 and C_4H_4S, proved to be so much too high that values less than 0.80 could be assumed for the efficiencies of transfer, (Ea and Ec), it would be apparent that there was nothing to be gained from re-circulating the oil in any one or all of the scrubbers.

The development of methods for the accurate and rapid determination of the small quantities of sulphur as CS_2 encountered in the gas, and the smaller quantities of sulphur which, as this study seemed to prove, were carried by the oil from the heating column, appeared to be a necessity before Ea, Ec, R and K could be evaluated, or much further progress could be made in building up a complete set of rules for the operation of the system at Halifax, and in finding the degree of accuracy with which the projected theory applied.

The operating cost of the process itself, without any reference to overhead or depreciation, was given in this paper as about 3¾ cents gross, and about 1½ cent net per thousand cubic feet. That might or might not compare favorably with the cost of the removal of benzol or the absorption of benzol in large coking plants, but it should be remembered that at Halifax they had utilized certain equipment not specially designed for the purpose, and that where only a comparatively small quantity of gas was treated, as compared with the enormous quantity handled in the ordinary coking oven plant, the unit cost would necessarily be greater.

A matter which he thought might be more fully investigated by engineers connected with gas utilities was the relation of the quantity of sulphur in the coal to the amount contained in the gas. From the data collected he thought it possible to predict with reasonable accuracy the mean total quantity of carbon-sulphur compounds which would be found in the finished gas from a given type of equipment when using coal containing a given percentage of sulphur, but this question needs further investigation than he had been able to give it.

Following the gathering of the data on this question which is shown in figure No. 4A the company had decided to change the type of apparatus in the plant from the present inclined slot retorts to continuous vertical ovens, and it was expected that in connection with the oil scrubbing system described in the paper, it would be possible to utilize coal containing from 2 to 2½ per cent of sulphur. At present coal with a sulphur content of less than 1.5 per cent must be used in conjunction with the oil scrubbing system, or with a sulphur content of less than 1 per cent if the oil scrubbing system was not employed.

J. J. Humphreys[3]

Mr. Humphreys observed that the process described by the author absorbed benzol and organic sulphur from the gas by means of heavy oil to the extent of about 50 per cent of the organic sulphur, and on distillation the benzol, and the sulphur which was absorbed as organic sulphur, came off together, leaving the heavy oil ready to be used over again. The benzol was apparently sold with the sulphur still in it.

In his opinion, the author's experiments and theories had shown that the process works, but costs too much, and left the sulphur in the benzol.

(3) Engineer of Gas Manufacture, Montreal Light, Heat and Power Consolidated.

F. W. Sperr, Jr.[4]

Mr. Sperr remarked that the author was to be congratulated on the work he had done on the removal of carbon-sulphur compounds from coal gas by oil washing.

The principle of oil scrubbing for this purpose was fundamentally sound, and he believed that it would come to be more generally applied when gas companies in different parts of the country had to face the use of higher sulphur coals. Fortunately for most people, in the United States at least, such a condition was still in the future.

He desired to compliment the author on the attention he had given to important theoretical considerations, and noted that the author's calculations did not appear to take into account the B.t.u. value of the benzol in the gas.

C. H. Wright, M.E.I.C.[5]

Mr. Wright desired to point out that in Cape Breton, Nova Scotia and across Newfoundland there were coal and iron areas of greater value than similar areas in the Saar valley, which was the economic cause of the Great War, as was well known.

In Nova Scotia, out of a population of about 500,000 people, over 125,000 persons were directly dependent upon the steel and coal activities of that province. As these activities prospered so would these people prosper. They had succeeded in getting the government of Canada to appoint the Duncan Commission, and one of the recommendations of that Commission was to the effect that the coal of Nova Scotia should be used in coking plants, and of course these would have to be established where gas could be used.

One point at which they would naturally expect a gas plant to be constructed was Halifax, and the author had taken the first step, or at least an important step, to make Nova Scotia coal available for the production of gas, such as could be used in our cities.

He did not think the percentage of sulphur compounds in domestic gas fixed by our public utility board was too low. They had in Halifax at one time a brand of gas which was absolutely nauseating; the Public Utilities Board stepped in, and to obtain relief it was then necessary to use American coal. The author had shown that this was no longer required, and he believed that coking plants should be established in all the centres of eastern Canada to use Nova Scotia coal.

A paper such as this was of importance to the economic life of the Maritime provinces, for it struck at the root of a very vital problem facing the province of Nova Scotia. The whole trend of gas-coke development in eastern Canada, including Quebec, would be influenced as a result of work like that of the author.

A. W. McMaster, A.M.E.I.C.[6]

Mr. McMaster wished to draw attention to the great amount of work done by the author in collecting his results and placing them before The Institute. His experiments went back to 1925, and dealt with a question of vital importance and removed a difficulty which had been a source of trouble for a number of years.

Nova Scotia coal had a variable sulphur content, sometimes running a little over two per cent, but the author had discovered a plan which would take care of the problem of

(4) Director of Research, Koppers Company's Laboratories, Pittsburgh.

(5) District Manager and Engineer, Canadian General Electric Company, Halifax, N.S.

(6) District Manager, Coal Sales, British Empire Steel Corporation, Montreal.

its removal, not only in the Maritimes but in the smaller communities in Quebec, which in another twenty-five years would have their own gas plants.

B. F. C. Haanel, M.E.I.C.[7]

Mr. Haanel, as chief engineer of the Division of Fuels and Fuel Testing at Ottawa, was greatly interested in all problems having to do with the utilization of native coal, especially in the Maritime provinces. While we had been led to believe that in general Cape Breton coals contained a high amount of sulphur, it was also the case that many coals there contained only a small amount of sulphur.

He believed that, unfortunately, the coals containing the largest proportions of sulphur were being mined in the largest quantities, and in view of that fact it should be the business of those conducting research work to see how such coals could be used to the best advantage in competition with coals of higher grade, so far as sulphur content is concerned, which were being imported into this country.

At present, he supposed that the amount of Canadian coal used in gas plants all over the country was small, amounting to only a fractional percentage of the total, and any contribution made by any individual which would lead to the more extensive use of native coal for gas-making merited a great deal of support; the man who did that work should be congratulated.

As far as the Department of Mines was concerned, research work on Canadian coal was being conducted and extended, but as yet they had not occasion or time or the necessary apparatus to deal with the question of sulphur compounds in gas. To a limited extent they had dealt with the question of the kinds of sulphur in the coal and the various methods which might be employed for its reduction, but the author had gone ahead on his own account and reduced the sulphur in the gas itself.

The author was thus responsible for the use of a considerable quantity of Nova Scotia coal instead of American coal in a gas-making plant, which had not been the case formerly, and since Nova Scotia had herself started to solve some of her own problems, Mr. Haanel believed there was a bright future for that province, especially when the rest of Canada extended the necessary assistance.

[7] Chief Engineer, Division of Fuels and Fuel Testing, Mines Branch, Department of Mines, Ottawa, Ont.

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President Smith Sounds Note of International Accord

In telegraphing his regrets at not being able to attend the Annual Summer Meeting of the American Society of Civil Engineers at Buffalo recently, President Smith sounded a high note of international accord when he said:—

> "Exceedingly regret that matters requiring important attention here before I sail for Europe next week will prevent my attending summer meeting this week of the American Society of Civil Engineers stop I had looked forward to an opportunity to take advantage of this gathering of American engineers so close to Canada and at a point where there has been so much international co-operation in engineering matters to have voiced the satisfaction of The Engineering Institute of Canada for the happy relationship which exists between its membership and that of your Society and to emphasize a personal hope that there might be found some more direct and continuous liaison between their governing bodies in order that the best interest of the engineering profession on this continent might be advanced irrespective of the imaginary boundary which defines but does not separate the spheres of influence of the two societies."

The Annual Summer Meeting of the American Society of Civil Engineers

The annual summer meeting of the American Society of Civil Engineers which was held at Buffalo, N.Y., on July 17th to 20th, 1928, was of particular interest to members of The Institute. The papers presented, in the main, dealt with engineering matters of great international importance and concern to the profession in Canada. These were:—

> "The Engineering Pioneers of the Niagara Frontier," by Walter McCulloh, consulting engineer, Niagara Falls, N.Y.; "The Interim Report of the Special International Niagara Board on the Preservation of Niagara Falls," by Robert S. Thomas, major, Corps of Engineers, U.S.A., district engineer, Buffalo, N.Y.; "The Sanitary Character of the Waters of Lake Erie and the Niagara River"; "Niagara Power," by N. R. Gibson, M.E.I.C., chief engineer of the Niagara Falls Power Company, Niagara Falls, N.Y.; "Regulation of Levels, Flow and Navigation on the Great Lakes," by George B. Pillsbury, lieutenant-colonel, Corps of Engineers, U.S.A., Philadelphia, Pa.

The Interim Report of the Special International Board on the Preservation of Niagara Falls, which has been published by the government, is truly of international interest. This report was discussed at the meeting in Buffalo by prominent engineers from both countries, and the complete proceedings will provide a valuable compendium on the subject.

President Julian C. Smith was to have been present at this meeting, but at the last minute was prevented from attending. However, he was represented by Dr. Arthur Surveyer, M.E.I.C., past-president of The Institute, who, in Dr. Smith's absence, delivered a short address at the banquet on the night of July 19th.

Dr. Smith had been invited also to present a discussion on the Interim Report of the Special International Board, and in his unavoidable absence this was presented by J. B. Challies, M.E.I.C., past vice-president of The Institute.

Discussion on Interim Report of Special International Niagara Board,* by Julian C. Smith, LL.D., M.E.I.C., M.Am.Soc.C.E.

The Interim Report of the Special International Niagara Board on the Preservation of Niagara Falls, dated December 1927, and recently made public, briefly crystallizes the results to date of a comprehensive and well coordinated investigation of the factors involved in the preservation of Niagara for both æsthetic and utilitarian purposes.

By fully summarizing the pertinent data, by frankly exposing its general conclusions, by clearly setting out its reasons therefor, and by making a safe and sane recommendation acceptable to the general public of both countries, the Board has paved the way for international accord upon a complicated situation which might under a less frank and wise exposé of the facts have prompted a deluge of controversial propaganda.

The Board deserves the congratulations of the engineering profession of both countries, and I hope this meeting may be the occasion for some endorsement of the

* Presented at the Summer Meeting of the American Society of Civil Engineers, at Buffalo, N.Y., July 18th, 1928.

Board's conclusions that those in authority will be encouraged to see that not only are the Board's recommendations for remedial measures to preserve and enhance the spectacle of the falls carried out promptly, but that the very important issue of reasonable additional withdrawals is left with the Board for further study and solution.

Perhaps nowhere else is there to be found a situation where commercial considerations are so far-reaching and where at the same time æsthetic interests are of such paramount importance.

Whatever additional withdrawals may be permitted, extreme care must be exercised to insure that further works at the falls and in the gorges below conform to such high standards of architectural treatment that the majesty and beauty of Niagara will not be marred.

While the Niagara district may continue for many years to be the mecca of the engineer bent upon studying the progress of hydro-electric practice on this continent, it might well also be an example for those seeking knowledge and inspiration for the proper treatment of monumental engineering works in important settings. Although excellent results have been achieved in this regard on both sides of the boundary, it is timely and appropriate that attention be focussed upon the need for a comprehensive scheme for beautifying the whole Niagara valley. The preservation of the beauty of the falls both as to colour and volume is a basic necessity, but it should be only the central motif of a major project embracing the district immediately contiguous to the whole river. The Board's duties might therefore be extended to incorporate the evolution of a regional planning scheme which would contemplate the best use of all the falls and rapids of the Niagara river as a world-famous scenic spectacle, coupled with a complete study of ways and means for conserving the usable fall of the river between lakes Ontario and Erie.

With regard to the Board's recommendations, the general character of the proposed remedial works seem to be adequately conceived as a corrective to the impairment of bared flanks of the Horseshoe falls and for a substantial betterment of the " curtain " over the American falls while preserving the volume and deep green colour of the toe of the Horseshoe.

The Board wisely emphasizes the importance of these initial remedial works being carried out gradually and in a manner to permit actual testing of their efficiency both as a corrective for past impairment and as a necessary preliminary to further withdrawals. Cautious " cut and dry " procedure is essential in regard to both the design and the construction of these remedial works, especially with respect to their effect upon ice conditions and their use for seasonal variations in diversions.

The Board aptly calls attention to the contrast between the curtain or fleecy effect of the American falls and the deep rich tones of the Horseshoe as one of the important artistic features of Niagara, and very properly records the opinion that this feature must be retained as contra to the urge from some quarters for uniformity of colour and volume from shore to shore.

The Board considerably corrects the impression which, unfortunately, is generally believed, that the Horseshoe falls is so rapidly " committing suicide " that within measurable time the falls will deteriorate into a series of cascades. It conclusively shows to the contrary that all the factors involved indicate that further recession into the notch of the Horseshoe will be greatly retarded and what recession does occur will but cause these falls to present a superior appearance.

While Niagara is the property of the people of the United States and Canada, in a very real sense it belongs to the millions who visit it from all over the world. It therefore behooves the engineering profession on both sides of the boundary, who appreciate the æsthetic as well as they know the commercial value of Niagara, to emphasize the importance of its preservation. So I am glad, as representing the profession north of the boundary, to take advantage of the summer meeting of the American Society of Civil Engineers to urge that the Niagara problem be studied and solved in the broadest possible way and according to the slogan of one of its largest users*, " The greatest good to the greatest number."

Address by Dr. Arthur Surveyer, M.E.I.C.**

Ladies and Gentlemen:—

I am greatly honoured at having been selected to represent The Engineering Institute of Canada at this convention of the American Society of Civil Engineers. I regret very much, however, that our president, Dr. Julian C. Smith, has been unable to attend this function on account of his approaching departure for Europe. Dr. Smith is one of the pioneers of hydro-electric development on this continent; he began his professional career at Niagara Falls, and it would have been most fitting if he could have addressed you on this occasion.

I bring you to-night the hearty greetings of all the members of The Engineering Institute of Canada. I wish, at the same time, to express to you my personal congratulations on your most successful convention. It is not often that one has the privilege of attending an engineering meeting where the subjects discussed are of such international importance and where the papers presented and the discussions have been of such high character.

The North American continent, taken as one, is probably, from the point of view of natural resources, the most complete economic unit in the world. Divided into the two political units known as the United States and Canada, each country stands separately somewhat impoverished and somewhat dependent upon the other country for some of the raw materials necessary to its industrial life.

A few days ago, an investment survey, prepared by a New York financial house, called attention to the fact that the interchange of products between the two countries was larger than the trade between any other two nations. It mentioned the fact that the merchandise exchanged, last year, between the United States and England had a value of $1,200,000,000 compared with a figure of $1,300,000,000 for the combined trade between the United States and Canada; and this last figure exclusive of what the economists would call the invisible imports represented by the continuous flow of Canadian spirits distributed in the United States by an organization of altruistic bootleggers.

Canada, with a population of less than 10,000,000 inhabitants, has a foreign trade of $2,500,000,000 per year, which is exceeded only by four other countries in the world. Her exports consist not only of raw materials but also of manufactured articles. The building up of these various industries has absorbed large sums of monies which, before the war, were generally supplied from the British Isles. The war, however, has left the United States so wealthy that the flow of American capital into our country has increased to such a large volume that some people have become alarmed at the possible financial conquest of Canada. But, " a fair exchange is no robbery," and I assure you that your capital is most welcomed. You have found

* The Niagara Falls Power Company.

** Delivered at the banquet of the American Society of Civil Engineers' Annual Summer Convention at Buffalo, N.Y., July 19th, 1928.

in our country a safe field for investment and we have found in your money the means of developing natural resources which would otherwise have remained unexploited.

It is the *function of engineers* to develop natural resources and to create wealth, generally for the benefit of others. With the advent of American capital into Canada came also the American engineers, employed by the bankers, to investigate Canadian possibilities or to supervise the expenditure of their funds. Just about that time, the necessity of studying some of our international engineering problems led to the creation of technical boards composed of representatives of the two countries. This co-operation of the American and Canadian engineers in the development of the resources of Canada and in the solution of our international engineering difficulties has brought about a feeling of mutual respect and has led to the formation of very friendly relations between the engineers of the two countries.

I do not think that there are in the world to-day two groups of engineers of different nationality who understand each other so well or who can work together as well as the American and the Canadian engineers. It is to be hoped, therefore, that any work which we may be called upon to undertake in co-operation may be the means of further cementing the existing bonds of friendship.

OBITUARIES

Onésiphore Horace Coté, A.M.E.I.C.

Sincere regret is expressed in recording the death of Onésiphore Horace Coté, A.M.E.I.C., which occurred at Woonsocket, R.I., on October 1st, 1927.

The late Mr. Coté was born at St. Hugues, Que., on November 9th, 1869, and graduated from the Ecole Polytechnique, Montreal, in May 1899.

At the time of his death Mr. Coté was connected with Messrs. Lamoureux Bros., general contractors of Woonsocket, and was superintending the erection of the Wallum Lake new hospital for children. His last completed work was the Woonsocket junior high school, which was opened in September 1927.

Prior to removing to Woonsocket, in 1925, Mr. Coté was industrial commissioner of the Quebec Board of Trade in Quebec city, and before that he had been located in Montreal, having been for some time chief engineer of the Phoenix Bridge and Iron Works.

Mr. Coté joined The Institute as a Student March 16th, 1899, and was transferred to the class of Associate Member April 19th, 1906.

Arthur Philip Holden Tully, A.M.E.I.C.

It is with deep regret that we record the death of Arthur Philip Holden Tully, A.M.E.I.C., who, after an illness of over two years, passed away on December 24th, 1927, at Kentville, N.S.

The late Mr. Tully was born at Kentville, N.S., on April 25th, 1887, and received his early education there, later taking a course at the University of St. Francis Xavier, which he completed in 1908.

Mr. Tully then entered the employ of the National Transcontinental Railway at St. John, N.B., as draughtsman. In 1912 he became attached to the Canadian Pacific Railway as bridge inspector on the reconstruction of the Dominion Atlantic Railway. From 1914 to 1916 he was transitman on the construction of the Windsor and Weymouth bridge; from 1916 to 1917 he acted as bridge and building inspector, including the inspection of stations, and from 1917 to May 1918 he was senior transitman on the Brownville Division.

From May 1918 to the time of his illness Mr. Tully was connected with the engineering staff of the Canadian National Railways in the Maritime provinces.

Mr. Tully joined The Institute as an Associate Member in 1920, and the news of his death will be learned with sincere regret by many of his fellow members.

PERSONALS

Owen F. C. Armstrong, S.E.I.C., who graduated from the Nova Scotia Technical College in 1928, with the degree of B.Sc., is at present attached to the general traffic department of the Bell Telephone Company of Canada, Montreal.

Milton E. Dines, S.E.I.C., who graduated from the University of New Brunswick in June of this year with the degree of B.Sc., is at present connected with the Bell Telephone Company of Canada in Montreal.

J. E. Archambault, S.E.I.C., formerly of Montreal, is at present connected with the North Shore Power Company at Three Rivers, Quebec. Mr. Archambault graduated from the Ecole Polytechnique in 1927, having obtained the degree of B.Sc.

H. Kirsh, Jr.E.I.C., is with the Dominion Reinforcing Steel Company, Montreal, engaged on design. Mr. Kirsh, who is a graduate of McGill University of the year 1925, was formerly on the engineering staff of the St. Regis Paper Company at Deferiet, N.Y.

A. W. Crawford, A.M.E.I.C., who for the past five years has been director of technical education in the Department of Labour, Ottawa, has accepted a position with the Ontario Provincial Government at Toronto as inspector of apprenticeship, his duties being to administer the Apprentice Act of 1928.

W. S. Lawson, M.E.I.C., structural engineer of penitentiaries for the past seven years, has been appointed chief penitentiaries engineer, Department of Justice, Ottawa. Mr. Lawson has been a corporate member of The Institute since 1907, and is a registered Professional Engineer, Ontario, in civil and mechanical engineering.

Wm. O. Scott, Jr.E.I.C., formerly mechanical engineer with Scott Foster and Company of Vancouver, has now joined the staff of Canadian Utilities, Limited, of Calgary. Mr. Scott, who joined The Institute as a Student in 1922, transferring to the class of Junior in 1926, graduated from the University of British Columbia in 1923, having obtained the degree of M.A.Sc.

V. W. G. Wilson, Jr.E.I.C., is laboratory assistant with the Spruce Falls Power and Paper Company, Limited, at Kapuskasing, Ontario. Mr. Wilson is a graduate of McGill University of the year 1926, and received the degree of Master of Science in mechanical engineering from the Massachusetts Institute of Technology in June of this year.

Walter G. Hunt, A.M.E.I.C., who for the past two years has been engaged in general contracting in Montreal, has now formed the firm of Walter G. Hunt Company, Limited, Coronation Building, Montreal, engineers and general contractors. Mr. Hunt, who is a graduate of McGill University of the year 1917, was associated with the firm of Ross-Meagher Company, engineers and general contractors, Ottawa, as engineer and general superintendent for the five years previous to coming to Montreal.

A. H. Pattenden, M.E.I.C., has accepted the appointment of industrial engineer of the new business department of the Montreal Light, Heat and Power Consolidated, Montreal. Mr. Pattenden previously held the position of electrical engineer of the eastern and western plants of the Dominion Rubber Company, Limited, having joined that company in 1918.

S. W. Shackell, A.M.E.I.C., formerly junior engineer with the Department of Railways and Canals at Ottawa, has been appointed to a position on the Trent canal at Washago, Ont., by the same department. Prior to becoming attached to the Department of Railways and Canals, Mr. Shackell was on the staff of the Canadian Pacific Railway Company.

Archibald Cox, A.M.E.I.C., is at present in charge of all construction and mechanical departments with the Corbin Coal Company at Corbin, B.C. Mr. Cox was for several years superintendent engineer of the City of Regina Light & 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.

E. T. Harbert, S.E.I.C., has been appointed engineer of pulp and paper research, as assistant to Mr. C. E. Planck, manager of the Pulp and Paper Department of the Canadian Ingersoll-Rand Company, Limited, Montreal. Mr. Harbert is now devoting his whole time to work in connection with the B. I. and S. micro-seal condensate removal system, the Van de Carr thin stock consistency regulator, the Haug refiner and the Shortt trap.

Theodore Kipp, Jr., M.E.I.C., vice-president and managing director of Kipp-Kelly, Limited, and partner in the engineering firm of Sullivan Kipp and Chase, Limited, of Winnipeg, has been elected chairman of the New Industries Committee of the Industrial Development Board of Manitoba. Mr. Kipp brings to the work of the committee wide experience in industrial investigations and promotion. During the War he was consultant to the British Food Board, for whom he designed and built a number of plants in England and Ireland.

J. H. Summerskill, A.M.E.I.C., who has been acting machine and building design engineer for the B. F. Goodrich Company, Akron, Ohio, has been appointed engineer of buildings and construction in charge of all property and building maintenance, new building construction and all machinery or equipment installations. Mr. Summerskill has been with the B. F. Goodrich Company for several years, having occupied the positions of inspector of mechanical insulations and material engineer prior to his appointment as acting design engineer. He is a graduate of McGill University in electrical engineering in 1914 and in mechanical engineering in 1915.

President of the American Institute of Electrical Engineers

The announcement of the election of R. F. Schushardt as President of the American Institute of Electrical Engineers for the year beginning August 1st, 1928, was made at the annual convention of that Institute which was held in Denver, Colorado, on June 25th to 29th. Mr. Schushardt is a graduate of the University of Wisconsin, and has been with the Chicago Edison Company, and its successor, the Commonwealth Edison Company, since 1898.

Colonel C. H. L. Jones, O.B.E., M.E.I.C., Appointed President of Mersey Paper Company, Ltd.

Colonel C. H. L. Jones, O.B.E., M.E.I.C., vice-president and manager of operations of the Spanish River Pulp and Paper Mills Company, Limited, which was recently merged with the Abitibi Paper Company, has severed his connection with that concern, and will shortly remove to Liverpool, N.S., where he will become president of the Mersey Paper Company, Ltd., being constructed there by the Royal Securities Corporation of Montreal.

Colonel Jones was born in Montreal, Que., and attended McGill University during the years 1891 to 1893. After graduation he worked on operation, maintenance-of-way and construction with the Canadian Pacific Railway Company.

During the year 1900 Colonel Jones was connected with the Algoma Central and Hudson Bay Railroad on construction work, in the years 1900-1903 he was associated in an assisting capacity in the planning and carrying out of engineering and construction details of the Algoma Central and Hudson Bay Railroad main line, and from 1904 to 1910 he was assistant general manager of the Lake Superior Corporation with direct responsibility over engineering and construction on the work carried out by that concern.

During the past eighteen years Colonel Jones has been associated with the paper industry, having been connected with the Sault Ste. Marie Pulp and Paper Company, Lake Superior Paper Company, The Spanish River Pulp and Paper Mills, Limited, Fort William Paper Company, Limited, and the Manitoba Pulp and Paper Company.

During the Great War Colonel Jones organized the 227th Battalion, and commanded it until it was absorbed into other units, after which he was transferred to the command of the C. F. C., Central Group in France, which command he held for eighteen months.

Colonel Jones has taken a great interest in public affairs and his departure from Sault Ste. Marie will be greatly regretted by his many friends in that city.

J. H. Wallis, A.M.E.I.C., Appointed Manager, Dominion Welding Engineering Company

J. H. Wallis, A.M.E.I.C., has recently resigned his position as manager and purchasing agent for the Ste. Anne Paper Company, Limited, and the Murray Bay Paper Company, Limited, to take over the management of the newly organized Dominion Welding Engineering Company, Limited, in Montreal. Mr. Wallis has been engaged on engineering work in Canada since 1903, his early work being land surveys, railway surveys and construction. In August 1914 he enlisted for overseas service as a private with the British Expeditionary Force, and throughout the war served overseas with distinction. In July 1915 he received his commission as Lieutenant and in 1916 that of Captain and in the following year that of Major.

Following his return to civilian life in 1919, Mr. Wallis entered the service of the Canadian Pacific Railway Company on maintenance-of-way on the Bowmanville division. In June 1920 he was appointed assistant engineer with the Department of Railways in connection with the Grand Trunk arbitration, and later in that year joined the engineering staff of the Canada Creosoting Company in Toronto. Subsequently, he was appointed supply engineer with the Riordon Pulp Corporation, Limited, at Temiskaming, Que., and, following the acquisition of this company by the Canadian International Paper Company, he was transferred to the construction department in charge of the purchase of equipment and materials for the extension to the mill.

The new company of which Mr. Wallis has been appointed manager is closely associated with the Dominion Bridge Company, Limited, and the Dominion Engineering Works, Limited.

BRANCH NEWS

Lethbridge Branch

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

Visit of General Secretary

On July 5th a gathering of thirty members and affiliates welcomed the general secretary, R. J. Durley, M.E.I.C., who visited Lethbridge during his annual western tour. The meeting commenced with a dinner in the new community hotel Marquis, during which the Rainbow Orchestra rendered several selections, later leading the community singing headed by Mr. J. Haimes. A pianoforte selection by C. Constantineau and vocal solos by Messrs. Smith and Meldrum were much appreciated by the members.

Mr. Bradley, chairman, introduced the visitor, who later explained various matters of interest in Institute affairs. Suggestions by members found a ready reception from Mr. Durley, who showed a keen interest in forwarding and helping the smaller branches of The Institute.

On account of the adverse weather conditions (a very heavy rain storm having occurred during the night), it was decided to abandon an auto trip to the Crow's Nest steam plant of the East Kootenay Power Co. Instead Mr. Durley met the executive at lunch and both he and they gained considerable information regarding local conditions concerning The Institute.

Montreal Branch

C. K. McLeod, A.M.E.I.C., Secretary-Treasurer.
W. McG. Gardner, A.M.E.I.C., Branch News Editor.

Moving Pictures from Coal to Electricity

Early in the year the branch was privileged to entertain a paper of particular interest when Irving E. Moultrop, Esq., chief engineer for the Edison Electric Illuminating Company of Boston, described the construction of the new Edgar power station at Weymouth.

As this plant was equipped with the first commercial 1,200-pound boiler, its development has been watched with considerable interest, and as a consequence the paper was reproduced in full in the June issue of the Journal.

To supplement this detailed description of modern steam power production, the branch was fortunate in receiving through the courtesy of the contractors, Messrs. Stone and Webster, two reels of film which were shown at a meeting on the 26th of April.

The first of these reels opened with a series of historical drawings illustrating the importance of operative power in the growth of civilization. By an ingenious representation of the principles discovered by Faraday in 1831, a simple electrical motor was depicted producing an alternating current of sufficient strength to light a lamp.

Contrasting the potential power of small rivers having a great fall with huge volumes of water at a low head, the Stone and Webster development at Bry creek, California, utilizing 2,062 feet of head was shown in conjunction with the large Keokuk plant on the Mississippi river.

Interesting charts illustrating the wide distribution of water power and coal deposits over the United States brought out the remarkable circumstance that where the former was scarce the latter was often found present in abundance.

The film concluded with clever drawings revealing the simple forces of impulse and reaction discovered in steam discharging jets thousands of years ago and still applied in our many vaned powerful steam turbines.

The second reel presented the operation of a steam plant in four stages. In the first stage of "Coal to Heat," huge piles of coal were unloaded and stored, conveyed from bunkers and hoppers to automatic stokers on which they are converted into ash by a preheated forced draught of air in the furnace.

In the second stage of "Heat to Steam," distilled water after being carefully freed of oxygen and impurities, and warmed in the condensers is passed through the hot tubes of the boiler and superheater till it is converted into hot dry steam at high pressure and temperature.

This high pressure steam, expanded to 500 times its volume in the turbine, generates the mechanical power of the third stage.

The fourth and last stage in which the turbine driven generator converts mechanical into electrical power brought the clever series of illustrating diagrams to a close.

It did not require graphs and charts to indicate why, in the face of rising prices for all other commodities, the cost of electrical power was steadily falling.

C. K. McLeod, A.M.E.I.C., secretary-treasurer of the branch, presided.

Ladies' Tea

The second monthly tea for the ladies of the branch members' families was held in the Prince of Wales salon, Windsor hotel, on Friday, April 27th, the guests being received by the ladies of the temporary committee: Mrs. J. L. Busfield, Mrs. George R. MacLeod, and Mrs. W. C. Adams.

A very enjoyable musical programme was thoroughly appreciated and the artists, pupils of Mr. Merlin Davies, were warmly thanked by Mrs. MacLeod.

A short discussion followed relating to the hour at which meetings should be called during the coming season and it was decided that 3.30 p.m. was the most convenient time for the majority.

The aims and proposed activities of the organization were announced in a brief outline by Mrs. MacLeod, who urged all to show their interest by being present at every meeting whenever possible.

Annual Summer Excursion of the Montreal Branch

The magnitude of the contemplated development of the St. Lawrence waterways has attracted the attention of members of The Institute for many years.

During this time numerous papers and reports have become available for technical study. While of great value, such reports do not always give the clear conception that comes of a personal acquaintance with the site of the undertaking.

Feeling that the development of the St. Lawrence was one of the most important projects facing the profession today and that members of the branch would wish to be well informed on the engineering aspects of the problem and view the scene of the proposed undertaking, the Montreal executive decided to arrange a tour of inspection that would enable the members to study the situation at first hand.

With such as the object, the C.S.L. steamer *Rapids Prince* was chartered by the branch for a two-day trip and invitations were extended to such public bodies as the Montreal Board of Trade, the Chambre de Commerce and others to join in the excursion. In response Mr. George Henderson, president of the Montreal Board of Trade, Hon. Raoul Grothe, president and Mr. J. A. Paulhus, vice-president of the Chambre de Commerce, were welcomed as guests from Montreal, while at Prescott the party was augmented by a contingent from the Ottawa Branch and a delegation from the Cornwall Board of Trade.

On Friday, June 1st, the party, consisting of some one hundred members and guests, left Victoria pier, Montreal, and proceeded up the river to Prescott; with good weather prevailing throughout the trip, splendid opportunity was provided to observe the existing conditions on the waterway and the general interest that was shown in the project by all on board proved to be the feature of the trip.

Following dinner Friday evening, O. O. Lefebvre, M.E.I.C., chief engineer of the Quebec Streams Commission and member of the Joint Board of Engineers, addressed the members of the party on the subject of the contemplated canalizing of the St. Lawrence river and the coincident development of its water powers.

Although principally confining his address to the general engineering features of the project and to interesting descriptions of the methods and costs of development, Mr. Lefebvre clearly expressed his personal opinion on the economic aspect of the subject in a reasonable and farsighted pronouncement.

"While Canada does not yet require an enlargement of the St. Lawrence canals, it would be in her interest to accept the offer of the United States should the latter, in her desire for increased navigational facilities between the sea and the Great Lakes, be willing to pay for the construction of a larger canal section in both the national and international sections of the river. Such an undertaking could be carried out in conjunction with the development of power in the international sections, then, when, and not before, she requires the additional electric energy, Canada can continue with the erection of power plants in her own territory. In view of Canadian expenditures on the new Welland canal and the river channel below Montreal the arrangement would not be unreasonable."

In proposing the vote of thanks to the speaker, Mr. George Henderson expressed the view that since the Joint Board of Engineers had pronounced on the feasibility of the project, it now remained for the taxpayers of Canada to pass on its economic soundness and desirability.

J. L. Busfield, M.E.I.C., was complimented by all present for the able manner in which such a successful trip had been organized.

Arriving at Prescott the party was met by Mayor W. J.

Taugher, who explained to the members the advantage of utilizing Prescott as a transfer terminal for the 600-foot freighters that will be able to descend into lake Ontario on the completion of the Welland canal. A unique advantage of this port would exist in its freedom from ice during the winter months.

Returning down the river Saturday, Mr. Lefebvre pointed out from the ship deck the main items of interest referred to in his address. After what was conceded by all to have been a most successful outing from every viewpoint the party disembarked at Lachine at 9 p.m. Saturday evening.

Peterborough Branch

S. O. Shield, Jr.E.I.C., Secretary.
B. Ottewell, A.M.E.I.C., Branch News Editor.

In the report of the annual meeting of the Peterborough Branch, which appeared on page 449 of the July issue of the Journal, several names were omitted from the list of officers for the season 1928-29. The complete list is given below:—

Chairman	W. M. Cruthers, A.M.E.I.C.
Secretary	S. O. Shields, Jr.E.I.C.
Treasurer	A. B. Gates, A.M.E.I.C.
Executive Committee	G. H. Burchill, Jr.E.I.C.
	J. A. G. Goulet, M.E.I.C.
	R. C. Flitton, A.M.E.I.C.
	E. R. Shirley, M.E.I.C.
	B. Ottewell, A.M.E.I.C.
	R. H. Parsons, M.E.I.C.
Ex-Officio	R. L. Dobbin, M.E.I.C.
	A. E. Caddy, M.E.I.C.
	W. E. Ross, A.M.E.I.C.

Report on Silica Deposits of Western Canada

The Mines Branch, Department of Mines, Ottawa, has recently issued a report entitled Silica in Canada, Part 2—Western Canada, (No. 686), by L. Herber Cole, M.E.I.C. This report describes a number of typical deposits of silica in that part of Canada west of Fort William, Ont., and gives a brief résumé of the latest development in this industry in eastern Canada since the first volume, Silica in Canada—Eastern Canada, (No. 555), was published in 1923. The report comprises 59 pages and is adequately illustrated with photographs, drawings and maps. Copies may be obtained on application to the Director, Mines Branch, Department of Mines, Ottawa.

Important Hydro-Electric Studies under Way in Upper St. Maurice River

Members of The Institute will be interested in watching the progress of the comprehensive engineering investigations that are under way on the St. Maurice river by the Power Engineering Company, of which Sven Svenningson, M.E.I.C., is chief engineer and vice-president. At the recent special meeting of the Shawinigan Water and Power Company Dr. Julian C. Smith, M.E.I.C., made public the terms of a concession that has been recently consummated with the Government of the province of Quebec looking to the early development of the remaining water power resources of the St. Maurice river. The concession granted to Shawinigan covers a 75-mile stretch of the river between the Manouane and La Tuque, within which the river drops approximately 650 feet. The bulk of this fall is fairly well concentrated in three falls and several rapid reaches and it is expected that it will require three or more power developments to utilize the potential power of this section of the river. In the absence of detailed topographic and hydraulic information, the Power Engineering Company has had under way for some time an elaborate engineering investigation. The field work is under the supervision of C. R. Lindsey, A.M.E.I.C., and under the immediate direction of Charles Luscombe, A.M.E.I.C., as resident engineer, with headquarters at La Tuque. A large staff of engineers, technical assistants, etc., is now busily engaged upon this work.

The concession granted to Shawinigan by the Quebec government imposes upon the company important obligations, the principal of which are as follows:—

(a) Complete by January 1st, 1930, a comprehensive engineering investigation of the whole reach of the river leased and to spend thereon at least $100,000.
(b) Commence construction operations on the first development by the 1st of July, 1930, and have 100,000 horse power developed by the 1st of July, 1933, at a cost of $10,000,000.
(c) Carry out the succeeding developments so that the fourth will be started July 1st, 1938.
(d) Spend at least $25,000,000 upon these developments and the necessary transmission lines.

Few members of The Institute appreciate the extent of the huge power reserves on the St. Maurice river within easy economic transmission distance of existing commercial centres. The provincial government engineers concerned with the St. Maurice river confidently predict that it will be producing at least 1,200,000 horse power within ten years. Such a result follows directly upon the wise policy of the government of Quebec through the Quebec Streams Commission in conserving and regulating the flow of the St. Maurice and its tributaries.

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 DRAUGHTSMEN

A manufacturing company located in Ontario has an opening for two draughtsmen with experience in mechanical work. The company intends that these men should be attached to the staff of the parent company in the United States for training prior to establishment of an engineering office in Canada. Apply with full particulars to Box No. 10-V.

COMBUSTION ENGINEER

A manufacturing company located in Ontario has an opening for a combustion engineer with experience in the design of coke and gas products. The company intends that this man should be attached to the staff of the parent company in the United States for training prior to establishment of an engineering office in Canada. Apply with full particulars to Box No. 11-V.

Situations Vacant

DRAUGHTSMEN

A large manufacturing company requires the services of two draughtsmen with four or five years' experience. Preference will be given to those having experience with electrical equipment. Give full particulars of qualifications with application. Apply Box No. 15-V.

MECHANICAL DRAUGHTSMAN AND DESIGNER

A well-known manufacturing company in Ontario has openings for two mechanical draughtsmen and designers, preferably men who have had two or three years' experience in industrial work. The work will be in connection with draughting and design of equipment. Apply Box No. 17-V.

CONSTRUCTION ENGINEER

A large industrial firm in Ontario has an opening for a young graduate engineer. Applications will be considered from men having two or three years' experience in industrial construction work. Apply Box No. 18-V.

Situations Vacant

MECHANICAL DRAUGHTING AND DESIGN

A large pulp and paper company in Quebec has an opening for a recent graduate, preferably in mechanical engineering. The work is in connection with mechanical draughting and design for the company's plant. The position offers possibilities of advancement. Apply Box No. 19-V.

ELECTRICAL ENGINEER

Two graduate engineers for electrical manufacturing development work. Experience in radio engineering desirable but not essential. Location, Quebec province. Apply Box No. 24-V.

INSTRUMENTMAN

Instrumentman required for municipal work in connection with sewer and waterworks construction. Apply Box No. 28-V.

CONCRETE DESIGNER

Reinforced concrete designer required for the Montreal office of a large structural engineering company. Apply Box No. 34-V.

STRUCTURAL DETAILER

A firm of consulting engineers in Montreal has an opening for a young engineer with experience in timber and concrete designing and construction. Apply Box No. 35-V.

(Continued on next page)

Situations Vacant

Sales Engineer

An engineering sales organization in Montreal requires the services of a recent graduate in mechanical engineering for work on the sales and installation of combustion and refrigeration equipment. Applicants must be able to speak French. This position is in Montreal. Apply Box No. 37-V.

Draughtsman

Manufacturing company located in Eastern Ontario requires a draughtsman to lay out plant, buildings and equipment, and to estimate costs of new plant. He must be experienced in the design of foundry, machine shop and metal working plant. Position good for six months at least. Apply with full particulars to Box No. 42-V.

Draughtsman

Chief draughtsman for the City of Winnipeg Engineering Department, Manitoba. Applicant must have experience in mechanical and structural design, including reinforced concrete. Apply, stating qualifications and salary expected, to W. P. Brereton, City Engineer, Winnipeg, Manitoba.

Draughtsman

A large public utility company in Ottawa requires the services of one draughtsman with three or four years' experience. Preference will be given to those having had experience in sub-station layouts and other work in connection with a distribution or transmission department. Apply Box No. 44-V.

Situations Wanted

Construction or Industrial Engineer

A.M.E.I.C., 37 years of age, with experience in industrial and general construction and management of lumber mill, and a knowledge of factory management and costing, desires a position as construction engineer on any large works or as executive with a manufacturing enterprise. Speaks French fluently. Apply Box No. 1-W.

Electrical Engineer

Graduate in electrical engineering, Canadian, 22 years of age, with one year's training with a large electrical equipment manufacturing company, desires a position on sales, design or construction. Speaks German and has a knowledge of French. Apply Box No. 2-W.

Civil Engineer

Civil engineer, M.E.I.C., Registered Professional Engineer of Alberta, fully qualified, thirty years' experience in railway construction, reconnaissance and highway work, is available for a position. Would prefer position as city engineer, or post of trust and responsibility, in western province. Apply Box No. 3-W.

Situations Wanted

Building Superintendent or Sales Engineer

Mechanical engineer, A.M.E.I.C., 41 years of age, with extensive mechanical and combustion engineering experience, wishes to improve his present position by appointment as building superintendent or as sales engineer on power plant equipment. Apply Box No. 5-W.

Mechanical Engineer

Graduate in mechanical engineering of this year, with experience in paper mill operation, would like a position on production or maintenance with a pulp and paper or other industrial company. Apply Box No. 9-W.

Pulp and Paper Mill Engineer

Graduate mechanical engineer, 33 years of age, with extensive and varied experience in pulp and paper mill work, including operation, design, maintenance and construction, occupying during the past three years the positions of mechanical superintendent and resident engineer with a large pulp and paper company on the Pacific Coast, desires a position with opportunities for further experience. Apply Box No. 10-W.

Electrical Engineer

Electrical engineering graduate, 23 years of age, with two years' training with an electrical manufacturing company, wishes to secure a position on design, operation or sales of electrical equipment. Apply Box No. 11-W.

Electrical Engineer

Young electrical engineer, S.E.I.C., 22 years of age, McGill University, wishes to secure a position. Will be available in October. Experience during vacations on electrical conduit construction. Apply Box No. 12-W.

Designing Engineer and Estimator

Graduate of University of Manitoba in civil engineering with degrees of B.A. and B.Sc., 30 years of age, with experience in structural steel and reinforced concrete design and estimating; at present located in Chicago, wishes to secure a position in Canada, preferably in Winnipeg. Apply Box No. 13-W.

Construction Engineer

Construction engineer, 39 years of age, with nineteen years' experience, including municipal work, harbour, power line and dam construction, and townsite and industrial housing development, desires a position as resident engineer or superintendent on construction. Apply Box No. 14-W,

Situations Wanted

Electrical Engineer

Graduate of 1926 in electrical engineering, 24 years of age, with two years' experience with a large electrical manufacturing company, desires a position with an industrial company or on sales work. Apply Box No. 15-W.

Civil Engineer

Graduate civil engineer, 32 years of age, with experience on highway, municipal and construction work, wishes to secure a position as town engineer or with a firm of building contractors as estimator or assistant engineer. Apply Box No. 16-W.

Electrical Engineer

Graduate of the University of New Brunswick in electrical engineering of the year 1926, with two years' experience on the manufacture of electrical equipment, desires position with an industrial organization or on electrical construction. Apply Box No. 17-W.

Construction Engineer

Graduate engineer with seven years' experience on construction work, including municipal, highways, and general building construction, wishes to secure a position on similar work. Knowledge of French, German and Spanish. Apply Box No. 18-W.

Electrical Engineer

Recent graduate of McGill University in electrical engineering, with two years' experience with large electrical manufacturing company, desires a position. Apply Box No. 19-W.

Construction Engineer

Graduate engineer with extensive experience in industrial construction desires a similar position with pulp and paper company or other industrial organization. Apply Box No. 20-W.

Construction Engineer

Engineer, 36 years of age, with considerable experience in power and municipal surveys and municipal construction, is available for a position on similar work, preferably in Quebec or the Maritime provinces. Apply Box No. 25-W.

Chemical Engineer

Chemical engineer, graduate of McGill University of the year 1922, desires a position in the vicinity of Montreal. Apply Box No. 28-W.

Civil Engineer

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The Preservation of Douglas Fir by Pressure Creosoting

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Paper presented before the Western General Professional Meeting of The Engineering Institute of Canada, at Vancouver, B.C., June 7th, 1928

History

Timber was the first structural material used by man, and he early discovered its proneness to decay, but it was with the commencement of the railway age that timber preservation received its greatest impetus, the wooden ties which replaced stone blocks and other solid supports decaying so rapidly that artificial means of prolonging their life was found necessary.

As early as 1756 attempts were made to impregnate wood with vegetable tars. In 1836 Franz Moll took out a patent for impregnating timber in closed iron pots with oils of coal tar.

The year 1838 saw the origin of the so-called creosoting process under pressure, when John Bethel took out a patent in England.

On the Pacific coast, the earliest pressure plants for the creosoting of Douglas fir were established by J. M. Colman in Seattle, Wash., in 1884, and by the Southern Pacific Railway Company at West Oakland, Cal., in 1887.

Today there are ten modern creosoting plants operating in California, Oregon, Washington and British Columbia, all treating Douglas fir exclusively.

A great increase in the use of creosoted timber has been evidenced since the early days of the industry on this continent. In 1909, 75 million cubic feet of timber were processed, while in 1925, 273 million cubic feet were treated, and last year over 300 million cubic feet.

Last year nearly 200 million gallons of creosote oil were used in Canada and the United States.

Creosote Oil

The preservative technically known as creosote oil is described in specifications as: "A distillate of coal gas tar, or coke oven tar," and standard specifications of the American Railway Engineering Association and the American Wood Preservers' Association require it to contain not over 3 per cent of water and not more than 0.5 per cent of matter insoluble in benzol. Its specific gravity at 38° C. compared with water at 15.5° C. must be not less than 1.03. It may distil not more than 5 per cent up to 210° C. for grade No. 1, 8 per cent for grade No. 2, and 10 per cent for grade No. 3. Up to 235° C. not more than 25 per cent may distil for grade No. 1, 35 per cent for grade No. 2 and 40 per cent for No. 3 oil. The residue above 355° C., if it exceeds 5 per cent, must have a float test of not more than 50 seconds at 70° C. The oil may yield not more than 2 per cent coke residue.

Detailed specifications are laid down for the methods of testing.

Creosote oil of the above standards is obtained from Great Britain, Belgium, Germany, the United States, Canada and recently from Japan. Grade No. 1 is most frequently used.

Some twenty years ago experiments were made using petroleum of asphaltic base instead of creosote oil, and others using a mixture of creosote oil and petroleum. Service records of ties so treated indicated a preference for the mixture, and today millions of ties and construction timbers are treated with mixtures varying from 75 per cent of creosote oil and 25 per cent of petroleum, to 50 per cent creosote and 50 per cent petroleum.

Grades of Timber for Treatment

As in untreated structures, the grade of lumber depends upon the use to which the material is to be put. Any standard grade of lumber, No. 1 common or better can be successfully creosoted.

Caps, stringers and important structural members should be at least of select common grade.

Sapwood is no defect, since when sound it is just as strong physically as heartwood, and takes the preservative more easily. This permits the use of less costly grades of lumber for some wood products such as pipe staves, conduit, bridge and culvert timbers, etc., etc., when these are creosoted.

All bark must be thoroughly removed before treatment.

Figure No. 1.—Pre-framed and Creosoted Railway Trestle Approach to Alberta Wheat Pool Elevator, Vancouver, B.C.

Processes

Brush and open tank immersion treatments are sometimes used, but the most economical method, though higher in first cost, is that known as the pressure process, and all of the timber for important uses today is so treated.

Before the preservative can be successfully forced into the timber, the moisture content of the wood must be reduced below the fibre saturation point, which for Douglas fir is about 22 per cent of the oven-dry weight of the wood. Poor results are obtained by endeavouring to impregnate before the timber is sufficiently dry to be receptive of the creosote.

The seasoning of Douglas fir before treatment is best done by what is known as the " boiling-under-vacuum process," although in some instances air seasoning is resorted to.

In the early days of treatment on the Pacific coast, timber was seasoned by steaming or boiling at high temperatures, often resulting in serious injury to the wood structure. In the boiling-under-vacuum process, timber may be seasoned by boiling it in creosote oil under a vacuum at temperatures 60 to 75 degrees lower than were used in steaming and boiling, and practically no injury to the timber results. This process has been used along the Pacific coast during the past fourteen years and now is the only treatment specified by purchasers. Some eastern plants are adapting its use to other kinds of wood with excellent results.

Standard specifications limit temperatures during the artificial seasoning period as follows:—

Piling—220° F. maximum.
Ties—220° F. maximum.
Lumber—200° F. maximum.

All lumber, however, may not be subjected to the maximum temperature of 200° F., and for small dimension lumber, temperatures of 180 to 190° F. should not be exceeded, or injury to the wood will result.

Just as in kiln drying, artificial seasoning in creosote oil must be conducted most carefully, otherwise warping, splitting and reduction in natural strength will result. Timber properly seasoned by boiling in creosote oil under a vacuum checks less than the same timber air seasoned, and the process has numerous advantages, among which are the reduced temperature necessary and consequent freedom from injury to the wood structure; quicker accomplishment of moisture extraction, and the thorough sterilization of the timber from incipient rot, which, authorities claim, is present in most sawn timber today. That complete sterilization does occur in this process has been proved by the Forest Products Laboratory and this is a valuable aid in increasing the useful life of timber.

Immediately following the seasoning period the impregnation with the preservative occurs. Specifications require timber to be treated either by the empty cell process or the full cell, with specified quantities of preservative.

The empty cell treatment consists in thoroughly coating the wood cell walls with the preservative and leaving no free oil in the cavities. In the full cell treatment not only are the cell walls coated, but free oil remains in the cavities.

The empty cell treatment is used for all timber structures to protect them from decay or insect attack and 6, 7 or 8 pounds of creosote oil per cubic foot of wood is commonly specified. For the prairie provinces, where decay does not occur quite so rapidly as on the Pacific coast, a 6-pound empty cell treatment for superstructure bridge timbers is considered sufficient, with 8-pound empty cell treatment for the piling and other sub-structures. In British Columbia it is advisable to use 7- or 8-pound empty cell treatment, depending upon the importance of the structure.

This treatment is accomplished by subjecting the wood, after seasoning, to air pressure of 50 to 65 pounds per square inch, after which, and without releasing pressure, creosote oil is forced into the timber in sufficient quantity to insure, when pressure is released and the " kick back " of creosote by the air imprisoned in the wood occurs, the specified net retention of preservative per cubic foot of wood remaining in the wood at the end of treatment. For example: for an 8-pound empty cell treatment, the gross absorption would be 11 to 12 pounds, of which 3 to 4 pounds is ejected after release of pressure.

After pressure is released, the treating cylinder is speedily emptied of the preservative and a vacuum of at least 20 inches promptly created and maintained until the lumber can be removed from the cylinder free of dripping preservative. Or, after pressure is completed and before removal of preservative from the cylinder, the preservative surrounding the lumber may be reheated to a maximum of 210° F., the steam being turned off the heating coils within thirty minutes after the maximum temperature is reached. The total time consumed, until the steam is turned off the coils in this expansion bath, must not exceed two hours. The preservative is then removed from the cylinder and the vacuum applied as noted above. Or, after the pressure is completed

Figure No. 2.—Creosoted Scow under Construction—Timbers Framed before Treatment.

and before removal of preservative from the cylinder, the preservative surrounding the lumber may be reheated to a maximum of 210° F. and a vacuum created during this heating period to assist further in expelling excess preservative from the lumber, the steam being turned off the heating coils within 30 minutes after the maximum temperature is reached. The total time consumed until the steam is turned off the coils in this expansion bath must not exceed two hours. The preservative is then removed from the cylinder and the vacuum applied as specified above.

The effect of these final periods in the treatment is to free the timber of dripping preservative and render its surface dry, and afford a better diffusion of the preservative in the wood.

Compressed air is sometimes used on the timber in the cylinder after the oil has been removed, which has the effect of driving surplus preservative into the wood and thus further drying the surfaces.

For timber to be used in salt water infested by marine borers, full cell treatment with 12, 14 and 16 pounds of straight grade No. 1 creosote oil is desirable, depending upon the probable intensity of the borer attack. In our Canadian waters a 12-pound full cell treatment is usually considered sufficient.

The desired physical result of creosoting is that all of the sapwood and as much of the heartwood as possible shall be impregnated without material loss in strength of the wood. It is the sapwood that rots first and the decay carries into the heartwood, therefore it is absolutely essential that there be complete saturation of all sapwood by the preservative.

The depth of penetration into the wood for the various treatments with creosote oil has been laid down as follows:—

For Piling

12-pound	full	cell	process—a	minimum	of	¾-inch	penetation
14	"	"	"	"	"	⅞	"	"
16	"	"	"	"	"	1	"	"

For Sawn Lumber

Average penetrations of	½-inch	for	6-pound	empty	cell	treatment
	⅝ "	"	7 "	"	"	"
	¾ "	"	8 "	"	"	"

It will be noted that specifications call for only *average* penetration for sawn lumber. It is obvious that the superficial area in lumber of small dimensions is much greater than in large timber, therefore the smaller dimension material will receive less depth of penetration than will the large timbers with the same quantities of preservative.

Creosoters naturally desire to turn out a product whose long life will warrant the continued and increased use of their product, and it is desirable that, where possible, engineers consult with creosoters as to the best treatment to be given any certain lot of timber required for specific purposes, thus obtaining their recommendations based upon the experience of a great many users and also upon service records.

There are available standard specifications of the American Wood Preservers' Association for the preservative treatment under pressure of Douglas fir piling, ties and sawn lumber.

Both the Bureau of Public Roads of the United States Government and the American Railway Engineering Association have concluded, after full consideration that, properly treated, the strength of timber is not materially reduced, and the same working stresses may be used as in untreated timber.

Plant Required

A modern creosoting plant for the treatment of Douglas fir by the boiling-under-vacuum process must include one or more steel treating cylinders 7 to 8 feet in diameter and 130 to 150 feet long made of at least ¾-inch plate, fitted with tracks, and efficient steam heating coils. In addition to these, vapour drums, condensers and drip tanks must be installed to permit the ready escape of the moisture in the form of vapour from the timber, followed by its condensation and measurement in order that the progress of the artificial seasoning may be noted hour by hour and the fact known when the timber is sufficiently dry to be properly receptive to the preservative.

Recording gauges for temperature, vacuum and pressure are used and records are carefully kept of the treatment of each charge.

A sufficient power plant for steam generation is essential together with air compressors, vacuum pumps, pressure pumps, etc.

Steel tanks are necessary for the storage of preservatives so that accurate measurements may be taken of quantities of preservative injected into each charge of timber.

Other equipment may include several miles of standard and narrow gauge trackage, together with 100 or more steel retort trams to convey the materials into the cylinders, also locomotive cranes, travelling derricks and other elevating and carrying devices, together with large booming grounds.

The most modern plants are equipped with a mill for the incising, adzing, boring and branding of railway ties before treatment. Such mills are expensive installations capable of putting through seven ties per minute. All railways today require their ties to be so machined before treatment, and this adds materially to the length of useful life.

Framing and Boring Before Treatment

It is now becoming usual to fabricate timber structures

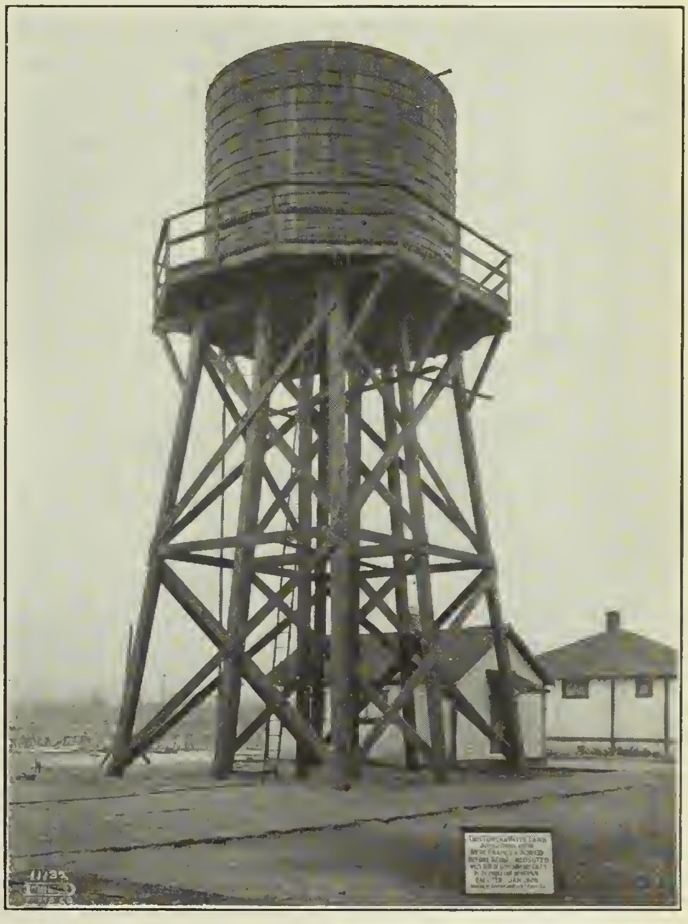


Figure No. 3.—Creosoted Water Tank and Tower.
All members framed and match marked for erection before creosoting.

Figure No. 4.—Creosoted Deck—Howe Truss Railroad Bridge, Vancouver, B.C.
All chords and web members were framed and then creosoted.

completely before treatment is given, therefore a framing mill is essential at a modern plant to permit of boring holes, cutting to length, dapping, etc.

Such fabrication of timber structures in accordance with detailed blue prints so that all parts in the structure "in contact" may receive the greatest benefit from the preservative treatment, is a matter to which too much attention cannot be paid.

It is the parts in actual contact in a timber structure which fail from decay, therefore it is absolutely essential that all possible framing and boring of holes be done before treatment.

In cases where timber has unavoidably to be cut after treatment the exposed untreated surfaces should receive three brush coats of hot creosote oil, and holes through untreated timber should be thoroughly swabbed out with hot creosote oil. These precautions will pay dividends.

Large users of treated timber have been a little slow to benefit by pre-fabrication, but much greater interest in this question has been shown during the past three years, and it received attention at the last annual convention of the American Wood Preservers' Association held in Montreal in January 1928.

Engineers having occasion to demolish a decayed wooden structure, such as a bridge, will discover, on careful examination, that practically all of the decay happens at points in contact and where bolts pass through the timbers, frequently leaving the remainder as sound as the day it was installed in the work. Millions of feet of one of our greatest natural resources are thus wasted because of the decay of about only 25 per cent of the wood used.

Reference may be made here to the incising of timber. This consists of running each stick through a machine having top, bottom and two side rolls studded with knife-like teeth which make incisions in the four faces of each timber, so spaced as to afford the deepest and best diffused penetration to the depth permitted by the quantity of preservative specified to be injected.

In sawn timber, where a great many varieties of surface grain exists and where we may have heartwood on one corner and sapwood diagonally opposite, it is impossible to get a uniform penetration. Incising tends to correct this, and does not reduce the strength of the timber more than two or three per cent, and the added protection of the deeper penetration of the preservative more than compensates for this small reduction.

Full size tests recently made on a number of incised, boiled-under-vacuum, pressure-creosoted stringers, size 6 inches by 12 inches, 12 feet span, and on full size ties, have shown an average modulus of rupture of 5,967 pounds per square inch, or 97 per cent of the untreated, not incised specimens.

Just as bridge, culvert and other structural timbers should be pre-framed, so railway ties should be adzed and bored for spike holes before treatment. Adzing is necessary only where hewn ties are used. The boring of the spike holes is essential to long life, and railways have, during the past five years, adopted this as standard practice.

Handling After Treatment

The following suggestions for the proper handling of creosoted material should be given attention:—

Creosoted timber is entitled to the same respect and care as steel, concrete or any other construction material, for its value can be greatly reduced or totally destroyed by improper handling.

Creosote does not penetrate the entire volume of the stick, but if no puncture or cut is made which will expose untreated wood, the stick is permanently protected against the attack of decay-fungi, marine borers, white ants, or other wood-destroying agency.

If cuts exposing white wood are unavoidable, always give exposed surface two brush coats of hot creosote.

Do not chop, drive dogs, peavies or other sharp tools into creosoted piles or timbers. If holes are unavoidably made, fill them with thoroughly creosoted, tight-fitting wooden plugs. This is particularly important with timbers used in sea water.

Protect creosoted material from chafing.

Apply at least two brush coats of hot creosote to the tops of piles after cut-off.

Bore all holes for bolts sufficiently small to give a driving fit.

Creosoted piles stand driving as well as untreated piles, but their additional value justifies greater precaution in protection against damage.

Use a follower or other means for avoiding injurious brooming or slivering of pile heads. Do not pound a creosoted pile longer than necessary.

Snipe the edge of butts before driving so that the hammer will strike on the heartwood in the centre of the pile.

Why Preservative Treatment is Desirable

Many records exist of the material increase in life of timber structures secured by creosote treatment and the corresponding reduction in the cost of the structure per year of life.

Decay in timber is only too familiar to engineers, whether due to infection by dry-rot, fungus, or the action of marine borers which, of course, affect timber used in sea water.

In tropical countries and throughout the southern half of the United States from one coast to the other, timber is quickly destroyed by termites; the white ant in the tropics, which operates in the dark and in moist soil, and the winged ant which attacks structures above the ground level.

Information has come to light during recent years of the serious depredations of this insect in North America, and users of telephone and telegraph poles in California have found it necessary to install full length treated poles in their service lines. The termite has been found as far north as Vancouver, particularly in telephone poles.

Alkali in the soil is another cause of failure of untreated wood. In certain districts in British Columbia where the soil is highly alkaline, untreated railway ties have been rendered unserviceable in four to five years.

Records of Long Life

Records of the long life of creosoted timber structures can now be found among the files of governments, railways, telephone, telegraph and power companies, the American Railway Engineering Association and the American Wood Preservers' Association.

Creosoted piling exists today in San Francisco harbour after thirty-seven years' use, and is still in good condition.

Seattle and Vancouver harbours contain many creosoted piles that have been in service for twenty-five years and are still sound.

The Southern Pacific Railway Company has records of many treated timber culverts that have been in service for thirty to thirty-five years, and any partial failures observed are reported as entirely due to cuts having been made in the creosoted wood and not properly brush treated.

The same railway has numerous creosoted bridges and trestles that have been in service thirty years and, quoting from the report of the engineer of bridges, " they have been using creosoted material for thirty years and the repairs to their structures have been very small." Their " average maintenance cost of treated timber trestles is about $1.00 per foot per year, which includes renewals as required from time to time due to mechanical causes."

He goes on to state that " from the standpoint of economy there is no structure that can compete with a creosoted wooden structure, where such a structure is at all suitable. We have not found the fire hazard of creosoted timber trestles to be any greater than that of the untreated structures, and our fire loss is extremely small."

Treatment of railway ties needs no further recommendation than that all of the railways on this continent and in England are practising this economy as well as in India and the Sudan.

Mine timbers that have been creosoted have been found to last five to nine times the life of the untreated.

Back in 1854 the London Port Authority installed at the Victoria docks, London, England, a creosoted wooden fence consisting of posts, stringers and palings. This fence is still in service after seventy-four years.

The United States Corps of Engineers some twenty-eight years ago commenced the use of creosoted timber barges and scows on the Mississippi river. There are now over one hundred in daily operation. The condition of a number of these that have seen twenty-seven years' continuous service, fully warrants the expectancy of thirty to thirty-five years' useful life.

The economy of their use is indicated by the very low maintenance expense over a period of years, which averaged (all repairs included) $59.00 per barge per year. Steel barges require docking for repainting about every three years, and this costs approximately $1,100 per barge.

In 1923 a pre-framed creosoted timber scow was built for use in Vancouver harbour and over a period of five years this scow has not cost one penny for maintenance or repairs.

Economics

The question of economics can only be touched on here.

Curves have been plotted by R. H. Rawson which show the relation of strength to years in service of not-incised untreated timber and incised creosoted timber. They give modulus of rupture in pounds per square inch as ordinates and time in years as a base, and show that for the first five years the not-incised untreated material has a slightly greater strength. During the next nine years the strength of the not-incised untreated material decreases rapidly to the low strength value at which it must be replaced, whereas it takes the incised treated material a further thirty-six years to reach the same low strength condition. The net

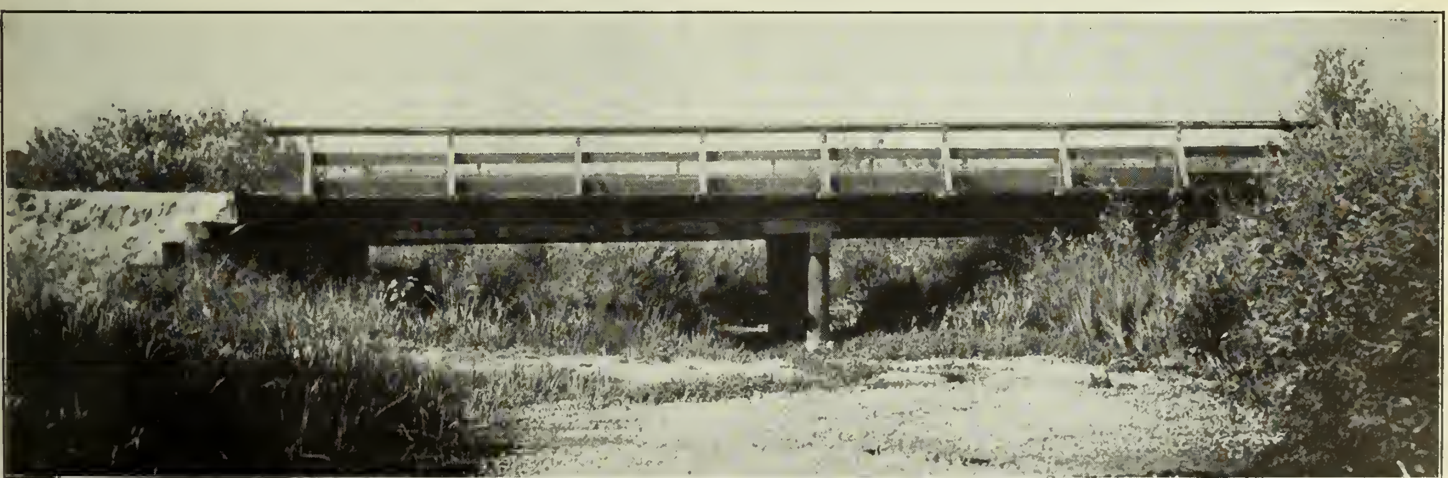


Figure No. 5.—Creosoted Highway Bridge.
Members framed before being creosoted.

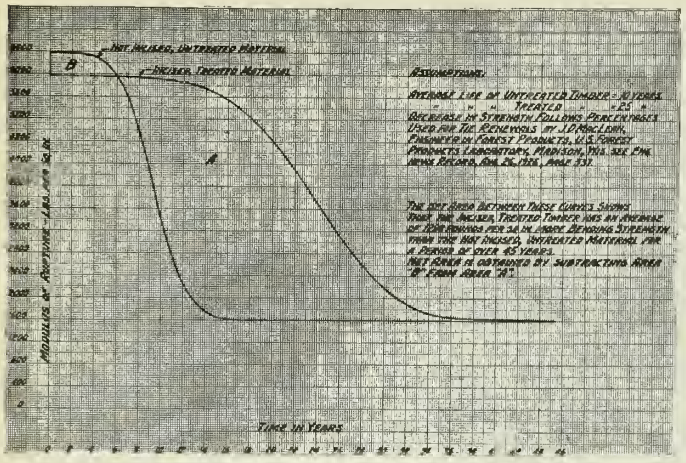


Figure No. 6.—Diagram showing the Relation of Strength to Years in Service of Not-incised Untreated Timber and Incised Creosoted Timber.

area between the two curves shows an average of 1,288 pounds per square inch greater strength for forty years in favour of creosoted material.

A diagram published on page 407 of bulletin No. 293, dated January, 1927, of the American Railway Engineering Association, shows the annual charges for timber trestles of various relative costs and for various periods of life, and is included in the report of the Committee on Wooden Bridges and Trestles. These charges are based on an interest rate of 6 per cent on the invested capital, a sinking fund providing for renewal at the end of the life of the structure, and a maintenance charge equal to one-half of the total cost of the structure spread over the life of the structure. The maintenance charge will naturally be small during the earlier years of the life of the structure and increased during the later years, but for the purpose of comparison it is assumed to be spread over the period of useful life uniformly.

Assuming a cost of untreated structures in place as unity,—for this example $75.00 per M. ft. b/m,—and of a similar creosoted structure in place, the 7-lb. creosote treatment adds about $29.00 per M. feet, b/m, making a total of $104.00 per M. feet, b/m, which is about 1.4 times the cost of the untreated structure. Allowing a life of twelve years for untreated and thirty-five years for creosoted, then the annual charges for untreated structures will be 0.173 times the cost as against 0.112 for creosoted structures.

The untreated structure, at $75.00 per M. feet b/m in place, at an annual charge of 0.173, thus results in an annual charge of $12.98 per M. feet b/m, while for the creosoted structure, costing $104.00 per M. feet b/m in place, at an annual charge of 0.112 results in an annual charge of $11.65 per M. feet b/m. This shows a saving of $1.33 per M. feet b/m. On one million feet b/m of timber the saving would be $1,330.00, which equals the interest charges at 6 per cent on $22,000.00.

If we take the annual charges on the untreated structure mentioned in the foregoing as unity, with a life of twelve years, and if a similar creosoted structure is 1.4 times as costly, then for the same cost per year as the untreated, the creosoted structure would have to last eighteen years in order to equal the cost of the untreated structure. As already mentioned, a life of thirty-five years is conservatively given as the estimated useful life of creosoted structures. Many such are in position today under much heavier loads than when originally built thirty years ago.

The same committee of the American Railway Engineering Association arrived at the following conclusions:—

1. Treated timber is more economical than untreated timber in wooden bridges and trestles and should be used for these structures except when the construction is temporary.

2. Timbers which are to be creosoted should be completely framed before treatment. If it is necessary to cut or damage the surfaces after treatment, they should have several coats of hot creosote applied to protect them.

3. If properly handled in the creosoting plants, the strength of the timber is not materially reduced and can be used with the same working stresses as untreated timber.

4. The fire hazard is somewhat reduced, and if ballasted deck bridges are constructed of treated timber, the hazard from inflammatory material dropped from trains is nearly eliminated.

5. Creosote in timber is not injurious to the metal fastenings.

6. Sapwood when treated is preferable to heartwood. It is inherently as strong and takes the creosote more readily.

Discussion

Mr. Durley enquired as to the effect of incising the timbers, and asked whether the incisions were specially arranged so as to avoid unnecessary loss of structural strength. The author replied that tests on incised timbers show only a very slight decrease in the natural strength of the timber due to incising, and that this decrease—amounting at the most to not over 2 per cent—was negligible in consideration of the greater and better diffused depth of penetration of the preservative into the wood. He explained that the incisions were so arranged, after a great deal of experimenting, as to afford the deepest and most uniform penetration of the preservative that could be obtained with the amount of the latter specified.

Colonel W. S. McDonald drew attention to a case of failure of pipe staves, which he had observed, due to the separation of the annular rings of the wood, and enquired whether that was due to any effect of the preservative treat-

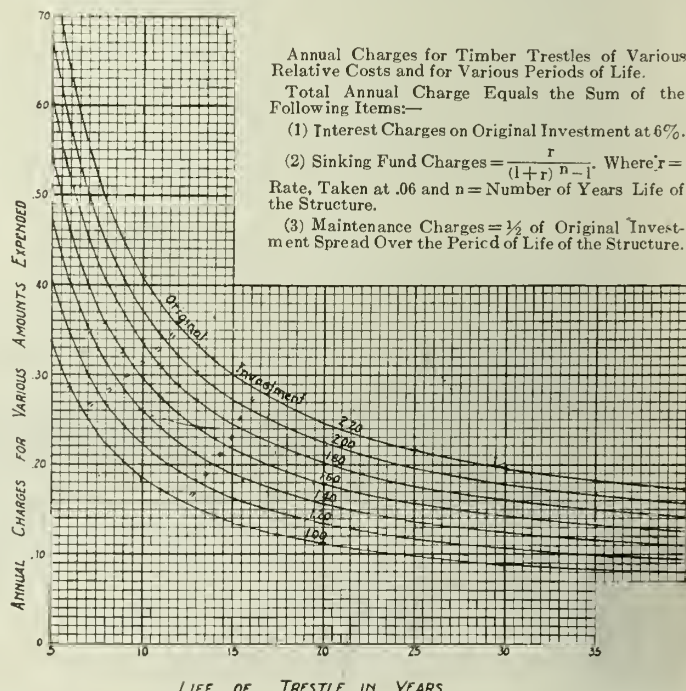


Figure No. 7.—Diagram showing the Annual Charges for Timber Trestles for Various Periods of Useful Life.

ment. The author replied that he was familiar with this particular complaint which had occurred in wood stave pipe under a 150-pound water pressure, and in discussing the matter with the companies which manufactured the pipe staves he had been informed that this same failure occasionally happened in untreated pipe where flat or slashed grain staves were used, being caused by the cinching of the pipe bands during erection of the pipe. The same fault is found in other untreated timber, such as slashed grain surface of planking.

The staves are received by the creosoting works either entirely seasoned or practically so, and therefore require but little artificial seasoning, during which hot treatment is necessary. With such staves as are artificially seasoned great care in the application of the seasoning temperatures is used, particularly so that the butts of the staves will not shrink unequally with the central portions. No greater shrinkage is found with creosoted pipe staves than with pipe staves that are air dried. For satisfactory results pipe staves should be milled from dry timber, because if they are not thoroughly dry when milled they will show greater shrinkage at the butts than in the middle, such difference in shrinkage occasionally being as much as 1/16 of an inch, and this happens whether the staves are creosoted or not.

Where partially dry stave lumber is milled and subsequent butt shrinkage occurs, it is difficult to obtain a thoroughly water-tight job until the butts have taken up considerable water. It was further stated by the author that it had been reported to him by the wood stave pipe companies that the creosoted pipes show materially less leakage than untreated staves.

Mr. H. P. Archibald had noted that creosoted staves were now being largely used for silos, and asked whether any effect from the creosote had been noticed in regard to tainting the silage. The reply was made that in order to determine and give the public the unbiased facts relating to this point, the U. S. Forest Service Laboratory at Madison, Wisconsin, recently conducted an investigation on this subject, and the following extract is taken from the report:—

> While but few of the experiment stations had had any experience with creosoted silos, and only a small number of owners of such silos could be located, not a single case was reported where the silage had been damaged or the health or appetite of the stock affected. It was the general opinion of the experiment stations that no danger need be anticipated on this account.
>
> With the present perfected methods of treating lumber, which remove all excess or free oils, the last doubt as to the value of a creosoted silo has vanished.

Mr. G. E. Herrmann remarked that the preservative treatment described in the paper—while not new and while thoroughly effective—was still in the process of development through experiments and tests, just as in the case of steel, concrete and other construction materials, and that considerable investigation and experimenting is constantly under way to better the methods employed and increase their efficacy.

In conveying to the author a hearty vote of thanks for the presentation of his paper, the chairman of the meeting stated that while he had always been thoroughly conversant with the preservation of timber with creosote oil, it had never been so forcibly brought home to him before that it is highly desirable to do all framing and boring of holes, in fact, complete fabrication, before the creosote treatment was applied.

Discussion of Paper on the Effect of Steam Treatment of Portland Cement Mortars on their Resistance to Sulphate Action, by T. Thorvaldson and V. A. Vigfusson, and on Appendices A and B of the 1927 Report of the Committee on the Deterioration of Concrete in Alkali Soils.[1]

A. G. Fleming[2].

Mr. Fleming wished to draw attention to some details of the expansion experiments described in the paper on the Effect of Steam Treatment of Portland Cement Mortars on Their Resistance to Sulphate Action, by Messrs. Thorvaldson and Vigfusson, which had been made with a lean mix, standard sand being used in the aggregate with certain water content. The consistencies stated for the two cements, (Nos. 126 and 555), were respectively twenty-four per cent and twenty-two and a half per cent, but in making up the mortar bars more water had been used with the cement of dry consistency than with the wet.

He believed that a very practical application of the lean mortar bar test might be made by standardizing it as a method of testing the alkali resistance of various brands of cements by exposing these bars to the action of sulphate solution under well defined conditions. This appeared to be a workable method of determining, in a general way, and with considerable saving of time, the relative resistance of different brands.

The work of the authors, though different in method and procedure from that being conducted by D. G. Miller[3], had led to very similar conclusions as regards the efficacy of steam-curing in increasing resistance to alkali action.

B. Stuart McKenzie, m.e.i.c.[4]

With reference to Appendices A and B of the Committee's Report, Mr. McKenzie stated that he had no intention of going into detail with regard to the early days of this committee, but it was a fact that its operations had met with very unsympathetic criticism in some quarters. This criticism came mainly from those who had fully developed theories of their own, but who refused to face actual conditions, as found, with an open mind.

There had been serious trouble in the sewers of Winnipeg, and chemicals in the sewage itself had been blamed. In the foundations of buildings in that city the same conditions had been found, accompanied by the smell of sulphur compounds, and the same theory had naturally been applied at first. Further investigation, however, indicated other reasons for the decay of the concrete. Conditions in an aqueduct had been remedied by draining the ground water

(1) This paper was presented at the Annual General Meeting of The Institute, Montreal, February 16th, 1928, and published in The Engineering Journal, March 1928.

(2) Canada Cement Company.

(3) See Proceedings A.S.T.M. Vol. 1, 1927, pp. 318-319.

(4) Secretary, Canadian Engineering Standards Association, Ottawa.

away from the outside of the concrete pipe, as it had been found that serious damage had been done by chemicals carried in solution by the ground water.

Conditions all through the West had been very serious, and many officials had spent sleepless nights over the work in their charge. It was a matter of great satisfaction and of personal interest to see how far the committee had gone in solving this problem. There had been sufficient evidence accumulated to indicate that the problem should be attacked from a chemical standpoint.

Mr. McKenzie believed that the committee was working in the right direction and had made remarkable progress. He wished them every success in their efforts, and was optimistic enough to make a personal prediction that the committee would reach its objective.

E. Viens, M.E.I.C.[5]

Mr. Viens observed that in order to appreciate these papers fully one should be familiar with the results of this research which had already appeared from time to time in different technical journals. He hoped that when the investigations were completed, the resulting information would be collected and be published in one book.

He felt justified in saying that the researches carried out at the University of Saskatchewan had gone further than any other known experiments in shedding light on the real cause of so many concrete failures in the sulphate waters of the alkali soils.

Some knowledge of the effects of steam curing at various temperatures and durations of exposure on the strength of cement and concrete had been obtained through the researches carried out by R. J. Wig at the Bureau of Standards of the United States. It had also been known for some years, through the researches of Dalton G. Miller, carried out at University Farm, St. Paul, Minnesota, that steam curing increased very materially the resistance of Portland cement mortars and concretes to the action of sulphate solutions.

The authors of the paper under discussion, however, were not content to know that the strength of concrete is increased, in some cases over one hundred per cent, and that it is rendered more resistant to the sulphate solutions by as many as thirty-fold, but they wanted to know why, hoping that in this research they might find a new clue leading to the cause for Portland cement failure in sulphate waters. So they had endeavoured to find out what constituent or constituents of Portland cement were affected by this treatment, and they "suggested the theory that it is primarily due to the action of steam on the tricalcium aluminate." This was a very important discovery, in that it proved conclusively that alumina in cement is present in the form of tricalcium aluminate, and also that this constituent of Portland cement is the weakest in the presence of sulphate solutions.

So far, commercially, the steam treatment of concrete must of necessity be limited, as it could only be applied to comparatively small units such as drain tiles and possibly other small building units. The difficulty in using precast building units treated in this way would be that one would still have to contend with the cement mortar for the joints of such units.

He hoped that the researches under way would find a solution to this perplexing problem. But in the meantime what was to be done? As far as tests had gone on admixtures and surface coatings for concrete, they had proved unsatisfactory; in fact, some had actually been found detrimental instead of being beneficial.

[5] Director, Testing Laboratories, Department of Public Works, Ottawa, Ont.

However, if the investigators had not yet found a remedy to render Portland cement immune, they had at least discovered that it is possible to make concrete that will endure for a reasonable time under ordinary alkali soil conditions and that there is considerable difference in the resistance to sulphate action of cements manufactured in different mills.

D. G. Miller had experimented with cements from thirty different mills of the United States as to their respective resistances to sulphate action, and had found a very wide variation between mills. He had pointed out that this fact should be taken into consideration in choosing cement for use in alkali soils, and was now working on an accelerated test whereby the most resistive cement could be detected.

The Committee on Deterioration of Concrete in Alkali Soils of this Institute in its Annual Report for 1927, (see The Engineering Journal, March 1928, pp. 200-202), had brought out very clearly this difference between the cements from different mills.

Mr. Viens considered that among other factors playing a part in the ability of concrete to resist sulphate action were: (1) The quantity of cement used. Experiments by many investigators had shown that only rich mixes should be used, while our committee was of the opinion that there is an optimum richness at which concrete is most durable; with richer and leaner mixes than this the concrete becomes less resistant. (2) The amount of water used. There was also an optimum quantity of water for the best results, which seemed to be at a relative consistency of about 1:1. (3) The quality and graduation of the aggregate. Naturally, the aggregate should be composed of the densest rock and one that is unaffected by the sulphates. (4) Time of mixing. Concrete for such purposes should be mixed for at least two minutes. (5) Proper curing. It is now known that for the best results concrete should be cured for as long as possible under moist conditions, at a sufficiently high temperature, and out of contact with sulphates. Finally, for the most severe conditions of sulphate action, he believed that the only reliable method of protecting the concrete was to drain it properly.

A. G. Larsson[6]

Mr. Larsson considered that the problem of protective treatments of concrete in alkali water would be best approached by a study of the composition of the hardened cement and of the main reactions of alkali water, and his views could be summarized as follows:—

(A) The Main Products in Hardened Portland Cement

The most important compounds in hardened Portland cement are:—hydrate of lime ($Ca\,O.H_2O$), hydrated dicalcium silicate ($2\,CaO, SiO_2\,.n\,H_2O$), hydrated monocalcium silicate ($CaO.\,SiO_2.nH_2O$) and hydrated tricalcium aluminate ($3\,CaO.\,Al_2O_3.5.5\,H_2O$). These make up the substance which cements the aggregates together. This being the case, it is evident that the strength and durability of the concrete will suffer if either or all of them are destroyed. The injurious effect of alkali waters must therefore be studied by observing their reactions on the four compounds contained in hardened cement.

(B) The Action of Alkali Waters

The alkali waters contain varying amounts of sulphates and chlorides of calcium, magnesium and sodium Investigations have proved that the injurious action of these salts on concrete is caused mainly by the ions of magnesium and sulphuric acid, and only seldom by chlorine.

[6] Chief Chemist, St. Mary's Portland Cement Company.

An investigation of the effect of alkali waters, which evidently should precede the one of protective treatments, must therefore be divided into two parts.

(1) The actions of magnesia on the hydrated products of cement.

(2) The actions of sulphuric acid on the hydration products of cement.

(1) The Action of Magnesia on Hardened Portland Cement

Careful studies of this subject have proved that magnesia (MgO) replaces the lime (CaO) in each one of the four compounds constituting the hardened cement. The final products of the reactions are a non-hydraulic magnesium silicate and colloidal hydrates of magnesia ($Mg(OH)_2$) and alumina ($Al(OH)_3$).

The two hydrated silicates, $2CaO.SiO_2.2n\,H_2O$ and $CaO.SiO_2.n\,H_2O$ are of vital importance for the strength of the concrete, as they act like glue in cementing the aggregates together. The injurious effect of their destruction is therefore evident. But the formation of the two hydrates $Mg(OH)_2$ and $Al(OH)_3$ marks also the beginning of trouble.

As both are colloidal, they will, when exposed to water, absorb large quantities and expand. This will be followed by contraction when the water is removed. It is, however, evident that repeated expansions and contractions will tend to destroy the concrete, already weakened by the action of the alkali water.

(2) The Reaction of the SO_2 ion or of Soluble Sulphates on Hardened Cement

The sulphate action is different from the one just described. The hydrated aluminates in the cement are now the most affected. Different reactions take place, depending on the different sulphates contained in the water. Suffice it to say that they tend to form calcium sulpho-aluminate. The building up of this compound is accompanied by considerable expansion, caused by the high percentage of water contained in the molecule. If, therefore, enough of this material is formed, it will result in cracking and crumbling of the concrete.

(C) Protective Treatment

Having thus made clear the composition of the hardened cement, together with the main reactions of the alkali waters, we are in position to consider the possibility of protecting the concrete. The problem may advantageously be studied by applying separately the two main reactions of alkali water, i.e., the actions of the magnesia salts and the actions of the sulphates on the hydration products of Portland cement.

(1) Protective Treatment Against Magnesia in Alkali Water

As has been pointed out under (A), hardened Portland cement contains hydrated lime, hydrated dicalcium silicate, hydrated monocalcium silicate and hydrated tricalcium aluminate. We have also seen that each one of these compounds is subject to the destructive action of magnesia salts. It does not seem possible that any treatment can prevent the magnesia from replacing, according to well-known chemical laws, the lime in the just named hydration products. The best we can hope to accomplish is to retard more or less the destructive action.

This may be done by neutralizing the free lime with silica. This has been done in Europe for over thirty years by adding trass and other materials to concrete in sea water. These additions increase the strength at later periods. The beneficial effect found by Professor Thorvaldson on steamed test-pieces exposed to magnesium sulphate solutions may be explained by comparing this treatment with the one used in the manufacture of sand-lime-bricks. Owing to the hydrolyses of the cement compounds at the higher temperature, part of the free lime would be in a very reactive state, so that the lime silicate could form at a much lower temperature than is required for the sand-lime bricks. The observed improvement was caused by the formation of silicates.

(2) Protective Treatment of Concrete Against the Action of Sulphates in Alkali Water

We have already seen that calcium sulpho-aluminates are formed by the reaction of sulphates in alkali water on the calcium aluminates in the hardened cement. The injurious effect of this compound has also been described. It is evident that in order to prevent its formation we must either remove the aluminates, or destroy them, and make the alumina less reactive. The first suggestion is evidently not feasible. We know, however, that it would be effective, as it has been found that cements in which the alumina (Al_2O_3) has been replaced by oxide of iron (Fe_2O_3) resist the sulphate action. In this connection, good results in sea water structure are claimed for the Krupp cement.

The improved resistance against the sodium sulphate solutions found by Professor Thorvaldson on steam-treated test-pieces may be explained by the second possibility, the destruction of the hydrated calcium aluminate. The comparatively high temperature of the steam reduces the solubility of the lime, thus destroying the equilibrium. In order to restore the latter, hydrolysis sets in. Lime is now liberated, and either precipitated or, as was pointed out under C(1), united with silica from the aggregate to form calcium silicate. The hydrolysis increases with the temperature. When equilibrium is finally restored, the hydrolysis products will contain various amounts of lime, aluminates and alumina. The heat of the steam had reduced the reactivity of the latter very much, and the possible amount of calcium sulpho-aluminate that can be formed is proportionally decreased. The hotter the steam and the longer the treatment the better the results will be.

(D) Summary

The study of the composition of hardened Portland cement, together with the injurious reactions of alkali waters, makes it evident that no really effective treatment of concrete and mortar is possible. It also teaches us that to get entirely satisfactory results we must produce and use cement of a very different composition. On the other hand, it also indicates that we may increase the resistance of the present product in various ways. Professor Thorvaldson's experiments, for instance, suggest one method useful for small units.

The care taken in making the concrete is of great importance. In a general way, we may state this as follows:—

The lower the strength the less is the resistance against alkali waters; or, the higher the water-cement ratio the lower the resistance. A relative consistency of 1:10 has been found best. Anything that tends to increase this ratio is therefore injurious. The grading of the aggregates is for this reason most important. The fineness modulus should for the best results be about 5:5 and concrete for the best resistance should contain about ten per cent more water than is required for the highest strength.

The richer the mix the better will the concrete withstand the alkali salts. Any admixture to Portland cement which decreases the strength should be avoided. In this case may be counted natural cement, lime, clay and kaolin. Substances like trass, containing soluble silica, have been found beneficial up to about 25 per cent for sea water construction in Europe. In this connection, it is a peculiar fact that in certain experiments with concrete in alkali waters it was found that the so-called alkali-proof compounds used assisted, instead of resisted, the destruction of the test pieces.

Robert S. Stockton, m.e.i.c.[7]

Mr. Stockton remarked that the very careful and thorough research work described by the authors promised to have very important and far-reaching results in the practical field.

While much remained to be done in adapting means of applying the information obtained, there would seem to be by this method a nearly complete protection from the action of sodium sulphate, and the action of magnesium sulphate was so much delayed that some further precautions could probably be devised which would insure a reasonable life to structures subjected to the action of magnesium salts. Since these were the alkaline salts that did most of the damage, the steam treatment constituted a great step forward. It was, of course, possible that further chemical research would discover some easier and cheaper way of bringing about the reactions that affect the aluminates, and so change the mortar that it is little or not at all affected by the sulphate solutions.

He believed that in this case it was the duty of the practising engineers of the West to try to devise economical and practical methods of steam-treating foundations and canal structures where concrete is subject to the attack of alkali water, and thought it would not be very expensive, on fairly large work, to devise coffer-dams that would be sufficiently steam-tight to allow of treating the surface of heavy structures to an extent that would furnish protection. Tile pipe and small slabs could be treated at the point of casting.

Those who had been responsible for the construction and maintenance of moderate-sized concrete structures in the canals and ditches of the Western irrigation systems had had a good deal of experience with alkali action on concrete and had learned to make better concrete, to provide drainage and to remove ground water. They had tried with some success surface protection with hard-burned glazed tile slabs set in the forms just before the concrete is poured. Possibly the same protection could be obtained, especially in sodium sulphate waters, by using steam-treated concrete slabs.

The study of alkali action on concrete in irrigation system structures had been particularly identified with the name of A. S. Dawson, m.e.i.c., chief engineer, Department of Natural Resources, Canadian Pacific Railways, who at an early date had initiated a large number of tests and investigations, all of which had helped The Institute Committee in laying out the most productive lines of investigation.

The authors had laid a broad foundation in this research, particularly along chemical lines, and it was most desirable that this work be continued by the men who are now in such favourable position to build on that foundation.

John R. Baylis[8]

Mr. Baylis was of opinion that, since disintegration is due largely to chemical changes, any comment should stress the need for more information on the chemical reactions taking place.

The rate of disintegration for submerged concrete depended largely on the rapidity with which the salts can get to the concrete, which, of course, meant the rate of diffusion through the pores of the concrete. It was also evident that the concentration of the salts in the solution affected this rate of diffusion. The tests performed by the authors would seem to indicate that failure due to union of the cement compounds with the SO_3 takes place somewhere near the point where 1.5 per cent additional SO_3 unites with the cement compounds after concrete sets. This 1.5 per cent meant the percentage of the total cement before water is added.

Mr. Baylis had conducted experiments in which sulphates were added to the concrete in various ways and amounts, but had never been able to determine the amount of SO_3 that actually caused failure. In experimenting on the addition of gypsum to the cement before mixing with water, he had used $CaSo_4,2H_2O$ to the extent of ten per cent of the weight of the dry cement, in addition to that already in the cement, and the sample was used for making 1:2 mortar blocks.

The time of setting was slow, but hard pieces of concrete were eventually formed. After standing for a few weeks, protected from the air, one of the blocks was submerged in a solution saturated with sodium sulphate. The submerged piece disintegrated within a year. Another piece had been alternately submerged in distilled water and then allowed to dry, and so far no deterioration had taken place.

He was of the opinion that disintegration was due to the formation of calcium sulpho-aluminate. It was thought that the addition of ten per cent additional calcium sulphate would furnish enough SO_3 to have an excess over the amount that would unite with certain of the cement compounds. This apparently was not the case. The purpose of the experiment was to see if concrete could be produced which would not unite with additional SO_3. The tests performed did not prove that this could not be done, but with cements so high in alumina as are most of the brands of Portland cement, the gypsum required for a saturated equilibrium of calcium, aluminum and SO_3 is so great that it probably would not be practical for making concrete.

There were indications that iron might be substituted for much of the alumina in Portland cement without sacrificing strength and other durable qualities. If this were the case, a cement might be developed containing so little alumina that concrete could be produced which would not unite with additional SO_3. Probably concrete made from such cement would be very resistant to the sulphate-bearing waters.

He thought that efforts to produce concrete which will withstand the so-called alkali waters should be continued along two lines of attack. One was to take the cement as now being manufactured and try to make it impervious. The other would be to develop a cement which, when it was hydrated, will not unite to any material extent with the compounds occurring abundantly in the waters of the regions where concrete disintegrates so seriously.

E. W. Reed-Lewis, m.e.i.c.[9]

Mr. Reed-Lewis remarked that in the first paragraph of Appendix A it was conceded that "the resistance of a concrete structure to the action of alkali water is determined by a number of factors, one of which is the natural resistance of the cement itself to the action of sulphates," and that that paper dealt almost wholly with this one factor, namely, "the natural resistance to sulphate action possessed by the cement when exposed under conditions where the sulphate water has free access to the cementing material."

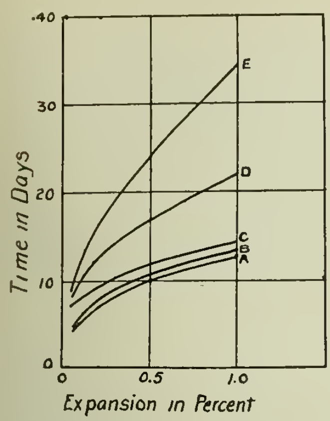
Later, the appendix referred to the nature of the test pieces employed as being such that "the sulphate has then almost as free an access to each particle of cement as if the cement, in finely powdered condition, were shaken with the solution."

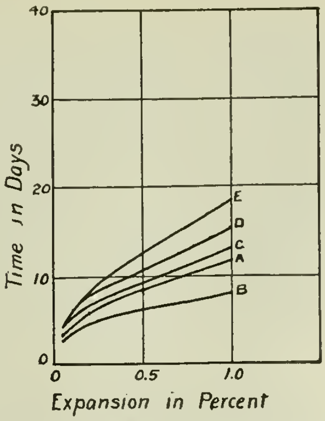
Employing test specimens of this nature, the "natural resistance" to sulphates of various cements was compared,

[7] Superintendent, Operation and Maintenance, Western Section, Canadian Pacific Railway, Department of Natural Resources, Strathmore, Alta.

[8] Experimental Filtration Plant, City of Chicago.

[9] Supt. Engr. Engineering Dept., Super Cement (America) Co., Ltd., Detroit, Mich.





(Figures Nos. 1 and 2 of original paper published in March 1928 Journal.)

Expansion of 1:10 Cement Mortar Bars in Solutions of Na_2SO_4.

Expansion of 1:10 Cement Mortar Bars in Solutions of $Mg.SO_4$.

and certain differences found, as shown graphically in figures Nos. 1 and 2 of Appendix A.

No evidence had been offered in the committee's report that any relation whatever existed as between the " natural rsistance " of a cement determined by these laboratory experiments and the actual resistance developed in the field by concrete produced with it.

On the contrary, it was stated that " the variation in sulphate resistance, (laboratory), between different brands of high-alumina cement was found to be greater than the variation with different brands of Portland cement," and further that " the resistance of all the samples of high-alumina cement in moderately rich mixes was found to be greater than that of any Portland cement."

Yet reference to the tabulation of field test specimens of concrete in Appendix B indicated that the high-alumina cement which showed the greatest laboratory resistance failed to produce concrete that was materially more resistant to field exposure than that produced with a Portland cement which ranked lowest of all Portlands in the laboratory tests.

Moreover, this same high-alumina cement concrete had proved in the field tests to be very definitely inferior in resistance to that produced with Super cement, though it was shown that a Super cement and a Portland cement produced, from the same clinker exhibited, essentially the same " natural resistance " as measured by Dr. Thorvaldson's laboratory technique.

It might be well to study these laboratory differences in " natural resistance " in the light of a previous paper by Dr. Thorvaldson entitled " The Expansion of Portland Cement Mortar Bars During Disintegration in Sulphate Solutions." This paper appeared in the April 1927 issue of The Engineering Journal, and described in some detail the laboratory methods on which Appendix A was based.

Quoting from this paper, we had the following statement:—" Each increase of 10° C. in the temperature, (of the sulphate solution), reduces the time necessary for equivalent expansion by about one-third."

This quotation referred to 1 to 5 mortar bars, and was followed by the statement that " experiments with 1 to 7½ mortar bars gave a somewhat larger effect for temperature."

It would be noted that the differences in " natural resistance " of various cements shown in figures Nos. 1 and 2 of Appendix A were based on expansion measurements of 1 to 10 mortar bars, which would presumably be influenced by temperature changes of the solution to an even greater extent than the 1 to 7½ mortar bars above referred to.

It would seem, then, by reference to figures Nos. 1 and 2 that the greatest difference found between the " natural resistances " of any two Portland cements was of the same order as the difference in resistance that would result with any one of them by varying the temperature of the solution to which it is exposed, a matter of something less than 10° C.

Without very convincing proof to the contrary, it would seem rational to conclude that such differences could have but little influence on the life of concrete which in the course of its field exposure to sulphate action would possibly encounter ten times such a temperature variation.

In the total absence of any evidence that the " differences " as between cements observed in the laboratory are reflected in their field behaviour, the data submitted in Appendix A would seem to warrant only one conclusion, viz.:—that, with the cements investigated, the " natural resistance " of a cement to sulphate action is an entirely negligible factor in respect to its ability to produce concrete that will endure exposure to such action in the field.

He considered this a significant fact which should be welcomed by the engineering profession; if we had to rely for the permanence of our concrete structures on such nebulous characteristics as those which appear to influence the " natural resistance " of cements to sulphate action, we would indeed be in sad case.

For we had been informed in Appendix A that, in respect to this " natural resistance," one Portland cement might show greater resistance than another to solutions of sodium sulphate, but the reverse under exposure to magnesium sulphate. Also, that while one cement might disintegrate faster in concentrated than in dilute solutions of sodium sulphate, a second cement might disintegrate at the same rate in both, and a third cement might disintegrate much more rapidly in the dilute solution.

As the sulphates present in ground waters were almost invariably a combination of at least two salts in proportions and concentrations that vary widely, not only from place to place, but also from time to time at the same place, (see Appendix B, table No. 1, Committee's report), it would take a wise man, indeed, to select the right brand of Portland cement if " natural resistance of the cement " were the controlling factor or even a significant factor in determining the field resistance of concrete.

" Natural resistance," or, in other words, the chemical stability of a cement under free exposure to the action of sulphate solutions, could be considered a factor of practical significance only when it existed to a degree that could be measured in years, not days, and under exposure to a variety of combinations and concentrations of salts such as one could expect to encounter in the field in any particular area over a period of time.

Even if such a degree of " natural resistance " could be found to exist in any present-day cement, or could be developed in the future, it would still be of paramount importance to have assurance that in attaining this characteristic those other qualities had not been impaired which have enabled existing cements of negligible " natural resistance " to develop in concrete an actual resistance which is apparently unimpaired after six years of the most rigorous field exposure.

Passing to Appendix B, Mr. Reed-Lewis drew attention to the suggestion there made that " in order to avoid reaching unwarranted conclusions from observations of the field specimens, all field tests should be considered in the light of the finding of the laboratory research as set down in Appendix A of this report."

Instead of confusing the issue by seeking to qualify the direct evidence of the field tests of concrete by reference to unrelated laboratory experiments of doubtful significance, he believed that it would seem more logical if the two were considered entirely independently, until they could be rationally and conclusively co-ordinated.

Appendix A showed one thing clearly, viz., that the various cements experimented with were chemically unstable when freely exposed to the action of sulphate solutions. Meticulous refinements of control and measurement had apparently indicated that degrees of chemical instability existed, but no evidence was offered to show that these variations had practical significance.

In referring to the superiority exhibited by the Super cement specimens over the Portland cement specimens in the field tests, it was therefore a statement neither of fact nor of warrantable assumption that by reference to Appendix A " we now know that different Portland cements show equally great variations in their resistance to sulphate action."

Since every effort was apparently made to control the field tests along lines directly comparable with the practical field use of the cements tested, the results of these field tests should be deserving of more careful consideration than had been given in the summary and conclusions of Appendix B.

It would seem to be at least a rational theory that the actual resistance developed by concrete to sulphate action in the field, in contrast to the negligible " natural resistance " of cement as determined in the laboratory, might be credited to whatever degree of impermeability the cement is able to develop in concrete.

Accepting that theory, in the absence of a better one, a finer distinction as between the behaviour of various field specimens seemed desirable than the committee's broad classification of "Affected " or " Unaffected " after six years of exposure.

On page 4 of Appendix B, for instance, under the heading of Super cement, it was stated that " of a total of forty-two Super cement specimens installed, twenty-three have been found unaffected."

Reference to table No. 7 of the same appendix would show that this broad classification would place in the same category specimen 5-3 of Super cement concrete, the condition of which after six years' exposure was reported as " Good, except for slight surface roughening at ground," and specimen 81-3 of Portland cement concrete which was reported as " Rapidly disintegrating " after three years, and " Completely disintegrated " after four years' exposure.

Without further detailed criticism of the committee's summarization of the field test data embodied in their report, and without suggesting that the scope and duration of the tests had been sufficient to warrant final conclusions, it might be stated that a study of the test data in detail would show that of the twenty different cements and supplementary treatments covered by these field tests, Super cement had alone consistently demonstrated its ability to produce concrete that had shown no action after six years' exposure to the severe conditions involved at the three sites.

This appeared to be true in spite of the fact that at least one of the cements included in the field tests showed in the laboratory a much higher " natural resistance " or chemical stability under free exposure to sulphate action than did the Super cement employed.

The lack of stability, under free exposure to sulphate waters and other disintegrating influences, of the substances composing hydraulic cements had been well-known for many years, and chemists had been endeavouring to follow this through to the development of a cement which would be chemically immune.

The attainment of this ideal, not only in the laboratory, but also within the field of commercial economics, would, of course, solve the problem of this type of concrete disintegration.

But, in the meantime, as our present-day cements lacked the necessary " natural resistance " that would render our concrete immune, at least it would seem reasonable to avail ourselves of the demonstrated superiority of any existing material, and thus ensure, to the best of our present ability, a longer life for our structures; and it should be remembered that, while the life of all other concrete under exposure to alkali ground waters might have been determined, time had yet to show that the life of well-made Super cement concrete fell short of eternity.

Author's Reply, by Dr. T. Thorvaldson.

Dr. Thorvaldson, in reply to the various points raised, stated that, as Mr. Fleming had suggested, lean and watery mortars were used in the early experiments on steam treatment for the purpose of obtaining in the shortest time possible an idea of any beneficial effect of steam on the stability of the hydrated cement itself when exposed to sulphate solutions. Considering the low resistance of the mortar used, the results seemed all the more conclusive, at least as far as solutions of sodium sulphate were concerned. If the expansion method were to be adapted to cement testing for the determination of the relative sulphate resistance of cements, it would be necessary to standardize the procedure along the lines which Mr. Fleming had suggested.

Mr. Larsson had taken a very optimistic position as to the extent of our knowledge of the exact chemical composition of the products present in hardened Portland cement.

It had been shown, [10]that solutions of magnesium sulphate acted slowly on the hydration products of the two silicates, tricalcium silicate and beta-dicalcium silicate, supposed to be present in Portland cement clinker. It had also been shown that the action of solutions of magnesium sulphate on hydrated tricalcium aluminate, (which was supposed to be the third main component present in set cement), was very rapid, compared with the rate of action on the hydrated silicates. On the other hand, mortar bars made from either di- or tricalcium silicate had proved completely resistant to the action of solutions of sodium sulphate, while the addition of tricalcium aluminate to the silicates rendered the mortar vulnerable. Since mortar bars made from a normal Portland cement and properly steam-treated acted towards solutions of magnesium and sodium sulphate exactly as mortar bars made from the calcium silicates without any steam treatment, the assumption that the steam treatment renders the aluminum compounds in the cement unreactive towards sulphates was reasonable and in accord with the facts at hand. Difficulties were, however, met with when attempts were made to explain the mechanism of the reaction on the generally-accepted assumption that the alumina was present as the hydrated tricalcium aluminate and that the steam treatment rendered this compound unreactive. While the theory of destruction through hydrolysis seemed most plausible, no free lime could be detected after hydrated tricalcium aluminate in the pure state had been treated with steam under conditions similar to those which rendered Portland cement resistant. Further work on this point was in progress.

With reference to the discussion by Mr. Viens, the authors wished to state that they did not consider that the experiments described in this paper presented a proof that the alumina was present in the form of tricalcium aluminate in normal Portland cement clinker. On the contrary, the failure of the steam treatment to render a mortar made from a cement to which tricalcium aluminate had been added immune to the action of sodium sulphate would have

[10] Thorvaldson, Vigfusson & Larmour, Proc. Royal Soc. of Can., 1927.

to be explained before one could accept without question the statement that the alumina occurred in normal Portland cement as tricalcium aluminate.

In his discussion of Appendix A, Mr. E. W. Reed-Lewis had mainly expounded the thesis that the resistance of a Portland cement in the form of lean mortar exposed to the action of sulphate solutions had no relation to the resistance to sulphate action developed in the field by concrete made from the same cement. It seemed that this hypothesis, which inferred that the chemical stability of a hydrated cement in a lean and permeable test piece had no relation to the chemical stability of the same cement in a less permeable test piece, required some supporting experimental evidence before it could be accepted.

Even in the case of the most impermeable concrete test piece, the surface was exposed. When the test piece was placed in contact with sulphate solutions, action on the cement took place progressively from the surface. The rate of the chemical action between the sulphate and the hydrated cement in the surface layer, or the stability of the cement in sulphate solutions, was one of the factors determining the rate at which the action progressed inwards from the surface.

Using very lean mortars, and thus allowing the solutions free access simultaneously to all the cement particles in the specimen, instead of to a very thin layer on the surface, gave one an accelerated test, and in such a test it was the ratio of the time intervals required to disintegrate two specimens rather than the actual time required which was significant.

That this was the case, had been confirmed by many laboratory studies on the resistance of mortars varying in richness of mix between 1:10 and 1:3. Thus, as the richness of mix was increased, with corresponding decrease in the permeability of the specimen, the ratio of the expansion of specimens made from a cement high in resistance, as determined by the accelerated test, to the rate of expansion of specimens made from a cement low in resistance was actually increased.

In view of the above, and the fact that sulphate action in the case of fairly impermeable concrete specimens proceeded progressively inwards from the surface, it would be seen that the observations of Mr. Reed-Lewis, (based on Figures Nos. 1 and 2), on the significance of the effect of temperature on the rate of sulphate action were entirely beside the mark.

After a study of tables Nos. 6, 7 and 8 of Appendix B, Dr. Thorvaldson was unable to agree with the deductions made by Mr. Reed-Lewis in his discussion of Appendix A as to the inferiority of high-alumina cement, assuming that the reference by Mr. Reed-Lewis was to the resistance of specimens to sulphate action. In tables Nos. 6, 7 and 8, it was reported that high-alumina cement test-specimens were weathered or cracked above the ground line, while all the specimens, except those in the Grandora test plot, were reported not acted on below the ground line, which was the portion exposed to the " alkali " soil. In the absence of any proof that the weathering above the ground was due to sulphate action, there was no direct evidence of such action on any of the high-alumina cement specimens exposed at the Manitoba and Alberta test plots and reported in tables Nos. 6 and 8. At the Saskatchewan test plot, action below the ground line on all the high-alumina cement test-pieces was reported. Reference to table No. 1 of Appendix B showed that the soil water at the Grandora site, in addition to being extremely high in sodium sulphate, contained a considerable quantity of sodium carbonate, which, as stated in the paragraph of high-alumina cements in Appendix A, was found to cause rapid disintegration of test-pieces of this cement. There was no evidence to indicate to what extent the action reported below the ground line at Grandora was due to sulphate action and to what extent it was due to the action of sodium carbonate.

The statements quoted by Mr. Reed-Lewis from the section of Appendix A dealing with high-alumina cements referred to the laboratory findings as to the resistance of the cements to sulphate action only, and there was no evidence that these were at variance with the results of the field tests.

Reply by Dean C. J. MacKenzie, M.E.I.C.

Professor Mackenzie remarked that in his discussion of Appendix B, Mr. Reed-Lewis had suggested:—

(1) That the great differences in " natural resistance " to sulphate action of different Portland cements as found by Dr. Thorvaldson in the chemical laboratory were a negligible consideration under field conditions.

(2) That in reaching conclusions, evidence from field tests only should be used.

(3) That the greater resistance shown in the field tests by the particular brand of Super cement used. as compared with the particular brand of plain Portland cement used, should be credited to differences in permeability of the two concretes.

Professor MacKenzie believed that few engineers would agree that the results of the experiments on the " natural resistance " of different cements, as reported in Appendix A, had no bearing on field tests. However, for those who believed, as Mr. Reed-Lewis did, that evidence should be drawn only from field tests such as reported, the following information might be offered. There were exposed at the " alkali test sites " referred to in Appendix B many other specimens which, not having been part of the committee's programme were not reported upon by the committee, but were inspected and any deterioration noted, just as and when the committee's blocks were inspected and reported. There were, at the Grandora site, concrete blocks made from certain American Portland cements and comparable in mix and cement content, which after the same length of time were found to be as little affected as those made from the particular Super cement used in their investigations. At another one of the sites there were three sets of similar specimens made from the following cements:—(a) A certain brand of Canadian Portland cement; (b) a certain brand of American Portland cement; (c) a Super cement. After six years' exposure, specimens (a) and (c) were found to be standing up well, while specimen (b) was completely disintegrated. Many such experiences might be cited, including the findings of Mr. Dalton G. Miller, drainage engineer, United States Department of Agriculture, who had found a very great difference in the rates of disintegration of high quality concretes made from different brands of Portland cement.

Consideration, then, of field tests only led to the inevitable conclusion that normal Portland cements differ very greatly in their resistance to alkali action.

As to the great difference in resistance between the Portland cement and Super cement in the field tests reported in Appendix B, when it was realized that similar differences had been noted between different brands of Portland cement, Professor MacKenzie felt that until field tests were available, giving a comparison between a Super cement and a Portland cement from the same clinker, the only logical and scientific conclusion warranted was that made by the committee, i.e., " That as our field investigation did not include tests with Portland cement and Super cement from the same clinker, we have no evidence that one is more resistant to alkali action than the other when subjected to the same field conditions."

Discussion of Paper on The Requirements for a Durable Concrete as Observed from Structures in Service, by R. B. Young, M.E.I.C.[1]

W. S. Lee, M.E.I.C.[2]

Mr. Lee remarked that the author had made comparisons between the expansion of concrete due to change of temperature and due to moisture, expressing the opinion that the expansion due to moisture was much the greater. He hoped that the author would discuss this point further, as comparatively little was known about the expansion of concrete due to moisture. It was well-known that in concrete which is porous, the voids would take up water which would reach into the mass due to capillary action. He believed that in the case of a concrete wall in a hydraulic plant subject to a continuous flow of water, very disastrous cracks might result. He was of the opinion that the cracks experienced in such structures were due to porous or bad concrete rather than to temperature expansion.

The author, in reply, stated that it was well established that concrete expands when wetted and contracts when dried, but the data available did not permit a person to compute accurately the amount of the changes in any given case, although it was known that they might be several times the volume changes caused by the usual variations in temperature. Further, it was known that expansion due to wetting took place relatively rapidly, while contraction due to drying took place much more slowly, as might be expected since the drying out of the concrete was a slower process.

As an indication of the rate at which concrete would absorb moisture, the author cited certain experiments made on the capillary pore determinator mentioned in the paper. A concrete, approximately 1:2:4, cured for two days, dried out and then tested, absorbed water at such a rate that it penetrated the specimen an inch an hour for twelve hours, and the total absorbed water amounted to approximately ten per cent of the volume of the specimen. One could imagine what must happen to a similar concrete in service when subjected to a heavy rain. The surface layers would expand rapidly and the concrete would be very unevenly stressed, and it was possible that such stressing is the cause of some of the map cracking found on certain concretes.

L. J. Street, Affiliate E.I.C.[3]

Mr. Street drew attention to certain compression test results obtained on set concrete test cylinders left out in the open over night in zero weather and tested immediately after being brought into the laboratory.

The result of such tests so far made seemed to indicate that when concrete that had reached its normal strength was exposed to low temperature it developed abnormal compression strength if tested at or approaching the low temperature to which it had been exposed. The abnormal strength seemed to be a function of the temperature at the time of testing, as when companion test specimens were similarly exposed and allowed to return to normal temperature before testing, the concrete resumed its normal strength.

He had not yet determined whether the increase of strength varied with the temperature to which the concrete had been exposed or whether it was constant at all low temperatures.

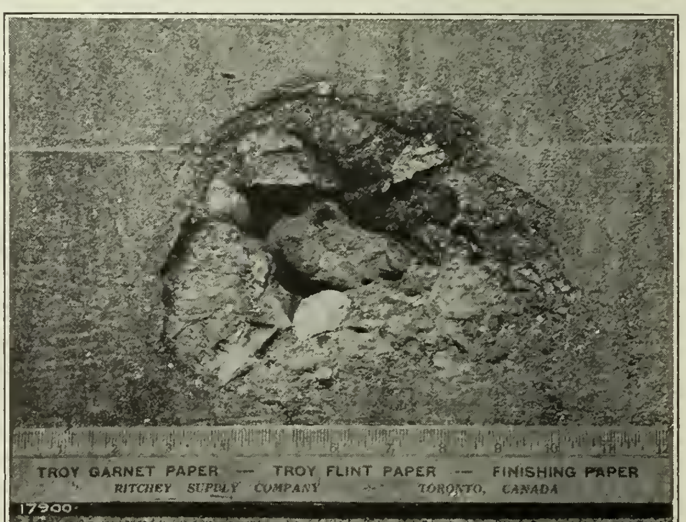
He believed, however, that the test results obtained so far, as shown on the accompanying table, would prove of interest to the members of The Institute.

John R. Baylis.[4]

Mr. Baylis agreed fully with the author's conclusions, and desired to stress the advice that engineers should be sceptical about the addition of substances to concrete to protect it against sulphate-bearing waters. The only thing that could be of help in such cases was to keep the water from getting to the concrete. He believed that any concrete manufactured from Portland cement containing more than one or two per cent of aluminum oxide would disintegrate if sulphates could get to the concrete; unless the hydrated cement compounds had been almost completely carbonated, that is, the $Ca(OH)_2$ converted to $CaCO_3$. The failure in such cases was considered to be due largely to the production of calcium sulpho-aluminate.

A certain hydrogen-ion concentration of the solution within the pores of the concrete was essential before calcium sulpho-aluminate could be produced, consequently, if the alkaline compounds in the concrete were carbonated to the extent that this concentration could not be produced, deterioration would not take place to any great extent. The chief danger of failure in this case would be at points where the certain salts were being concentrated due to moisture being evaporated from the surface of the concrete. However, it was not desirable to manufacture concrete in which all the high calcium compounds can be carbonated after the concrete has set. Such concrete would have to be so porous that it would not be likely to withstand the weathering agents, even though no sulphates were present.

(4) Physical Chemist, Department of Public Works, city of Chicago.



(*Figure No. 4 of original paper published in March 1928 Journal.*)

Spalling Caused by the Decay of Unsound Stone. Moisture Reached the Stone Through the Porous Concrete Causing it to Swell.

(1) This paper was presented at the Annual General Meeting of The Institute, Montreal, February 16th, 1928, and published in The Engineering Journal, March 1928.

(2) Vice-President and Chief Engineer, Duke Power Company, Charlotte, N.C.

(3) Vice-President, National Testing Laboratories Limited, Winnipeg.

Figure No. 21.—Spalling Caused from a Piece of Aggregate Containing Considerable Sulphates.

The author had shown an example of spalling caused by the decay of unsound stone, (see figure No. 4), and this recalled another interesting case of spalling inside of a building over water filters, as shown in figure No. 21. Under certain temperature conditions there had been considerable sweating on the surface of this concrete, but the concrete did not come in contact with other water. The stone causing the spalling was so soft and porous that it seemed impossible that it could have exerted much pressure, if any, on the surrounding concrete. The fact that the pores of the concrete near the piece of stone were filled with calcium sulpho-aluminate indicated that the soft stone had caused the flaking-off of the concrete by giving up sulphates to it and causing the surrounding concrete to expand. There were several spalled-off places in the building, this one being the largest, and the actions occurred after the building was twelve years old. The material remaining in the soft piece appearing dark in the photograph was found to contain 16 per cent of SO_3.

Volume changes due to moisture might be more serious than is generally believed. He had filled a glass tube about ¾ inch in diameter with neat cement mortar and allowed it to stand a few months tightly stoppered. When the glass was broken from around the mortar, the surface was very smooth. The piece was dried for a day at about 100° C. to be used in making a water absorption test. After cooling to room temperature and weighing it was immersed in water. The cracking of the surface could have been heard 10 to 15 feet away. When removed from the water two or three minutes afterwards, it was found that there was no place on the surface over one-half inch which did not have a noticeable crack. The conditions may have been ideal for crazing, but the experiment tended to confirm the author's views as to the cause of these cracks.

The "capillary pore determinator" deserved careful consideration. Mr. Baylis had given considerable thought to methods for measuring the pores in concrete that would not also measure the larger voids, such as spaces produced by air-bubbles in the concrete.[5] The method he had used was somewhat different from that given in the paper, but the results would be largely the same. It was found that when a piece of concrete was submerged in water the larger voids were not filled within 24 hours, and that this test gave a very good indication of the power of the concrete to resist the weathering agents. Due to the possibility of uneven distribution of the coarse aggregate in the mortar, the samples of concrete were crushed and all aggregate retained on the No. 8, (8-mesh), sieve excluded from the mortar measurement. By this method, the mortar volume

[5] John R. Baylis, Corrosion of Concrete. Trans. American Society of Civil Engineers, vol. 90, p. 791, 1927.

Comparative Strengths of 6″ x 12″ Concrete Cylinders Tested at Low Temperatures and at Ordinary Temperatures

(As referred to in discussion by L. J. Street, Affiliate E.I.C.)

Lab. No.	Designed Strength	Age when Tested	Curing Conditions	Compressive Strength lbs. per square inch	
1442	2,500 lbs.	2 months	A	5485	Same batch of concrete
1443	2,500 "	2 "	B	2783	
1483	2,500 "	32 days	C	5100	" " "
1482	2,500 "	32 "	D	2506	
1505	3,000 "	34 "	E	5907	" " "
1506	3,000 "	34 "	F	3800	
1508	1 500 "	33 "	G	3870	" " "
1509	1,500 "	33 "	H	2180	
1510	1,500 "	33 "	I	1661	
1518	1-15 mix	1 day	J	2830	

	In Air	In Water 65°F.	In Air	In Air
A	1 day	6 weeks	2 weeks—65°F.	24 hours—15°F.
B	1 "	8 "	....	....
C	1 "	28 days	2 days over radiator	24 hours—10°F.
D	1 "	31 "	....	....
E	1 "	27 "	4 days—65°F.	2 days—zero temp.
F	1 "	27 "	6 " —65°F.	....
G	1 "	27 "	4 " —65°F.	2 days—zero temp.
H	1 "	27 "	6 " —65°F.	....
I	1 "	33 "	....	....
J	....	....	....	1 day—zero temp.

Table No. 1—Densities, Absorptions, Porosities and Strengths of Mortars of Equal Flowability.

Proportions by Volume		Cement Mortar lbs. per cubic yard	Density	Porosity	Cement Density	Per cent. Absorption by Volume	Volume of Specimen c.c.	Solids plus Absorption c.c.	Compressive Strength lbs. per square inch (six days)
Cement	Sand								
1	0	2850	0.704	0.296	0.704	29.9	204	205	4075
1	1	1550	0.742	0.258	0.550	25.5	204	203	2420
1	2	1050	0.743	0.257	0.500	23.8	204	200	1300
1	3	795	0.747	0.253	0.433	26.3	204	204	760

and the voids within the mortar were determined, which was the information desired.

He wished particularly to emphasize the importance of the author's statement:—"It is seldom that the deterioration of a concrete is caused by a single agency, for if it is of such poor quality that it is susceptible to one form of attack it is usually susceptible to others. . . . It is seldom possible to protect an exposed concrete from freezing temperature, but it is possible to build one in which the porosity has been reduced to a point where it is no longer damaged by frost action." Many erroneous conclusions had been formed as to the causes of concrete deterioration, and failure to realize the importance of porosity was causing the production of much concrete which would undoubtedly disintegrate in the near future. Surely this excellent paper would have some influence on the production of better concrete.

G. M. Williams, a.m.e.i.c.[6]

Professor Williams observed that, in spite of porosity and absorption, impermeable concretes can be made if proper attention is given to cement, aggregate and water. He would define the terms porosity, absorption and impermeability in much the same manner as the author had done, but would distinguish between porosity and absorption on the one hand and permeability on the other. As would be shown in the following tabulations, concretes varying from the richest to the leanest had almost identical total pore space, yet the degree of impermeability varied directly as the cement content. There were two methods in general use, both adapted to laboratory study, and one adapted only to field tests of concrete, by means of which a fairly accurate determination of total pore space in a concrete or mortar specimen could be made.

The method of absorption, used both in laboratory tests and in tests of set concrete samples obtained from structures, was not generally considered to be reliable, but he believed that this method permitted of a fairly accurate determination of total pore space. Unfortunately, as indicated by the test data, there was apparently little relation between pore space and concrete quality.

The computation of density or solidity ratio was especially adapted for obtaining this value for laboratory concretes, where the actual weights and specific gravities of all of the ingredients in a batch of concrete of known volume could be measured, but was of no value in the study of field concretes. The sum of the absolute volumes of dry materials in a unit volume divided by the unit volume was a measure of the density. For concrete mixtures, this was always less than unity and usually varied between 0.70 and 0.85. Porosity was computed by subtracting the density from unity.

Generally, in computing solidity ratio the specific gravity of the ground clinker was employed to obtain the absolute volume of the cement. This figure might vary from 3.08 for old storage cement to as high as 3.16. He used, and would suggest as a more accurate value, the specific gravity of hydrated neat cement. This figure is considerably less than that of the clinker, and for the tests reported below was 2.42. Such a figure resulted in a density which was more nearly the true solidity ratio of the hardened concrete.

Permeability was usually determined by applying water under pressure to one side of a test slab and noting the time required for water to appear on the opposite face, or the amount per unit area passing through in a given time, but the determination of the permeability of specimens of neat cements or rich concretes was very difficult, owing to the high water pressure required and the tendency to overstress the test specimen. For example, he had found that under certain conditions test slabs 2½ inches thick, when made of concretes of medium to dry consistencies, were impermeable for an indefinite time to a head of 80 feet when the cement content was more than 375 lbs. per cubic yard. Such a concrete with local materials having the proper

[6] Professor of Civil Engineering, University of Saskatchewan, Saskatoon.

Table No. 2—Physical Properties of Three Concretes Differing in Cement Content, but having Equal Flowabilities.

Proportions by Volume		Lbs. Cement per cubic yard of Concrete	Density	Porosity	Cement Density	Per cent. Absorption by Volume	Solids Plus Abs. in c.c.	Per cent. of Volume	Compressive Strength lbs. per square inch (28 days)
Cement	Aggregate								
1	4	582	0.816	0.184	0.435	18.2	687	0.975	2860
1	5	465	0.814	0.186	0.378	18.7	697	1.000+	2090
1	6	410	0.810	0.190	0.348	18.9	693	1.000	1360

Table No. 3—Physical Properties of Three Concretes of Same Proportions, Flow Varied from Dry to Wet.

Proportions by Volume		Flow	Lbs. Cement per cubic yard of Concrete	Density	Porosity	Cement Density	Per cent. Absorption by Volume	Solids plus Absorption c.c.	Per cent. of Volume	Compression Strength Lbs. per square inch (28 days)
Cement	Aggregate									
1	5	125	497	0.843	0.157	0.436	15.4	688	0.998	2750
1	5	170	487	0.825	0.175	0.403	17.5	697	1.000	2065
1	5	206	476	0.810	0.190	0.379	18.9	694	1.000	1530

aggregate gradation had about a 1 to 6½ volume proportion. It had been fairly well established that, with other factors the same, permeability decreased with increase in cement content.

To illustrate the relations between strength, porosity, absorption and permeability, he gave the results of several groups of tests employing local aggregates, the results being typical of those obtained with the same materials and conditions of these tests, but quite consistent with the range in values found for aggregates, differing rather widely in gradation, from other sources. " Density " in the tabulations was the computed value for solidity ratio in which the specific gravity of the cement in the hydrated form was found to be 2.42.

" Porosity " is equal to unity minus the density. " Cement density " was obtained by dividing the absolute volume of hydrated cement by the sum of absolute volume of cement and void space. " Per cent absorption by volume " was obtained by immersion to practically constant weight. " Solids plus absorption " was the sum of the absolute volumes of solids in a test piece plus the volume of the absorbed water. When this value was divided by the volume of the test specimen a value of approximately unity was usually obtained.

Table No. I gave tests of mixtures ranging from neat cement to 1-3 mortar.

These figures indicated that the computed porosity was practically the same for 1-1 or 1-3 mortars, and slightly less than for neat cement. The slight differences found for absorption were not sufficient to distinguish differences in cement content.

For concrete, at an early age, the computed volume of solids in a specimen plus the absorption by volume was practically equal to the volume of the specimen. Disregarding the small volume of water absorbed by the aggregate particles, the absorption by volume appeared to be a measure of pore space in a mass. Tests made on the same specimens after they had been exposed to the air of the laboratory for about one year indicated an appreciable increase in dry weight, no doubt due to the carbonization of free lime, and when again immersed they attained practically their original wet weights, so that the percentage absorption by volume was less when determined with old specimens.

Permeability of the mortars increased as cement content decreased. The neat cement would be impermeable under all pressures, while the 1-3 mortar would be least water-tight under any given condition of test. Compressive strength and cement density decreased in the same order. Apparently there was no relation here between permeability and density or absorption.

Similar test data for concretes were shown in table No. 2. In this group the cement, aggregates and flowabilities were constants and cement content was the variable.

Compressive strengths, as would be expected, increased with cement content. Permeability tests showed permeability to decrease as cement content increased. The same relation held for durability in sulphate waters. The 1-4 mixture would rank highest, and the 1-6 lowest, with relation to these three important properties. Porosity and absorption seemed to have no relation to these properties, since pore space calculated as well as measured by absorption was a constant. The figures for cement density appeared to bear some relation to quality of concrete for this single aggregate gradation.

In tables Nos. 1 and 2 had been shown mixtures differing in richness or cement content, and no definite relation was apparent between quality of mortar and concrete, and pore space and absorption in the mass as a whole. The computed cement density was the one density figure which seemed to bear any relation to concrete quality. It should be noted here that whereas engineers to-day generally speak of density regardless of cement content, the earlier methods of proportioning concrete by the maximum density theory restricted the density comparison to concretes of equal cement content.

In table No. 3 were shown tests of three concretes of the same cement content, differing only in flowability which varied from dry plastic to wet; slumps from nil to about eight inches.

As would be expected, the mixture of lowest flow was the strongest; approximately 80 per cent stronger than the 206 flow concrete. Permeability tests indicated the times required for penetration through a 2½-inch test slab to be approximately 36, 24 and 12 hours respectively. Porosity and absorption both showed appreciable increases as flowability increased. These results indicated that variation in consistency may result in much greater variations in density than variation in cement content. Cement density, as in the previous tables, showed appreciable decrease as consistency increased.

It would be seen from the foregoing results that porosity may appear to be a criterion for quality when the comparison is restricted to concretes of the same cement content and containing the same aggregate gradation. For the same concretes, the compressive strength would appear to be just as satisfactory a measure.

He had not included any data to show the variation in physical properties with (*a*) change in gradation of fine aggregates or (*b*) change in relative proportions of fine and coarse aggregate. In general, coarser sands would increase the computed density and finer sands would lower the density, other factors being the same. In the same manner, reduction in sand content of the aggregate increased density while an increase tended to lower density. He had also found that with cement contents and flowabilities constant, highest strengths and most impermeable mixtures resulted from aggregate combinations somewhat lower in density than the maximum. Nor did it appear, when comparing aggregates from different sources, with cement content and flow constant, that the mixture of highest density was the concrete of best quality, as measured by strength or permeability tests.

The quality of the cement itself was no doubt an important factor in establishing the life of concrete. Studies had shown that different brands of Portland cement differed greatly in their resistance to sulphate action. It was possible that these same characteristics, which resulted in short life under such conditions, might also contribute to earlier breakdown where exposed to normal atmospheric conditions. For example, it had been noted that a Portland cement, meeting the requirement of the standard soundness test, but unsound when exposed to high-pressure steam, when made up into mortars and exposed to the dry air of the laboratory might crumble away in a few years, whereas the same brand of a cement, sound in high-pressure steam, was unaffected when exposed as a mortar to the same conditions.

He believed that there was no accurate measure of durability or life of concrete, but it seemed that exposure to sulphate waters should in some measure serve to classify mixtures in this respect. Experience had shown that concretes of high cement content were more resistant to sulphate action than those of low cement content; also, that medium dry, plastic mixtures were more resistant than wet flowable mixtures. Laboratory tests indicated those concretes most resistant to be more impermeable than less durable ones. It should be noted, however, that neat cements were less resistant to sulphates than very rich mortars or concretes.

He was of the opinion that the factors of porosity and absorption would give little or no indication of possible life of concrete, whereas strength and permeability, together with "cement density," whenever it was practicable to determine this factor, were fairly good measures of durability.

No doubt as progress was made in the study of cement itself, the engineer could build with greater assurance of permanence. As the author had pointed out, the majority of concrete structures were probably giving good service with ultimate life undetermined and probably sufficiently great to justify the continued use of concrete under most exposure conditions. In the meantime, long life could most certainly be assured by the use of rich plastic mixtures without the addition of more mixing water than is required for placing with a reasonable amount of labour.

Discussion of Paper on a Study of Transmission Line Power-Arcs by Paul Ackerman, A.M.E.I.C.[1]

A. E. Davison[2]

Mr. Davison observed that a feature which had an important bearing upon the protection of apparatus involved in power-arcs was the observation that arcs spread horizontally in a more marked way than they do vertically. This was to be noticed especially in the later pictures, where two post-type insulators separated possibly three or four feet from one another were used to support the lead which carried the loops between which the power-arc was to play and to be studied.

A review of the paper indicated that the performance of the arc between the loops was given much attention as follows:—

(a) Early bending of the arc.
(b) Marked chimney effect.
(c) Change in the resistance of the arc due to short-circuiting of the chimney effect and to various offshoots or irregularities.

Without having a further opportunity to study the films and photographs he had carried away from the meeting, the above impression was regarding the performance of these arcs, namely, that each arc seemed to be cut off about the time that the base of the arc had travelled laterally down the loops, over the first, or nearest insulator, across the lead between the two units, and until it reached the lead outside the second insulator from the loop. At this point the circuit was opened. These arcs did not travel down the loops and across the lead between the two supporting insulators uniformly on each side of the gap, possibly because of a slight wind or other similar irregularity.

If this observation were correct, he wondered whether the author was impressed at the time the work was done with the difficulty of controlling these arcs insofar as they involved the leads.

Was it not an observed fact, that whereas the distance from the top of the horn to the top of the arc was, say, six feet, the distance out to out of the arc horizontally at the close of each experiment must have been of the order of three times that dimension. Doubtless there was in this experiment some repulsion of the two arc columns; however, there seemed to be considerable evidence that once arcs of the type with which the author had experimented were set up long enough to burn appreciably any conductor with which they are connected, then it might be expected that they could not be confined to a reasonably limited part of the apparatus or equipment.

He believed that the author had done the electrical industry a great service in his work on arcs, and should be complimented on his experimental work and his thoroughly modern methods of recording it.

C. R. Reid[3]

Mr. Reid desired to congratulate the author on the adoption of such a bold method for obtaining the desired information, and for the thorough and systematic manner in which his experiments were carried out. The results obtained confirmed operating experience to a great extent, and shed a good deal of light on the limitations of air break switching in particular. In this connection the formula for critical arc length and data given in table No. 4 should be of especial value to the designer and operating engineer in determining the conditions under which a circuit may be safely interrupted on an air break switch.

There might be some difference of opinion in regard to the conducting medium of the arc. In some quarters this medium was regarded as the metallic vapour derived from the arcing surfaces. This question, however, had no bearing on the practical value of the paper. The author had pointed out the sensitiveness of the arc to air currents. This was of importance in connection with the design of bushings and insulators, and was a point that the manufacturer might study more carefully. During a recent flash-over test of a 220,000 volt bushing the break-down arc formed as a true geometrical arc between the top and collar mounting of the bushing. However, the lower part of the arc was immediately carried up against the surface of the bushing by the rising current of heated air. It should not be forgotten, however, that if a power-arc had been present, the magnetic flux set up by it might have been sufficient to hold the arc out away from the bushing surface.

(1) This paper was presented at the Western General Professional Meeting of The Institute, Vancouver, B.C., June 7th-9th, 1928, and published in The Engineering Journal, May 1928.

(2) Transmission Engineer, Hydro-Electric Power Commission of Ontario, Toronto.

(3) Superintendent of Generating Stations, Shawinigan Water and Power Company.

Discussion on "Forest Conservation in British Columbia," by Mr. P. Z. Caverhill[1]

A. C. R. Yuill, M.E.I.C.[2]

Mr. Yuill enquired as to the relation between the cost of reproduction of the forest and the revenue derived from stumpage.

The author replied that it was difficult to give a specific answer, since the cost of reproduction depended on the method of reforesting and on the damage done to the forest during the process of logging. High-lead logging, which came into use ten years ago, was, of course, economical mechanically and enabled large areas to be dealt with which could not be logged by other methods; the apparent destruction in small material was largely offset by taking timber from steep slopes. Notwithstanding the débris left, many extensive areas, as, for example, spruce forest in the Queen Charlotte islands, had been logged by this method and had shown satisfactory natural reproduction. Similar experience had resulted in the case of Douglas fir, where eight or nine years after logging, young trees in excess of five hundred per acre had been found on 60 per cent of the areas examined and on 87 per cent of the areas where fire had been kept out. All factors governing the natural seeding of Douglas fir were not thoroughly understood, though it appeared that while Douglas fir seed will easily travel a quarter of a mile, cases had been observed of seedlings starting as far as three-quarters of a mile from the parent tree. It was, however, true that some areas, when burnt or logged, would be seedless unless seed trees had been left. An important problem was the protection of such seed trees, which are particularly liable to be blown down owing to their exposed situation and are open to damage from slash fires and other causes. Replanting would have to be employed to fill up spaces where natural seeding cannot be obtained. As to the cost of forest reproduction in British Columbia, he observed that planting might cost from $15.00 to $20.00 per acre, and no return could be expected from this outlay for fifty or more years. He deprecated the practice of estimating the cost of artificial planting by assigning compound interest to the original cost of planting, as even if the planting cost were as low as five cents per tree, this sum at compound interest for seventy-five years would reach a prohibitive value.

Major McHugh enquired as to the method adopted in the Okanagan district, where it appeared to him that selective logging would be necessary.

The author replied that such selective logging would probably be advisable in the future in districts where conditions were such as to make it possible. He observed that the selective system, as carried out in Europe, is applied successfully where the timber is small and transportation facilities are good, these conditions being characteristic also of certain localities in the Okanagan. He looked forward to the time when, in the somewhat distant future, selective logging would be possible over a great part of the second growth forests of the province.

Major McHugh was glad to hear this and hoped that in deciding upon the logging methods to be permitted, due consideration would be given to the effect of the removal of the forests on the natural flow of streams and rivers, particularly with regard to the fisheries of the province. He hoped also that it would be possible to pay more attention to the disposal of slash.

The author replied that the cost of piling and burning slash might run to $1.25 per acre, and that at present money for this purpose was not available. On the other hand, if the slash were allowed to remain upon the ground, it not only increased the fire hazard, but endangered the neighbouring standing timber, because it afforded a breeding place to certain bugs and wood-eating beetles which attacked neighbouring trees.

In conclusion, the author pointed out that there were three practical methods of artificial reforestation:—(a) The raising of seedlings from seeds in nursery beds, these being transplanted and finally placed in position in the woods when three or four feet high, the number planted ranging from 500 to 5,000 per acre, depending on the class of timber desired. If not planted sufficiently close, the development of limbs would be encouraged, and the resulting timber would have too many knots. If planted too close, subsequent thinning was necessary. (b) Broadcast seeding, the disadvantage of this being the high cost of seed, which may range from $1.00 to $10.00 per pound. As a rule, the results had not been encouraging, as small rodents busily collected the seed as soon as it was scattered and stored it up for their winter use. When seeding took place under natural conditions, the trees did not drop their seed all at one time, and the period of scattering of the natural seed extended over several months. In this way, the forest animals had not so much chance for collecting and wasting this valuable material. (c) The third method was spot-seeding, where small spots were prepared as beds to receive seed at regular intervals; this had proved more successful than broadcast seeding.

(1) This paper was presented at the Western General Professional Meeting of The Institute, Vancouver, B.C., June 7th-9th, 1928, and published in The Engineering Journal, June 1928.

(2) Consulting Engineer, Vancouver, B.C.

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Memories of the Cariboo Trail

Busy with the affairs of today, we are apt to forget the achievements of our predecessors, and often take as a mere matter of course the advances they made in opening up the country, and in making it possible to provide the facilities for transportation and the conveniences of life which we now enjoy.

Much of our progress in Canada is based on the work of the "old-timers," as they are affectionately termed in the west. Their lives, whether spent in pioneer exploration, construction, or development, were tinged with a romance of which they never dreamt. We need only recall, for example, the picturesque scenes which must have occurred along the Fraser river in the sixties, when, as Patrick Philip, M.E.I.C., told us in describing the old Cariboo Road at the recent Professional Meeting in Vancouver,* stage coaches, gold escorts, prairie schooners, and travellers of all kinds thronged that rugged highway, a road which had been developed from a mule trail, and then formed the only means of through communication between the coast and the rich mining region four hundred miles in the interior of British Columbia.

Appreciation of such pioneer spirit as that which actuated the builders of the Cariboo Road is a very proper function of The Engineering Institute of Canada. Much has been done towards the recognition and marking of our historic sites in Canada, and this work is carried on by a number of public bodies, such as the Historic Sites and Monuments Board, but in many cases the people and events commemorated are connected with war-like or political events rather than with industrial progress, and The Institute can fitly associate itself with movements drawing attention to the peaceful work of the early engineers and constructors.

It is not often possible to erect a monument recording at the same time both the accomplishment of an arduous task, and the admirable qualities of the body of men who carried it out, but an opportunity of this kind has recently occurred on the completion of the new motor road through the Fraser canyon.

On Dominion Day, this year, there was unveiled at Spuzzum, on a cairn near the new Alexandra suspension bridge across the Fraser river, a bronze memorial tablet to the memory of the detachment of Royal Engineers who founded New Westminster and built much of the original Cariboo Road. The Chairman of the Vancouver Branch of The Engineering Institute, in his address on that occasion, suggested that there was something of Imperial significance about the day's ceremony. In using this phrase the word Imperial was not used in any boastful sense, but because the event commemorated, and the body of men to whom honour was rendered, may be regarded as typical of the agencies which give the widely separated constituent portions of the Empire their mutual interests. Such links do not necessarily depend on written treaty or act of parliament, but their effectiveness is due to the memory of past achievement and the possession of common traditions.

The Engineering Institute of Canada and the Association of Professional Engineers of British Columbia have joined in erecting this memorial cairn and tablet, and in doing so have placed a memorial to a body of men belonging to a distinguished corps, who, as the event proved, exemplified the qualities of idealism, practical ability and sound common sense, combined with a love of the Old Land from which they came and the New Land to which their duty led them.

The majority of our historic memorials have been erected to the memory of individual pioneers, explorers, soldiers or statesmen, thus the Fraser canyon monument is somewhat unusual in being dedicated to a body of men and their joint contribution to the welfare of the country.

The tablet was unveiled by Judge Howay, of Vancouver, well known as an authority on the history of British Columbia, who pointed out that this party of Royal Engineers, sent out by Lord Lytton, and chosen for this duty from among hundreds of volunteers, were the first builders of roads through the wilds of the lower mainland of British Columbia, and that they developed such an attachment for their adopted country that none of them, except the officers, elected to return to England when their task was finished.

The road, of which these Royal Engineers built the original portion through the Fraser canyon, has now been developed by the provincial government as a portion of the main highway from Vancouver to Prince George, and many miles of it will, before long, form an integral part of the trans-Canada highway. The scenery through which it

* See The Engineering Journal, July 1928, p. 399.

passes, the engineering difficulties which have attended its construction, and the road as finally completed, were fully dealt with in the address by Mr. Philip, to which reference has already been made. The motorist will now travel with speed and comfort through the canyon where, in the days of the gold rush, the slow-moving wagons struggled with the difficulties of the way.

The contrast between the modes of travelling then and now reflects the change in the spirit of the age. It is true that for a time, the old trail having grown into disuse, everyone supposed that the place of highway traffic had been taken for all time by the railways, and indeed portions of the original Cariboo trail were destroyed, either by the construction of the Canadian Pacific on one side of the canyon or the Canadian Northern on the other. With the coming of the motor, however, this was all changed, the necessity of road transport was recognized anew, and the Cariboo road now stands as a monument, not only to its original builders, but also to the far-sighted highway policy of the government of British Columbia.

Recent Progress in Aeronautics

A very complete periodical review of recent progress in aeronautical science is to be found in the Annual Report of the British Aeronautical Research Committee. This Committee's report for 1927-28, which has just been issued,* covers an extremely wide field of work and investigation, ranging from the standardization of symbols to the solution of theoretical and experimental problems in hydrodynamics.

An important decision taken by the Committee, following an interchange of information between the Aeronautical Research Committee and the United States National Advisory Committee for Aeronautics, has been the establishment of a compressed air tunnel at the National Physical Laboratory, which will have a working section five feet in diameter, and in which experiments can be made under air pressures as high as twenty-two atmospheres. The necessity for this equipment arises from the fact that it is impossible to test small aeroplane models in conditions really corresponding with those experienced by the full sized machine, since the Reynolds Law of Comparison, on which model experiments are based, breaks down if the speed of flow approaches the velocity of sound. Fortunately, tunnel experiments carried out under pressure remove this difficulty, since at high air-pressures conditions of dynamic similarity between model and aeroplane can be secured without requiring excessive air speeds. It is expected that work with this tunnel will be particularly valuable in making researches on the thick winged sections from which so much has been expected. The Committee points out, however, that ample facilities must still be provided for full scale experiments as an ultimate standard of reference.

It is interesting to note that a number of British models have been tested in the United States variable density wind tunnel, and the Committee acknowledge their indebtedness to the United States authorities in this connection, the American tests affording a notable example of international scientific co-operation.

Airscrews have been the subject of much study during the past year, particularly with regard to the conditions necessary for operation with high tip speeds. There seems no doubt that consultation between research workers and designers in Britain had much to do with the Schneider Cup victory last year, for a great deal of the research work on which the design of the successful machine was based was carried out at the National Physical Laboratory, under the auspices of the Committee. Further work on sea planes is in progress, and a high speed tank for hull and float-resistance work is being constructed.

Considerable advances have been made in the study of the effect of lead ethyl and similar substances in stopping detonation in engines, the Committee's work being directed towards ascertaining the physical principles on which the prevention of knock must be based.

In connection with the proposed extensive flights of the large airships now being constructed in Britain, there has been further inquiry as to the stresses to which such vessels may be subjected in flight or when moored to a mast, and for this purpose a research on wind structure has been commenced, with a view of obtaining some indication of the forces that may be experienced by a moored airship.

The Committee is of the opinion that during the next few years the most important requirements for successful commercial air transport will be an engine of large horsepower, burning a heavy fuel-oil and economical in fuel, thick-winged monoplanes, all-metal structures, and the use of pusher airscrews and geared engines, with a view of decreasing the discomfort to passengers from noise.

In regard to stability and control, various methods of using slots at the wing tips to improve stability and control are being extensively tried, and a scheme of standard tests for balance, stability, and controllability to be applied to every new type of aeroplane is being worked out. Progress is also being made in the study of the spinning of aeroplanes. The Committee has paid considerable attention to problems of fluid motion, both theoretically and by experiment.

An interesting series of investigations is being carried out on the effect of small obstacles or projections on the drag of an aeroplane body, this having been rendered necessary by lack of precise knowledge as to the extent to which, for example, the projecting cylinders of air cooled engines give rise to unnecessary resistance to the rush of air.

The study of compression-ignition engines is being proceeded with. The advantages offered by an engine of this type would include the diminution of fire risk by using a fuel of high flash-point; a fuel consumption as low, if not lower, than that of a gasoline engine; a cheap fuel, and the elimination of electrical ignition. On the other hand, difficulties due to starting, and the greater ratio of weight to horse-power of the engine would have to be overcome.

Among other topics dealt with in the report of the Committee are the use for fuel of hydrogen withdrawn from the ballonets of an airship, thus utilizing some of the gas which has, in the past, had to be wasted when the airship's lift has to be reduced to correspond with the gradual reduction in load; methods of securing more efficient control of aeroplane carburetors in flight; the fatigue of metals when subjected to corrosive agencies and to alternations of stresses of very high frequency up to 15,000 cycles per second; the torsional vibration and critical speed of crankshafts; and problems connected with the prevention of fire in aircraft resulting from a crash.

During the year over sixty important reports have been approved for publication, and last, but not least, the work of the Committee has been carried out after discussion of its programme with representatives of the Society of British Aircraft Constructors. It is satisfactory to note such close co-operation between a technical and scientific body, and the manufacturers who are particularly interested in its work.

* Aeronautical Research Committee, Report for the years 1927-28. London. H.M. Stationery Office, 2/- net.

OBITUARIES

William Boyd Davis, A.M.E.I.C.

It is with deep regret that we record the death of William Boyd Davis, A.M.E.I.C., which occurred at the Western Hospital, Toronto, on July 26th, 1927, after a long illness. The late Mr. Davis was born at Ivy, Ontario, on August 9th, 1889, and graduated from the University of Toronto with the degree of B.A.Sc. in 1912. Immediately on graduation Mr. Davis became a leveller on the Trent canal, and continued in this capacity until 1914 when he was made assistant engineer, which position he held up to the time of his death, being at that time in charge of the Severn division. Mr. Davis joined The Institute as an Associate Member on June 27th, 1922.

Charles Napier Wylde, A.M.E.I.C.

Members of The Institute will learn with regret of the untimely death of Charles Napier Wylde, A.M.E.I.C., which occurred on August 26th, 1928, as a result of injuries received at the plant of the Dryden Paper Company at Dryden, Ontario. Mr. Wylde, who was born at Montreal on November 13th, 1898, was educated at Lower Canada College, afterwards proceeding to the Royal Military College, Sandhurst, England, where he was trained for the Imperial army. Following graduation he was granted a commission in the Royal Fusiliers and proceeded overseas with his unit. When unable to serve further in France on account of his wounds, he was returned to England, and later served in Ireland.

In 1921 Mr. Wylde returned to Canada, and in 1923 graduated from McGill University with the degree of B.Sc. On graduation he became identified with the firm of Charles Walmsley and Company, Limited, but severed his connection with that firm in 1925 to join the Dryden Paper Company, Limited, where for two years he was in charge of the steam plant and electrical equipment. In 1926 he was placed in charge of mill maintenance and new construction work, and in June 1927 he was appointed chief engineer of the company, which position he occupied at the time of his death.

Mr. Wylde joined The Institute as a Student in 1921, and was transferred to the class of Associate Member in 1927.

PERSONALS

Elbert H. Hayes, S.E.I.C., who graduated from the University of New Brunswick in 1928, is now connected with the engineer division of the Northern Electric Company at Montreal.

F. D. Taylor, S.E.I.C., is now connected with the Canadian International Paper Company at Hawkesbury, Ont. Mr. Taylor graduated from McGill University this Spring, with the degree of B.Sc.

H. J. Racey, S.E.I.C., is at present field engineer on the investigation of the St. Maurice river with the Shawinigan Engineering Company, Limited, at La Tuque, Que. Mr. Racey graduated from Queen's University this Spring with the degree of B.Sc.

Marc Boyer, S.E.I.C., who graduated from the Ecole Polytechnique in 1928 with the degree of B.Sc., is now connected with the Consolidated Mining and Smelting Company at Trail, B.C. During the summers of 1925, 1926 and 1927, Mr. Boyer acted as transitman for the Quebec Streams Commission.

A. W. Swan, A.M.E.I.C., formerly assistant editor of this Journal, and now publicity manager for Evershed and Vignoles Limited, electrical engineers, London, England, has recently been on a visit to Canada. While here Mr. Swan was married at Magog, Quebec, on August 14th, and has returned with his wife to England, where he will reside.

Syd. H. Davis, A.M.E.I.C., who graduated from McGill University in 1923, is now field engineer with J. M. Forbes, consulting mining engineer of Sudbury, Ontario. Mr. Davis was formerly connected with the Gatineau Power Company as resident engineer for highways and bridges and later as engineer with the development department.

Captain C. R. S. Stein, R.C.E., A.M.E.I.C., is at present stationed at Military District No. 5, Quebec, Que. Captain Stein has just returned from England, where he has been attached to the Royal Military College at Woolwich. Prior to going to England, Captain Stein was district engineer officer for Military District No. 10 at Winnipeg, Man.

E. G. Cullwick, Jr.E.I.C., has accepted a position as assistant professor of electrical engineering in the University of British Columbia. Mr. Cullwick, who graduated from Cambridge University in 1925 with the degree of B.A. in engineering, was for some time connected with the Canadian General Electric Company, Limited, at Peterborough, Ontario.

Thomas Foulkes, S.E.I.C., has accepted a position in the electrical department of the Spruce Falls Power and Paper Company at Kapuskasing, Ontario. Mr. Foulkes graduated from the University of New Brunswick in 1926 with the degree of B.Sc., and was formerly connected with the Canadian General Electric Company at Peterborough, Ont.

Gordon H. Kingan, Jr.E.I.C., who graduated from McGill University in 1925 with the degree of B.Sc., has resigned from the staff of the Riordon Pulp Corporation, Limited, at Temiskaming, Que., to which he has been attached since graduation, to accept the position of designing engineer on the Montreal staff of the Fraser Brace Engineering Company, Limited.

A. S. Rutherford, S.E.I.C., is at present acting in the capacity of superintendent with the George A. Fuller Company of Canada, Limited, on the construction of the new Dominion Square Block in Montreal. Mr. Davis, who graduated from McGill University with the degree of B.Sc. in 1922, was formerly with the Church Ross Company, Limited, as superintendent of construction and had been connected with that firm since 1923.

H. W. R. Shepherd, A.M.E.I.C., recently severed his connection with the James Ruddick Construction Company in Quebec to accept the position of resident engineer with the Foundation Company on the construction of the Ghost river dam for the Calgary Power Company. Mr. Shepherd was formerly resident engineer for the highway department of the province of Alberta, and from 1914 to 1919 was overseas with the Alberta Dragoons and the Second Battalion of Canadian Engineers.

Stanley R. Job, A.M.E.I.C., of Niagara Falls, Ontario, is at present connected with the Herbert Morris Crane and Hoist Company on the design and detailing of cranes. From 1920 to 1922, Mr. Job was designer in the hydraulic department of the Hydro-Electric Power Commission of Ontario, and in 1924 he was assistant mechanical engineer and resident engineer on construction of an elevator at Port Colborne for the Department of Railways and Canals. In 1925, he was assistant designer of mill buildings for the Acheson Graphite Company at Niagara Falls, N.Y., during 1926-27, he was assistant designing engineer on the building of the Canadian Shredded Wheat Company, and prior to accepting his present position he was designing engineer and draughtsman for the Light and Power Manufacturing Company at Niagara Falls.

J. L. Bieler, S.E.I.C., has recently accepted the position of assistant engineer with the Dominion Oilcloth and Linoleum Company in Montreal. Subsequent to his graduation from McGill University with the degree of B.Sc. in 1923, Mr. Bieler took an engineering course with the Bailey Meter Company in Cleveland, Ohio, and remained with that firm until 1925, being on the sales and service staff and in the research department. In 1925, Mr. Bieler was in charge of a party on a Gatineau river power survey, and from January to June 1926 he was engineer with the Consolidated Pipe Company. During the years 1926 to 1928 he was sales engineer and later chief engineer of Industrial Combustion Engineers, London, England.

K. G. Cameron, A.M.E.I.C., has been promoted to the position of assistant chief engineer of the Canada Sugar Refining Company, Limited. Mr. Cameron, who is a graduate of Edinburgh University of the year 1912, was designing engineer with this company until his recent promotion. He came to Canada immediately after graduation, and was on the engineering staff of the bridge department of the Grand Trunk Railway from 1912 to 1916. He was for a number of years located in Nova Scotia, and occupied the position of chief draughtsman in the mechanical department of the Dominion Iron and Steel Company at Sydney, N.S. While located at Sydney, Mr. Cameron was secretary-treasurer of the Cape Breton Branch of The Institute.

A. L. Morgan, A.M.E.I.C., formerly assistant chief engineer of the Canada Sugar Refining Company, Limited, has been appointed chief engineer of that company. Mr. Morgan is a graduate of Queen's University, from which he received the degree of B.Sc. in mechanical engineering in 1912. Prior to entering the university, he had considerable machine shop and draughting experience, and upon graduating he became designing engineer with the mechanical equipment department of the locomotive plant and power house of the Canadian Locomotive Company at Kingston, Ontario. Subsequently, he occupied various positions with industrial manufacturing concerns until March 1st, 1923, when he was appointed assistant chief engineer of the company with which he is now engaged.

Captain W. A. Irvine Grim, M.E.I.C., is at present connected with the Lago Petroleum Company at Tampico, Tamps, Mexico. Captain Grim has been located in Mexico for a number of years, having been engineer in charge of standard gauge railways and irrigation system for the United Sugar Companies at Los Mochis; with the Rockefeller Foundation of New York as secretary to the commission at Colima, Col.; and with the Huasteca Petroleum Company at Tampico. Captain Grim was on active service overseas from 1914 to 1919, being attached to the 16th Battalion of the Canadian Scottish from 1914 to 1917 and to the Canadian Engineers from 1917 to 1919. He enlisted as a private, was commissioned lieutenant in 1915 and was made a captain in 1917 when he was transferred to the Canadian Engineers.

Harry J. Buncke, M.E.I.C., has been appointed chief engineer of the Abitibi Power and Paper Company for the entire group of mills. Mr. Buncke graduated from Columbia University with the degree of C.E. in 1915, and, in 1916, having taken a special course in pulp and paper manufacture at the University of Maine, obtained the degree of M.S. from that institution. In 1916, Mr. Buncke joined the staff of the Abitibi Power and Paper Company as draughtsman and general assistant to the master mechanic, and in 1917 he was appointed superintendent of the groundwood mill. In 1918, he served as first lieutenant in the United States Engineers. In 1919 he became technical assistant to the manager of the Abitibi Power and Paper Company. In 1921, he was promoted to the position of plant engineer, and from 1923 onwards was chief engineer of the Iroquois Falls division of the company. Mr. Buncke was the author of the section on groundwood pulp in " The Manufacture of Pulp and Paper," and is the present chairman of the technical section of the Canadian Pulp and Paper Association.

Charles C. Ross, M.E.I.C., Receives Appointment

Charles C. Ross, M.E.I.C., who was recently appointed by Hon. Charles Stewart, Minister of the Interior, to set up departmental administrative machinery in northern Manitoba and northern Saskatchewan in connection with the mining development which is taking place there, is a well-known member of the Calgary Branch of The Engineering Institute of Canada, where for the past ten years he has been in charge of the department's administrative work in Alberta relating to mineral development.

The appointment of Mr. Ross to set up the local administration in the new mining fields of Manitoba and Saskatchewan and to recommend to the government such changes in the mining laws and regulations as will speed up development and place the industry on a sound basis for future expansion, is a popular one which has brought forth commendation from the press in the prairie provinces. The Calgary *Herald*, in commenting on Mr. Ross' promotion to a larger field of activity, sees much reason for satisfaction in the announcement that the appointment does not mean that his supervision of Alberta's resources will cease, and that, on the contrary, one of his important functions will be the continued administration of all mining and oil regulations in that province.

Mr. Ross, who graduated from McGill University in 1909, went to Calgary in 1916. As senior mining inspector and later as supervisory engineer for the Department of the Interior, he accomplished noteworthy results in the evolu-

CHARLES C. ROSS, M.E.I.C.

tion and harmonious operation of the regulations for the development of the mineral resources of the prairie provinces. He has been chosen to organize the administrative machinery necessary to perfect a similar satisfactory service in northern Manitoba and northern Saskatchewan and also in the Northwest Territories as development may proceed.

Mr. Ross has lately returned from a trip of inspection of the Flin Flon, Cold Lake, Lac La Ronge and other mining regions which come under his new jurisdiction. One of his first and most important undertakings will have to do with alteration of the Quartz Mining Regulations, revision of which is under consideration by the federal government, which administers the resources of the western provinces. The solution of the problems arising in the development of the new mining areas of northern Manitoba and northern Saskatchewan will devolve on Mr. Ross, and those who know him feel that the undertaking is one for which the former Ottawa and McGill hockey and rugby star is adequately equipped.

John Grieve, M.E.I.C., Joins Brandram-Henderson, Limited

John Grieve, M.E.I.C., is now connected with Brandram-Henderson, Limited, Montreal, as general sales manager of industrial sales. In order to accept this position Mr. Grieve resigned from the Dominion Paint Works, Limited, with which firm he had been connected since 1914, and of which he was director and general manager of sales, and from the Detroit Graphite Company of New York, N.Y., with which firm he has been connected for some time. Mr. Grieve's early education was obtained at the Heriot Watt College, Edinburgh, Scotland, and as apprentice to Messrs. Carrick and Ritchie, crane and hydraulic engineers, after which he was draughtsman for Messrs. George Russell and Co., Ltd., Motherwell, Scotland, chief draughtsman for the Steel Company of Scotland, Hallside works, Newton, draughtsman and resident engineer in charge of mill equipment, Lanarkshire Steel Company, Limited, Motherwell, and on coming to Canada in 1911 was connected with the Dominion Bridge Company on designing and estimating.

Leonard E. Schlemm, M.E.I.C., Elected Director of Algoma Steel Corporation

Leonard E. Schlemm, M.E.I.C., who was recently elected a director of the Algoma Steel Corporation, Sault Ste. Marie, Ont., is a consulting landscape architect and town planner, practising in Montreal. He is also a director of the Lake Superior Corporation, and more recently was elected to the boards of the Lake Superior Coal Company, the Cannelton Coal and Coke Company and the Algoma Eastern Railway Company. Mr. Schlemm graduated from the Massachusetts Institute of Technology in 1903, and commenced his professional career as topographer and instrumentman with the Gulf, Colorado and Santa Fe Railway on location surveys, and was later connected with the engineering department of the Chicago North Western Railway on reconnaissance and location surveys. From 1908 to 1910 Mr. Schlemm was connected with Brett and Hall, landscape architects of Boston, being in responsible charge of all construction, and from 1910 to the present time he has been in private practice as consultant in landscape architecture and town planning. Mr. Schlemm is a member of the Boston Society of Civil Engineers, the Town Planning Institute of Canada, and the Corporation of Professional Engineers of the Province of Quebec, and is also a member of various town planning organizations such as the International Cities and Town Planning Association, National Housing Association, and the Town Planning Board of the Metropolitan District of Montreal. Mr. Schlemm is a member of the advisory board of engineers of the Metropolitan Commission for the Island of Montreal.

Canadian Engineering Standards Association Progress of Work

(*First half year 1928*)

Branch of Industry and Subject

Subject	Specification No.	Stage of Progress
A—Civil Engineering and Construction		
Steel Railway Bridges	A1—1928	6
Portland Cement	A5—1927	6
Steel Highway Bridges	A6—1922	4R
Reinforcing Materials for Concrete	A9—1923	6
Movable Bridges	A20—1927	6
Steel Structures for Buildings	A16—1924	2R
Concrete and Reinforced Concrete		4
Bituminous Roads		3
Block Pavements		4
Broken Stone Roads		4
Concrete Roads		3
Earth Roads		2
Foundation and Sub-Grade Preparation		2
Sand Clay Roads		4
Gravel Roads		2
Road Structures		3
Definitions of Road or Highway Terms		3
Brick Sizes		4
B—Mechanical Engineering		
Gearing		1
Cast Iron Pipe		3
Machine Screws		4
Sheet Metal Gauges		2
Fire Hose Connections		1
C—Electrical Engineering		
Distribution Type Transformers	C2—1920	5R
Power Transformers		2
Eastern Cedar Poles for Transmission Lines	C15—1924	3R
Western Cedar Poles for Transmission Lines		3
Canadian Electrical Code (Part I)	C22—1927	6
Electrical Overhead Crossings		1
Rating and Testing of Electrical Machinery		5
Control Cable for Elec. Power Plant Equipment	C21—1927	6
D—Automotive Engineering		
Traffic Signals for Highways		4
G—Ferrous Metallurgy		
Steel Castings		3
Sampling for Check Analysis of Steel Billets, Bars and Shapes		4
Carbon Steel Billets and Bars of Forging Quality		4
Commercial Bar Steels	G8—1923	4R

Stages of Progress:—

1. Decision made to undertake standardization.
2. Draft proposal under consideration.
3. Sent out for criticism.
4. Submitted for approval.
5. Approved for publication.
6. Published.

The letter R following the number of stage of progress indicates that the respective specification is under revision.

Link-Belt Limited has just issued Crawler Crane Book No. 995, entitled "Built for Service," which is one of the most attractive and complete of its kind ever published. It covers the complete Link-Belt line of gasoline, Diesel and electric crawler cranes of capacities up to and including the 2 cu. yd. heavy duty machine, as well as standard locomotive cranes.

The Northern Electric Company, Limited, has just issued Bulletin No. 121, describing a wide assortment of standard designs of double deck bus bar supports, which have been produced through the enterprise of the manufacturers, The Electrical Engineers' Equipment Company, and are now available in Canada from the Northern Electric Company. Copies of this booklet may be obtained from the Power Apparatus Department, Northern Electric Company, Limited, 121 Shearer street, Montreal, Que.

BRANCH NEWS

Montreal Branch

C. K. McLeod, A.M.E.I.C., Secretary-Treasurer.
W. McG. Gardner, A.M.E.I.C., Branch News Editor.

PRELIMINARY FALL PROGRAMME

The Papers and Meetings Committee are now able to release a tentative programme of branch activities for this autumn. The high professional standing of the prospective speakers, coupled with their comprehensive knowledge of the subjects chosen for their addresses, promise a programme of exceptional interest to all members whatever their specialty. Attendance at these meetings, whether or not the subject is representative of the field of our own particular endeavour, will broaden and intensify individual opinion and interest in the vast expanse of our great profession, create and renew enthusiasm in its far reaching accomplishments, extend and strengthen our contacts with fellow members.

Membership in The Institute is an honour and privilege charged with responsibility. We have each undertaken to facilitate the acquirement and interchange of professional knowledge, encourage original research, promote the interests of the profession by developing and maintaining high engineering standards and to enhance the appreciation of the public for our work by the notable character of our service.

By their presence at these meetings senior members add prestige and dignity to the proceedings, extend honour to the speaker, who by reason of this appreciation will more usually be a leader in the profession. The example set by their attendance will draw the attention and interest for personal improvement of the junior members to whom the opportunities will be self-evident.

Oct. 4—Water Turbines....by H. A. Van Patter, A.M.E.I.C.
" 11—Ville Emard Sewer...by G. R. MacLeod, M.E.I.C.
" 18—Lap Pipe Joints..................by A. M. Houser
" 25—Anticosti Development, by J. H. Valiquette, A.M.E.I.C.
Nov. 1—Ore Survey by Electrical Methods, by Prof. A. S. Eve.
" 8—Unit Cars..................by R. G. Gage, M.E.I.C.
" 15—Student Paper.
" 22—Engineering Finance........by John H. Williams
" 29—Acoustics......................by Prof. H. Reilly
Dec. 6—Co-relation of Operation of Electrical System, by J. Morse, M.E.I.C.
" 13—Development of Resources, by G. G. Ommanney, M.E.I.C.
" 20—Annual Meeting.

The Committee responsible for this programme would welcome any suggestions for future meetings that may be sent to any one of their number as follows:—

Chairman ....H. Massue, A.M.E.I.C.
Vice-Chairman ....J. L. T. Martin, A.M.E.I.C.
Civil Section:—Chairman.........A. Plamondon, A.M.E.I.C.
Vice-Chairman ....L. L. O'Sullivan, A.M.E.I.C.
Electrical Section:—Chairman....N. L. Morgan, A.M.E.I.C.
Vice-Chairman ....A. S. Runciman, A.M.E.I.C.
Mechanical Section:—Chairman..G. H. Dickson, A.M.E.I.C.
Vice-Chairman ....H. G. Thompson, A.M.E.I.C.
Municipal Section:—Chairman...J. F. Brett, A.M.E.I.C.
Vice-Chairman ....P. E. Jarman, A.M.E.I.C.
Railway Section:—Chairman....F. F. Clarke, A.M.E.I.C.
Vice-Chairman ....H. B. Montizambert, A.M.E.I.C.

TRANSOCEANIC WIRELESS TELEGRAPHY BY THE BEAM SYSTEM

Notable achievements accomplished by recent developments in wireless transmission were vividly presented before the branch on May 3rd, when in an enjoyable illustrated lecture and demonstration J. H. Thompson, A.M.E.I.C., chief engineer of the Marconi Wireless Telegraph Company, described "Transoceanic Wireless Telegraphy by the Beam System."

The continuous application of electrical discoveries to the wireless transmission of sound has been so remarkable, it is difficult to believe that hardly more than forty years have passed since Hertz announced the results of his scientific investigation on the production of electric or Hertzian waves. Yet today the development of electric waves telegraphy has revolutionized our means of communication across land and sea.

In the earliest stages the apparatus employed consisted of a simple transmitter and a receiver or coherer. Later huge reflectors were employed to collect the waves and concentrate them on the coherer.

The introduction of the aerial by Marconi, the first investigator to realize the practical possibilities of wireless, opened a wide field of application. Late in 1901 by suspending aerials from box-kites he succeeded in sending wireless signals across the Atlantic from Newfoundland to Cornwall, England. His success encouraged many other inventors and from that time onward progress has been rapid.

Wooden towers were subsequently substituted for the uncertainty of kites and ship stations were utilized to relay messages to distant destinations.

These early installations transmitting through the medium of an intermittent spark which dispersed waves equally in all directions proved inefficient under heavier service. As a consequence it was not long before the process of wave production was greatly improved by a method which placed the transmitting arc in an atmosphere of hydrogen, coal gas or other non-oxidizing gas, and at the same time subjecting it to the influence of a strong magnetic field. By this means an apparatus was developed capable of propagating continuous waves of an oscillation better suited to wireless purposes. With its introduction wider range and sharper tuning became possible.

This notable achievement was, however, hardly in use before the remarkable improvement in the construction of the vacuum or thermionic tube and the development of the Alexanderson high frequency alternator made their immediate installation desirable.

So effective was the latter device in creating waves of great power that its introduction made possible the equipping of long distance stations capable of transmitting directly across the world. Nevertheless the development of these long wave installations was impeded by the ohmic resistance of the atmosphere which in contrast with the radiation resistance is high. The great masts and heavy antennæ proved a source of heavy expense while the problem of adequate insulation for such high voltages provided another serious limitation. In illustration a station in France was equipped with an 820-foot mast supporting an antennæ weighing 3½ tons of 1,000-k.w. capacity and 200,000 volts pressure. Due to frequent fires Oregon pine masts were found unsuitable under such circumstances and very light triangular steel columns were substituted in their place.

Long wave transmission is further handicapped by the difficulty experienced in attempting to concentrate the radiated energy in any one direction. While this may be achieved by ranging parabolic reflectors round the antennæ at the centre the device is awkward to build and almost prohibitive as to cost.

A far simpler method of controlling the direction of propagation is found in the erection of two parallel aerial curtains situated at right angles to the desired transmission.

The forward curtain, made up of antennæ coils suspended in double triangles as a check against windsway, is placed a half wave length in advance of the second or reflector coil curtain. Both hang vertically in space with the reflector coils directly to the rear, in which location they serve to reflect the energy emanating from the antennæ curtain, returning it in place to be projected forward as one solid sheet of current.

The utilization of such a device is so advantageous that employing the same energy of transmission it has been found possible to increase the field strength 200 times.

Many auxiliary appliances, such as wave suppressors, phase shifters and condensers, assist in the attainment of this accomplishment while the feeder distribution system creates problems of tube insulation and expansion besides the usual necessity of being electrically balanced as regards to distance from the transmitter. When the station is not sending, absorbing valves utilize resistances to soak up the current.

In order to detect the signals broadcasted from these very high frequency continuous wave beam stations, it is necessary to resort to heterodyning. By this process a second current is superimposed on either the transmitting but more usually upon the receiving current of almost an identical frequency, when it becomes possible by making suitable adjustments to obtain a beat within the audible frequency.

In commercial electric wave telegraphy where continuous reception at all times is of primary interest the heterodyning and superheterodyning appliances become a very essential feature of the installation.

In describing the construction of the new short wave beam wireless station at Drummondville, P.Q., with its 25-kw. capacity and 300-foot masts, the speaker not only illustrated his remarks with lantern slides but demonstrated a machine used in transmitting messages.

This machine, controlled from a typewriter keyboard, punches paper tape before feeding it to a high speed key operating an oscillator where the current is modulated in preparation for the transmitter. This automatic modulator handles 120 words a minute. Samples of tape bearing "Greetings to The Engineering Institute" were distributed to the members.

The speaker referred to the advantage of high frequency transmission in the field of television and illustrated a new development whereby it is possible with paper made sensitive to hot and cold air currents to photograph these radio pictures.

In moving a vote of thanks, N. L. Morgan, A.M.E.I.C., while taking note of the rapid development, looked to even greater progress in the enormous field for advancement lying ahead where 2,000 words a minute will be attained.

G. A. Wallace, A.M.E.I.C., presided.

Sault Ste. Marie Branch

A. H. Russell, A.M.E.I.C., Secretary-Treasurer

Visit of General Secretary

A special dinner meeting was held on Thursday, July 26th, at 6.45 p.m., to welcome R. J. Durley, M.E.I.C., the general secretary of The Institute.

Following the dinner two 400-foot films of Algoma were shown. These films gave a most vivid close-up view of the splendid fishing and hunting in this part of the country. As numerous speckled beauties were seen landed safely in the angler's net, the followers of Isaac Walton present began to get the fever, and it was only the lateness of the hour that prevented them hiking out to the nearby streams. But, oh boy! when a large bull moose came on the scene real excitement prevailed, but, thanks to the presence of Mr. Durley and the treat ahead, (as he had yet to address the branch), the members did not run home for their shooting irons.

In his remarks Mr. Durley expressed his pleasure at being back with the members of the Sault Branch. He outlined the year's work at headquarters and gave a general talk on his visit to the other branches. He expressed his satisfaction at the way the branches were increasing in membership and becoming stronger, and predicted a bright future for the Canadian engineer in Canada and, as he pointed out, that between 70 and 80 per cent of our graduates in the past ten years were still in Canada and not in foreign countries, as some people would like to believe.

The new venture of the council in getting out the E-I-C News was discussed and the reasons for getting this weekly bulletin was explained, and also the manner in which the branches could help in this venture.

A general discussion followed and many interesting points were brought out in regard to the relationship of the branches to headquarters and also in the way that branches and members could make it easier for the council.

Mr. Wilson expressed the feeling of all present when he said it was a pleasure to have Mr. Durley at the meeting and to hear him speak. He moved a hearty vote of thanks to Mr. Durley, which was unanimously supported.

Vancouver Branch

F. P. V. Cowley, A.M.E.I.C., Secretary-Treasurer.

At a regular meeting of the branch, held on May 22nd, a very interesting paper was given by Nathan A. Bowers, Pacific coast editor of the Engineering News Record, on "The St. Francis Dam Failure." An attendance of seventy at a summer meeting testified to the interest taken by the members in Mr. Bowers' paper. Mr. Bowers was on the scene the day following the catastrophe, and his address was illustrated by lantern slides, the material for which was obtained by himself on the ground.

From samples of the material below the foundations, actually taken on the ground, and from photographs of the laying of the foundations and of the excavation prior thereto, the speaker maintained that the surprising thing was not that the dam had failed, but that it had stood as long as it did. The dam failed because the material under the foundation was not suitable for the purpose for which it was used. The loss of life and destruction of property was deplorable; but to offset that the work of rescue and of rehabilitation was swiftly and admirably organized and carried through.

On June 7th, 8th and 9th the General Western Professional Meeting was held in Vancouver. Full descriptions of this successful convention have already been given in The Journal. At a meeting of the Executive, held on July 18th, the Secretary-Treasurer submitted audited accounts of the convention, showing that the excess of receipts over disbursements amounted to $4.63.

Memorial to Royal Engineers, Dedicated at Spuzzum, B.C., July 2nd, 1928

On Monday, July 2nd, 1928, a party of engineers travelled from Vancouver to Spuzzum, B.C., for the purpose of dedicating a cairn that had been erected jointly by The Engineering Institute of Canada and the Association of Professional Engineers of the Province of British Columbia, to commemorate the work of the Royal Engineers in the construction of the original Cariboo road.

Unveiling of Memorial to Royal Engineers.

The cairn has been erected on the highway at the north approach to the Alexandra suspension bridge, which spans the Fraser river about one and one-half miles above Spuzzum, and is in a setting of wonderful beauty; the magnificence of the mountains and the rushing Fraser river combine to unite with the memorial as a lasting tribute to the skill and energy displayed by the Royal Engineers in the pioneer work of the early days.

His Honour Judge Howay, of New Westminster, B.C., accompanied the party and performed the unveiling ceremony.

W. Brand Young, A.M.E.I.C., chairman of the Vancouver Branch of The Engineering Institute of Canada, acted as master of ceremonies and in introducing Judge Howay paid tribute to his honour's services as historian of the province and to the splendid qualities of the Royal Engineers. He suggested that there was something of Imperial significance about that day's proceedings, and this simple ceremony would be the means of pulling just a little closer the common ties which bound us together. J. F. Frew, M.E.I.C., president of the Association of Professional Engineers of the Province of British Columbia, associated himself with Mr. Young in his introductory remarks.

Judge Howay dealt at some length with the early trading days, and spoke of the difficulties of transportation through this undeveloped section of British Columbia. He paid glowing tribute to the work of the Royal Engineers and to the calibre of the two companies of engineers who were sent out by Queen Victoria to this outpost of the Empire to assist in its early development.

His Honour recited the following well-known passage from the address delivered to them by Bulwer (Lord) Lytton, colonial secretary, before they left England:—

> Farewell! Heaven speed and prosper you. The enterprise before you is indeed glorious. Ages hence industry and commerce will throng the roads that you will have made. Travellers from all nations will halt on the bridges that you will have first flung over solitary rivers, and gaze on orchards and cornfields that you will have first carved from the wilderness. Christian races will dwell in the cities of which you will map the sites and lay the foundations. You go not as enemies but as the benefactors of the land you visit, and children, yet unborn, will, I believe, bless the hour when Queen Victoria sent forth her sappers and miners to found a second England on the shores of the Pacific.

George A. Walkem, M.E.I.C., past president of The Engineering Institute of Canada, proposed the vote of thanks to Judge Howay, following which refreshments were enjoyed picnic fashion.

The cairn is built of rough granite and is located at the end of a bend in the roadway as it approaches the suspension bridge. A bronze tablet has been built into the cairn, which bears the following inscription:—

> In commemoration of the work of His Majesty's Royal Engineers and in respectful admiration of the skill and energy displayed by them from 1859 to 1863 in the construction of the original Cariboo highway through the Fraser canyon, this tablet is erected and dedicated by The Engineering Institute of Canada and the Association of Professional Engineers of British Columbia.

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

Structural Detailer

A firm of consulting engineers in Montreal has an opening for a young engineer with experience in timber and concrete designing and construction. Apply Box No. 35-V.

Sales Engineer

An engineering sales organization in Montreal requires the services of a recent graduate in mechanical engineering for work on the sales and installation of combustion and refrigeration equipment. Applicants must be able to speak French. This position is in Montreal. Apply Box No. 37-V.

Designing Draughtsman

A sales organization in Montreal requires the services of a draughtsman with experience in the design of concrete structures. Apply with full particulars to Box No. 41-V.

Sales Engineer

A large manufacturing company in Montreal has an opening for a graduate engineer on its engineering sales staff. The company manufactures pulp and paper machinery, and preference will be given to those having pulp and paper mill experience. Apply with full particulars to Box No. 55-V.

Mechanical Engineer

A Montreal company has an opening for a recent graduate in mechanical engineering for work in Ontario. The position is permanent. Apply with full particulars of qualifications to Box No. 56-V.

Resident Engineer

A public utility company which contemplates the construction of a large hydro-electric power development in the near future may shortly have an opening for a competent resident engineer with extensive experience on work of a similar nature. The date of commencement of the work is not yet decided, but applications will now be received for consideration. Apply Box No. 57-V.

Electrical Designer

A public utility company, which contemplates the construction of a large hydro-electric power development in the near future, may shortly have an opening for an electrical designing engineer with experience on work of a similar nature. The date of commencement of the work is not yet decided but applications will now be received for consideration. Apply Box No. 58-V.

Hydraulic Engineer

A public utility company which contemplates the construction of a large hydro-electric power development in the near future, may shortly have an opening for a competent hydraulic engineer with experience on work of a similar nature. The date of commencement of the work is not yet decided, but applications will now be received for consideration. Apply Box No. 59-V.

Situations Vacant

Supplies Engineer

Competent man familiar with up-to-date store keeping methods, to take complete charge stores department large public utility Brazil. Must be thoroughly experienced, good organizer, with sound knowledge material and equipment. Knowledge Portuguese or Spanish desirable but not essential; give full details education, experience and references. Apply Box No. 60-V.

Field Engineer

Recent graduate engineer wanted for laying out construction work and inspecting for large industrial and mining company in northern Quebec. Apply Box No. 61-V.

Designing Engineer

An engineer required to design reinforced concrete and structural steel for hydraulic structures. Location, Nova Scotia. Apply Box No. 62-V.

Railway Construction Engineer

A construction company in Montreal has an opening for an engineer with experience in railway construction. Applicants must be able to speak Spanish, as work is in Colombia. Apply with full particulars to Box No. 64-V.

Mechanical Designer

A well-known manufacturing company in Montreal has an opening for a young mechanical engineer for draughting and designing of mechanical equipment. Apply Box No. 68-V.

Electrical Engineer

Recent graduate required by a large electrical manufacturing concern for work on factory methods and manufacturing problems. Please state in first instance, education, full qualifications, references, salary required, age, and when available. Apply Box No. 69-V.

Railway Construction Engineer

A construction company with headquarters in Montreal has an opening for a young civil engineer with experience in railway location and layout. This position has a possibility of permanency, and the work will be in eastern Canada and the middle west. Apply Box No. 71-V.

Reinforced Concrete Designer

There is a permanent position available for a reinforced concrete designer with a large public utility organization in the province of Quebec. The work is in connection with structures for water supply systems. Apply Box No. 72-V.

Draughtsman and Designer

Experienced draughtsman and designer on railway location and construction in the province of Quebec. Applications must contain full details of experience and samples of drawings. Apply Box No. 73-V.

Situations Vacant

Assistant Distribution Engineer

Wanted by a large public utility in Brazil. Must be a university graduate with at least five years operating and construction experience after graduation, including underground and overhead light and power and tramway distribution combined with terminal station and substation operation. Apply, giving details of education, experience and salary, to Box No. 74-V.

Meter Engineer

Must be a graduate engineer with wide experience in various types of meters, particularly General Electric and Westinghouse, and competent to assume charge of meter department of a large utility in Brazil. Apply, giving details of education, experience and salary, to Box No. 75-V.

Municipal Engineer

Graduate engineer experienced in municipal work with a knowledge of sewer design and sewage disposal. Salary dependent upon qualifications. Permanent position. Apply, giving full details of experience, to Box No. 76-V.

Town Engineer

Town engineer for a town in the Maritime Provinces. Applicants must give full particulars as to qualifications, experience and salary expected. Apply to Box No. 77-V.

Crane Estimator and Designer

A Canadian manufacturing company, near Montreal, has a permanent position for a good crane estimator and designer. Apply, giving full particulars, to Box No. 80-V.

Situations Wanted

Electrical Engineer

Electrical engineering graduate of McGill University, age 27, single; five years public utility experience, including G. E. test course, extensive design of power stations and substations and industrial sales. Apply Box No. 8-W.

Electrical Engineer

Graduate of the University of New Brunswick in electrical engineering of the year 1926, with two years experience on the manufacture of electrical equipment, desires position with an industrial organization or on electrical construction. Apply Box No. 17-W.

Electrical Engineer

Recent graduate of McGill University in electrical engineering, with two years experience with large electrical manufacturing company, desires a position. Apply Box No. 19-W.

Construction Engineer

Construction engineer, 36 years of age, with considerable experience in municipal and power surveys, and municipal construction, is available for a position on similar work, preferably in Quebec or the Maritime provinces. Apply Box 25-W.

Chemical Engineer

Graduate McGill University '22, desires a position in the vicinity of Montreal. Apply Box No. 28-W.

Situations Wanted

MECHANICAL ENGINEER

Graduate of McGill University in mechanical engineering of the year 1912, with experience in hydro-electric work, development and nine years experience as manager in charge of a large industrial plant, and at present engaged in industrial consulting work, is available for a position with an industrial organization as plant manager, superintendent or assistant engineer, or as sales engineer on mechanical or construction equipment. Apply Box No. 31-W.

CIVIL ENGINEER

Graduate of the University of Toronto of the year 1911, with extensive experience in industrial development work, including preliminary survey, design and construction, is available for a position with a pulp and paper or power company as resident engineer or construction superintendent, or with engineering staff of some other industrial organization. Apply Box No. 33-W.

ELECTRICAL DESIGNER

Advertiser wishes to connect with contractor or consulting engineer who can offer part time electrical design work. Electrical engineer, B.Sc., M.Sc., P.E.Q., M.E.I.C. Advertiser, having considerable time available, would like to submit industrial power and lighting design and layouts to contractor or engineering firm. Experience includes design construction and testing of electrical equipment, supplemented by extensive installation, operation and maintenance practice. Apply Box No. 40-W.

ELECTRICAL ENGINEER

Young electrical engineer, graduate of University of British Columbia '25; fifteen months' electrical test course, C.G.E.; two years junior assistant engineer switchboard engineering department with large electrical manufacturing company; experience with all types of switching equipment and supervised the construction of all types of switchboards. At present available. Apply Box No. 68-W.

DESIGNING AND CONSTRUCTION ENGINEER.

Fully qualified designing and construction engineer with extensive experience in building and industrial construction, harbour, railway, hydro-electric work and public utility valuation, until recently engaged on general construction and harbour work in the Far East, now wishes to relocate in Canada; at present in Montreal and available immediately. Apply Box No. 70-W.

CIVIL ENGINEER

The advertiser has had seven years experience on surveys as instrumentman and party chief. At present employed, but would like to secure a position with construction company offering a future to one who is willing to work for it. Will go anywhere and willing to start at the bottom. Apply Box 71-W.

DESIGNING ENGINEER

Graduate R.M.C. '25 and McGill University '27, desires new location with promise of advancement. Experience includes maintenance and installation draughting and designing in paper mill work. Apply Box No. 72-W.

CIVIL ENGINEER

Graduate University of Toronto '21, experience including instrumentman on location of railways, inspector on railway and other materials, plan examiner and road superintendent, is open for a position. Apply Box No. 74-W.

MECHANICAL ENGINEER

Young mechanical engineer, graduate McGill University '23, with two years' experience in designing layouts and care of installation of new equipment; two years as efficiency engineer; draughtsman on maintenance work; at present draughtsman on building and equipment in connection with industrial plant, wishes to locate with company where there is promise of advancement. Apply Box No. 80-W.

DESIGNING AND CONSTRUCTION ENGINEER

A.M.E.I.C., with experience in the design, field supervision and organization of the construction of reinforced concrete, reservoirs, filter plants, pumping, underground conduit system, and various types of buildings, wishes to locate with a construction company. Apply Box No. 81-W.

MECHANICAL ENGINEER

A.M.E.I.C. experienced in drawing office, production and plant maintenance; four years as engineer-in-charge of works plant installation and maintenance, mechanical and electrical; three years as sales engineer; conversant with wide variety of machinery; recently mainly on pneumatic plant; having just returned from residence abroad is open for engagement in suitable capacity. Apply Box No. 84-W.

ELECTRICAL ENGINEER

Grad. Queen's Univ. '27, with experience in various departments of manufacturing company, desires a position in sales, hydro-electric development, or industrial organization. Apply Box No. 85-W.

CONSTRUCTION ENGINEER

A.M.E.I.C., with twenty-six years' experience, including ten years railway construction and sixteen years on reinforced concrete bridge, as resident engineer in Canada and United States, desires position. Apply Box No. W. 93-W.

According to a statement made by the Hon. J. E. Perreault, Minister of Colonization, Mines and Fisheries, the Tache bridge at St. Joseph d'Alma, which was carried away by the floods in the early spring, and the St. Felicien bridge which was also seriously damaged, will be reconstructed immediately.

It has been announced that the contract for the construction of the new Canadian National Railways station and hotel at Halifax, N.S., has been awarded to the Foundation Jupiter Company, Limited, Halifax, a subsidiary of the Foundation Company of Canada of Montreal. The contract for the steel has been awarded to the Dominion Bridge Company.

A contract for the construction of a large trunk sewer at Three Rivers, Que., has been awarded to Robertson and Janin Limited, Montreal.

Tenders are being called by the Department of Public Works, Canada, for the construction of an earthen mound and timber superstructure control dam across the Okanagan river at Penticton, Yale District, B.C. Tenders will be received until noon, September 18th, 1928.

Announcement has been made of the award of a contract to Canadian Vickers Limited, Montreal, for the building of a new seventeen knot cruiser to be used in customs preventive service in the Atlantic division. The new vessel, which is required to be delivered at Halifax within nine months, will be 165 feet long, and will be powered by three 500-h.p. oil burning engines.

According to a Bureau of Statistics bulletin, total traffic on the Welland canal exceeded a million tons in June for the first time. The chief increases were in wheat and oats.

The contract for dock construction in the Owen Sound harbour has been awarded to the Jackson Company of Seaforth, Ontario.

A recent report states that Messrs. Lang and Ross, of Sault Ste. Marie, Ontario, have commenced work on the construction of the power line to the Montreal river in connection with the large power development being undertaken by the Great Lakes Power Company, Limited, near Sault Ste. Marie.

Preliminary Notice

of Applications for Admission and for Transfer

August 22nd, 1928.

The By-laws now 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 election 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 1928.

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 or 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 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

BLAIR—DONALD, of 173 Daly Ave., Ottawa, Ont., Born at Fredericton, N.B., Oct. 14th, 1887; Educ., 3 years Applied Science, McGill Univ., 1908-10; 1909-10 (summers), constrn., G.T.P. Ry.; 1911-12, asst. engr., engrg. dept., Moose Jaw, Sask.; 1912-13, dftsman., land survey, Peace River Block, B.C.; 1916-17, asst. engr., Fraser, Brace & Co., smokeless powder plant, Trenton, Ont.; 1918-21, sanitary engr., Public Works Dept., Ottawa, Architect's Branch; 1922-23, mgr., Gilmour Construction Co., Ottawa; 1923-24, chief clerk and dftsman., div'l office, T. & N. O. Rly., North Bay, Ont., also 8 mos. in 1925; 1925 (4 mos.), dftsman., Ottawa Car Co.; 1926, res. engr., Nat. Trans-Continental Rly.; 1927 (5 mos.), dftsman., Farley & Cassels, Land Surveyors, Ottawa; Oct. 1927 to date, engr., Federal District Commission, Ottawa, Ont.

References: J. M. Wilson, A. K. Hay, A. F. Macallum, S. B. Clement, G. E. Bell, G. G. Gale, L. T. Martin, W. L. L. Cassels.

BUCHANAN—ALBERT MILLAR, of 82 Charles St., Hamilton, Ont., Born at Hamilton, Scotland, Jan. 18th, 1892; Educ., three years, mech. engrg., Glasgow Technical College; 1910-15, dftsman., John Marshall & Co., boiler makers, Motherwell, Scotland & London Public Utilities Commn., London, Ont.; 1915-16, asst. engr. on track and mech'l equipment, London Street Rly. Co., London, Ont.; 1916-19, overseas, C.E.F.; 1919-22, dftsman., mech'l engrg. dept., Steel Company of Canada, Hamilton, Ont.; 1922-26, plant engr., and 1926 to date, i/c of design and constrn. of new plant for Gartshore Thomson Pipe & Foundry Co., Ltd., Hamilton, Ont.

References: E. H. Darling, W. L. McFaul, R. K. Palmer, W. F. McLaren, J. Stodart.

BUCHANAN—WALTER SAMUEL, of 407 St. Cyrille St., Quebec, Que., Born at Liverpool, Eng., Jan. 11th, 1878; Educ., High School, Liverpool, Eng., and engrg. training with professional engrs., 1901-22; 1901-04, switchboard operating, meter testing, elect'l repairs; 1904-10, asst. engr., Que., Jacques Cartier Electric, Quebec; 1910-14, Quebec Railway Light, Heat & Power Co.; 1914-16, elect'l mtce. engr., Price Bros., Kenogami; 1916-22, asst. engr., Quebec Public Service Corpn., Quebec; 1922-28, gen. supt., elect'l contractor, Goulet & Belanger, Quebec, Que.

References: J. M. McCarthy, R. B. McDunnough, P. S. Gregory, L. G. Denis, T. L. Tremblay, H. E. Huestis.

COMETTE—ROMEO, of 7784 St. Denis St., Montreal, Que., Born at St. Alexandre, Que., Jan. 28th, 1897; Educ., C.E., Ecole Polytech., Montreal, 1920; 19 9 (summer), instr'man on surveys and road work; 1920-21, field engr. on mill extension; 1921-24, constrn. engr. and supt. on mill extension, Belgo Paper Co.; 1924-25, supt. of bldg. constrn., Newfoundland P. & P. Co., and 1925-28, mtce. engr. with same company; July 1928 to date, engrg. office work, estimator, ordering materials and equipment for Lake St. John Power & Paper Co., Montreal, Que.

References: J. Stadler, G. Claxton, J. B. Gough, R. L. Weldon, S. J. Fisher, J. C. Day.

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. & gauge makers, 4 years in different depts. in shop and 3 years in drawing office; 1902-05, mechanic, dftsman. & foreman with various machine tool firms in New England and Middle West states; 1905-09, works mgr. & 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. & president of company.

References: E. H. Darling, L. W. Gill, H. U. Hart, J. J. MacKay, R. K. Palmer.

GELDARD—PERCY WALTER, of 93 Boon Ave., Toronto, Ont., Born at Hartlepool, Eng., Nov. 29th, 1903; Educ., has just finished third year, Faculty of Applied Science, Univ. of Toronto; 1920 (Feb.-Oct.), rodman, C.N.R.; Jan. 1921 to Apr. 1922, rodman, F. Barber & Co.; 1922-23, instr'man, F. Barber & Co.; Mar. 1923 to Oct. 1925, and Apr. to Oct. 1926, instr'man, Township of York; 1927 (Apr.-Nov.), asst. engr. i/c of 20 miles of rock ballasting, C.N.R.; April 1928 to date, asst. engr. i/c of rock ballasting (40 miles), C.N.R.

References: O. M. Falls, F. B. Goedike, W. B. Dunbar, T. R. Loudon, L. I. Stone, E. G. Hewson.

GRUNSTEN—ARNE WILLIAM, of 921 St. Clair Ave., Toronto, Ont., Born at Bjorneborg, Finland, Feb. 2nd, 1904; Educ., B.A.Sc., Univ. of Toronto, 1928; 1922-23, junior dftsman., city arch't's dept., Toronto; 1924-27 (summers), dftng. with various companies; two months to date, struct'l designing engr., with H.E.P.C. of Ontario, Toronto, Ont.

References: E. Hugli, W. B. Dunbar, J. J. Spence, P. Gillespie, C. R. Young.

PARKER—JOHN SPENCE, of Ottawa, Ont., Born at Cottesloe, Ont., Sept. 26th, 1887; Educ., B.A.Sc., Univ. of Toronto, 1912; 1908-09, Lake Superior Power Co.; 1910, hydraulic design & inspection, H.E.P.C. of Ont.; 1912-17, mech. supt., and, 1923-26, gen. mgr., Knight Bros. Co,. Ltd., Burks Falls, Ont.; 1917-23, asst. engr., municipal dept., 1926-27, asst. engr. on special work, H.E.P.C. of Ont.; at present, gen. mgr., The Gatineau Electric Light Co., Ltd., Ottawa, Ont.

References: G. G. Gale, T. H. Hogg, F. A. Gaby, W. P. Dobson, S. S. Scovil.

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

STAIRS—GORDON SALTER, of Windsor, N.S., Born at Selma, N.S., Aug. 31st, 1889; Educ., two years, Dalhousie Univ., B.Sc., N.S. Tech. Coll., 1911; 1913-14, asst. engr., Western Canada Power Co., Stave Falls, B.C.; 1914-16, with Arthur V. White, consulting engr. to International Joint Commission on Lake of the Woods investigation, resigning to enlist; 1916-19, with Can. Engrs. on fortress work at Halifax; 1919-23, asst.

engr. with City Engr., Halifax, N.S.; 1923-25, town mgr., Wolfville, N.S.; 1925 to April 1928, town mgr., Windsor, N.S.; at present sales mgr. and engr., L. E. Shaw, Ltd., Avonport, N.S.

References: J. F. Cahan, F. W. W. Doane, R. R. Murray, C. St.J. Wilson, G. A. Gaherty.

SWAN—HAMILTON LINDSAY, of Merritt, B.C., Born at Gilford, Co. Down, Ireland, Aug. 29th, 1890; Educ., Crystal Palace School of Engrg., Norwood, Eng., short course, 1905-07, leading to apprenticeship to Beyer Peacock & Co., engrs., Manchester, Eng., 1907-10, cert. in advanced applied mechanics, Manchester School of Technology, admitted to Engineering Institute as Assoc. Member by exam, 1915; 1910-12, junior positions in field & office, Sir W. G. Armstrong Whitworth, Kettle Valley Ry. Co.; 1912-16, chief dftsman., Kettle Valley Ry., Hope to Midway & Merritt, B.C.; 1916-19, overseas, lieut., Can. Engrs.; 1919-24, partner, Swan & Augustine, civil engrs. & land surveyors, Penticton, B.C., engaged in irrigation, municipal work, bldg. constrn., land surveys, chairman, Board of Works, and acting municipal engr., 1924;1924-25, sales engr., Pacific Pipe & Flume Works; 1925-27, res. engr., Dept. Public Works, B.C., on Fraser Canyon section of Cariboo road, i/c constrn., Alexandra bridge, Spuzzum, B.C.; 1927-28, Dept. Public Works, B.C., asst. district engr., i/c Chilliwack & Delta districts; at present, i/c Yale district.

References: A. McCulloch, P. Philip, G. P. Napier, A. L. Carruthers, D. McMillan, E. E. G. H. Verner.

WEBB—CHRISTOPHER EVEREST, of Vancouver, B.C., Born at Granton, Ont., Jan. 16th, 1887; Educ., B.A.Sc., Univ. of Toronto, 1909; 1906-09 (summers), rodman to transitman, Can. Nor. Ry.; 1909-11, asst. engr. to engr. in charge of location party, Can. Nor. Ry. in Ontario; 1911-13, res. engr. on constrn., Can. Nor. Ry. in B.C.; 1913 to date, in British Columbia, with Dominion Water Power & Reclamation Service, Dept. of the Interior, as follows: 1913-18, asst. engr. to asst. chief engr.; 1918-25, asst. chief engr.; 1925 to date, district chief engr., responsible charge of engineering for Dept. of Indian Affairs throughout B.C., covering design & constrn. of domestic water supply systems, irrigation and reclamation projects and electric lighting plants.

References: J. T. Johnston, E. A. Cleveland, W. H. Powell, P. Gillespie, E. E. Carpenter, J. C. MacDonald, E. Davis.

FOR TRANSFER FROM THE CLASS OF JUNIOR TO A HIGHER GRADE

COOPER—PAUL EMERSON, of 141 Brinkerhoff St., Plattsburg, N.Y., Born at Ottawa, Ont., Feb. 8th, 1900; Educ., B.Sc. (C.E.), McGill Univ., 1923; 1916-17, rodman and precise leveler, International Boundary Survey; 1918-20, inst'man for Grand Trunk lines in New England; 1921, instr'man, Manitoba-Ontario Boundary Survey; 1922, highway inspr. and engr. on highway constrn., Village of Carp, Ont.; 1923, field engr., Barometric Topographical Survey and mapping for Singer Mfg. Co. on Blanchard Nation Limits; 1924-25, office engr., railroad location and constrn. of Thurso & Nation Valley Railroad for Singer Mfg. Co.; 1926-27, asst. engr., paper mill constrn. at Gatineau, and 1927 to date, res. engr. on constrn., hydro-electric development at Kent Falls, N.Y., for International Paper Company.

References: A. H. White, A. I. Cunningham, H. M. MacKay, S. H. Davis, L. Rochester.

NENNIGER—EMIL, of 564 Notre Dame de Grace ave., Montreal, Que., Born at Berne, Switzerland, July 4th, 1901; Educ., struct'l. engr., Technical School at Burgdorf, 1921; 1917-19, supervision of bldg. constrn. for G. Rieser, gen. contractor, Berne; 1921-23 designing engr., office of W. Schreck, reinforced concrete design of pulp & paper mill and pulp & paper printing plant, struct'l. design of apartment house, all in Switzerland; July 1923 to date, designing engr., office of Dr. Arthur Surveyer, M.E.I.C., Montreal, responsible for design of many large projects.

References: A. Surveyer, J. Labelle, H. Massue, J. B. Challies, O. O. Lefebvre.

FOR TRANSFER FROM THE CLASS OF STUDENT TO A HIGHER GRADE

ARCHER—AUBREY CLIFFORD, of 534 Notre Dame st., Lachine, Que., Born at Barbados, B.W.I., Feb. 18th, 1901; Educ., B.Sc., (Mech. Eng.), McGill Univ., 1924; 1924-25, production dept., Northern Electric Co.; 1925, time clerk & mapping of pipe line extensions, Montreal Light, Heat & Power Co.; Jan. 1926 to date, medical dept., Sun Life Co. of Canada, selection of risks, in charge of appointments of medical examiners.

References: H. M. MacKay, C. M. McKergow, A. R. Roberts, E. Brown, J. A. Coote.

BIELER—JACQUES LOUIS, of 223 Milton St., Montreal, Que., Born at Chexbres, Switzerland, Aug. 17th, 1901; Educ., B.Sc., McGill Univ., 1923; 1920 (summer), constrn. work for Canadian Explosives; 1922 (summer), and after graduation, cadet engrg. course, Bailey Meter Co., Cleveland, Ohio; with same company on sales and service staff from Oct. 1923 to Nov. 1924, and in research dept., Nov. 1924 to Sept. 1925; 1925 (Sept.-Dec.), i/c of party, Gatineau River Power Survey; 1926 (Jan.-June), engr., Consolidated Pipe Co., Montreal; 1926-28, sales engr., and subsequently chief engr., Industrial Combustion Engineers (Bailey Meter Licencees), London, Eng.; at present asst. engr., Dominion Oilcloth & Linoleum Co., Montreal, Que.

References: C. M. McKergow, A. R. Roberts, F. T. Kaclin, C. J. Desbaillets, L. R. Thomson, W. E. Blue.

COCKSHUTT—CLARENCE FOSTER, of 172 Chatham st., Brantford, Ont., Born at Brantford, July 16th, 1901; Educ., B.A.Sc., Univ. of Toronto, 1923; 1920-21 (summers), labourer, mine & mill of Coniagas Mines, Ltd.; 1922-23 (summers), asst. on geol. survey parties, Ont. Dept. of Mines; 1924 (Apr.-Dec.), and 1925 (May-Nov.), field engr. for Victoria Syndicate, Ltd.; 1926 (Jan.-May), field engr. with Dome Mines, Ltd.; 1927 (Jan.-Mar.), instr'man. on storage basin survey with Land & Ross; Apr. 1927 to date, res. engr., in charge of all work on properties of Grover Daley Mines, Ltd., Amos, Que.

References: H. E. T. Haultain, H. G. Thompson, H. A. Lumsden, deG. Beaubien.

EMERSON—THEODORE ROOSEVELT, of 3 Algonquin Ave., Toronto 3, Ont., Born at Buffalo, N.Y., June 12th, 1901; Educ., B.A.Sc., Univ. of Toronto, 1924; 1924-25, Bell Telephone Co. of Canada; 1926 (6 mos.), Acton Tanning Co., Acton, Ont.; Aug. 1926 to date, on terminal engr.'s staff, C.N.R., Toronto, to May 1927 as concrete inspr., and May 1927 to date, instr'man, with experience in field and office.

References: C. R. Young, P. Gillespie, S. B. Wass, H. L. Currie, J. R. W. Ambrose.

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References: R. W. Boyle, R. S. L. Wilson, H. R. Wake, R. W. Ross.

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References: J. A. Dickinson, B. S. McKenzie, A. B. McEwen, H. J. Buncke, H. M. MacKay.

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References: A. F. Baird, J. Stephens, E. O. Turner, W. L. Ball, B. T. Weston.

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The Rivers of the Province of Quebec in their Legal Aspect

Features of the Laws of the Province of Quebec as they Affect the Public Rights, Ownership and Administration of Rivers within the Province

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Engineer, Price Brothers and Company Limited.

Paper presented before the St. Maurice Valley Branch of The Engineering Institute of Canada, March 17th, 1928

The rapid growth of the pulp and paper industry concurrently with the widespread development of water power in the province of Quebec during the past decade has greatly increased the commercial use which is being made of our rivers. The latest census of these industries shows that nearly 1,700 million feet board measure, or 3 1/3 million cords of wood, are being taken from the forests of Quebec annually, and it is safe to say that over 80 per cent of this large amount of raw material is taken to mills or market, for part of the way at least, by being floated down rivers and streams.

It is also known that turbines of some 2,200,000 h.p. are now installed on the rivers of the province of Quebec. We find during the last ten years our hydraulic power plants have reached their present-day capacity at an average rate of increase of 130,000 h.p. annually, while the increase in the last three years alone has been nearly 900,000 h.p.

Hundreds of millions of dollars have been invested in timber lands, wood-using mills and river improvements, as well as in water power developments and flow regulation works, while considerable sums of money are spent every year by the two basic industries which make use in common of our running streams.

The interests involved are large, as one can well realize; the common law and special legislation by which they are governed in practice are, therefore, of importance, not only to the lawyers who pass upon and approve of the title deeds, etc., for the bankers who finance those enterprises, but also to the engineers responsible for or connected with the projects, and to their colleagues and the public, who are interested in the use and development of the rivers and water powers of the province.

Rights of the Public

According to the common law, running water, like the air and the sea, is considered as belonging to every one. " Equidem maturali jure communia sunt omnium, aer, mare et aqua profuens " was the formula used by the Romans some 1,400 years ago, (Code of Justinian), and the French laws, whence our Quebec laws concerning water courses are derived, also admitted this principle.

Rivers are, by nature, public highways, and everybody has a right to use them as such; it follows, therefore, that the works, of whatever nature they may be, erected in or over any river must not destroy this character of suitability for traffic in the way of navigation and the floating of logs.

To quote from " The Law of Waters " by Coulson and Forbes: " A navigable river is a public highway navigable by all His Majesty's subjects in a reasonable way and for a reasonable purpose. The public right of free passage extends to the whole of the navigable channel, which it appears may be used as a highway by the public whenever it suits their convenience, whether such navigation be valuable or not."

Various texts of our Quebec law may be cited, as for example, (Art. 3, Ch. 264, R.S.Q. 1925), " It shall be lawful to make use of any river or water course, lake, pond, ditch, drain or stream in which, or to the maintenance of which, one or more persons are interested or bound, and the banks thereof, for the conveyance of all kinds of lumber, and for the passage of all boats, ferries or canoes, subject to the charge of repairing, as soon as possible, all damages resulting from the exercise of such right, and all fences, drains or ditches damaged."

It results therefrom that a legal servitude, (Art. 507 C.C.), is established in favour of the public at large for navigation and log driving purposes, not only over all rivers and bodies of water, but also on the shores or banks thereof.

Article 31, div. V., Ch. 46, R.S.Q. 1925, provides that any person, firm or company may, during the spring, summer and autumn freshets, float and transmit timber rafts and craft down all rivers, lakes, ponds, streams and creeks in this province."

Article 516 of the Municipal Code also recognizes this same right in connection with municipal water courses which are defined under Article 499 of this Code as being, "every water course draining several pieces of land with the exception of road and boundary ditches, and every river or natural water course in the parts thereof which are neither navigable nor floatable in the technical sense."

Article 516 reads as follows: "Any person may use any municipal water courses, as well as the banks thereof, for the conveyance of all kinds of timber or wood, and for the passage of all boats, ferry boats, and canoes, subject always to the obligation of repairing, without delay, all fences, drains or ditches damaged thereby, and to the payment of all damages resulting from the exercise of such right."

Private Rights

Although streams are not susceptible of ownership as such, their banks or shores, and the bed in some cases, may be private property, and he who possesses them is in a position to enjoy certain exclusive rights which will be dealt with later on.

Width of Rivers

With regard to the division line between the bed of a river and the riparian lands bordering thereon, or, in other words, to define the width of rivers, we still have no law by which these boundaries may be fixed, but our jurisprudence clearly admits that everything which is included within the limits of the highest water level without overflowing or flooding forms part of the bed. It is, therefore, the high water marks when a stream is flowing full but not overflowing which separate it from the adjacent land. This rule applies to all rivers and streams whether navigable and floatable or not.

Navigability and Floatability

Rivers and lakes, in the province of Quebec, are classed either as navigable and floatable, or as not navigable and not floatable in the same manner as they were in France.

Navigability is a matter of fact. In principle a stream is navigable which can be used for transportation in a practical and profitable manner, either downstream or upstream, so that it can properly be said to be a natural highway.

When logs and timber, (en trains ou radeaux), can be driven down a river in rafts or in the form of cribs, this stream is said to be floatable, and is considered as being in the same class as a navigable one.

All other water courses, even those down which large quantities of loose logs can be driven, are said to be unnavigable and not floatable.

Although the government of this province could rule and declare which streams are navigable and floatable and which others are not, the decision in any particular case has always been left with the courts. Several judgments of our courts have already defined the general character of some rivers, seemingly setting forth the principle that a stream does not cease to be navigable by the fact that, in certain places, navigation is interrupted, due to the presence of falls and rapids, provided that the general characteristics of this river be such as to make it navigable.

According to this formula, tributaries are treated each on its own merits, and may be classed irrespectively of the general character of the main river, but channels forming part of a navigable stream must also be considered as such whether they be navigable in fact or not.

Let us note that the Ottawa and St. Francis rivers were declared by the courts to be navigable and floatable in rafts, while the rivers Jacques Cartier, Rouge, (County of Labelle), Chaudiere and Gatineau were classed as non-navigable and not floatable in rafts.

As regards the Gatineau river, however, by a subsequent judgment, the Supreme Court held that this river was navigable from its mouth to the first rapids which interrupt navigation, the river thus being navigable over a distance of a few miles only. This ruling enunciated a different theory from that which had heretofore been adhered to, and this interpretation might have very far reaching effects in the future if it ever were confirmed by the Privy Council.

Rights of Ownership Upon Navigable Streams

Navigable and floatable rivers and streams are considered as being dependencies of the Crown domain according to Art. 400 of our Civil Code. They are the property of the province, in view of the fact that they are part of the territory included within its boundaries. This right of ownership by the province or its grantees implies, as accessories to the bed, certain useful rights, amongst which the most important is the right to water powers. It must be remembered, however, that, to quote again Coulson and Forbes, "The right of navigation is paramount to the right of property of the Crown and its grantees in the bed of the river, and such property cannot be used in any way so as to derogate or interfere with the public right of navigation."

Federal Authority

On account of this public right of navigation and in virtue of clause 10, section 91 of the British North America Act 1867, the Parliament of Canada, having full legislative authority in matters concerning navigation, can declare what must be considered as an obstacle to navigation and can exercise the necessary control over all works built or placed in navigable water; this federal jurisdiction is such that the refusal of the Governor General in Council to authorize the erection of any proposed works would ipso facto cause the provincial grant regarding the part of the bed upon which the said works would have been built to be of no practical effect.

By the 1867 Act, the federal government was also awarded the property of all recognized public harbours and that of certain water powers derived from navigation canals. This matter being "sub judice" at the present time, any comments must be avoided.

Riparian Ownership Along Non-Navigable Streams

Riparian ownership along navigable streams extends to lands above the high water mark only. As stated previously, the shores, banks or riparian lands are subject to a legal servitude in favour of the public, but, on the other hand, they benefit by their proximity to water courses and their owners can enjoy many useful rights.

The right of alluvion is that by which "deposits of earth and augumentations which are gradually and imperceptibly formed on land contiguous to a stream or river," (Art. 420 C.C.), become the property of the owners of the adjacent land. In a like manner, "the ground left dry by running water which insensibly withdraws from one of its banks by bearing in upon the other" accrues to the proprietor of this bank, but "the proprietor of the opposite bank cannot reclaim the land he has lost." (Art. 421 C.C.)

It may be noted also that "Islands, islets and deposits of earth formed in the beds of navigable and floatable rivers or streams belong to the Crown, if there is no title to the contrary." (Art. 424 C.C.)

The other outstanding privilege is the right of access and egress on to the river which inures to the riparian owners and which, if interfered with, gives grounds for compensation.

Riparian Ownership Along Navigable Streams

In regard to unnavigable or not floatable rivers, the jurisprudence has set the rule in this province, that the bed belongs to the riparian proprietors; that when one holds property on one side of an unnavigable river, his rights of ownership extend to the middle thread of the stream, (usque ad medium filium aquæ), and that, should he be the proprietor of both sides, he owns the bed entirely, subject, however, to the general right of the public for navigation and the floating of logs.

In a judgment " Re the Queen *vs.* Robertson by Judge Strong," it is stated:—

" No principle of Law can be better established, both in England and America, than the rule which ascribed the ownership of the soil and bed of a non-navigable river prima facie to riparian proprietors of the opposite banks, each to the middle of the stream. It results from the proprietorship of the riparian owner of the soil in the bed of the river that he has the exclusive right of fishing in so much of the river as belongs to him, and this is not a riparian right in the nature of an easement, but is strictly a right of property," (R.C. Sup. 6, p. 114). This also applies to water powers.

In accordance with this rule, which is based on the old French law as well as on the English Common law, all rivers, which are not navigable or floatable, located within the Seigniories, are privately owned. In the townships, the bed of all such rivers is also private property whenever it is adjacent to lands alienated from the Crown before June 1st, 1884, when a law was passed whereby all sales and free grants of Crown lands bordering on non-navigable rivers and lakes were to be made subject in the future to a reserve three chains, (198 feet), in depth along the water's edge.

Doubts arose as to the extent of this three-chain reserve, which, it was claimed, in some cases, was subject to a mere servitude for fishing purposes. As a matter of fact, in the cases of McLaren *vs.* Hansen and the Attorney General intervening, the Superior Court, (Champagne J.), held that the three-chain reserve did not imply a right of ownership in favour of the Crown but only a servitude for fishing purposes, and that the strip was the property of the owner of the lot. The Privy Council confirmed the judgment, (Paugan Falls, Gatineau river). The matter was finally settled, for the future at least, by an act passed in 1919, (9 Geo. V. Ch. 31, Sec. 1), which declares that this strip of land remains in full ownership by the Crown.

These two enactments are now recorded in Art. 7 of Ch. 83, R.S.Q. 1925, which reads as follows: " Sales and free grants of lands belonging to the Crown are and have been since June 1st, 1884, subject to a reserve, in full ownership by the Crown, of three chains in depth of the lands bordering on non-navigable rivers and lakes in the province."

Moreover, by an enactment of 1918, (8 Geo. V. Ch. 72, Sec. 1), all lakes and non-navigable and non-floatable rivers and streams and their banks bordering on lands alienated by the Crown after February 9th, 1918, are declared to be dependencies of the Crown domain, so that, since that date, all rivers, streams and lakes, of whatever class they may be, are retained by the province in the meaning of Art. 400 C.C. The Courts having not yet determined the effect of the Act of 1919, (9 Geo. V. Ch. 31), above referred to, the situation as regards water powers or non-navigable rivers contiguous to lands granted between June 1st, 1884, and February 9th, 1918, is at the present time uncertain.

Riparian ownership along rivers and streams which are not navigable or floatable in rafts, besides revolving the strict right of property of the bed to the middle of the stream, implies also many useful rights, such as those of developing water powers, fishing, alluvion, etc.

" Islands and deposits of earth which are formed in rivers which are not navigable or floatable, belong to the proprietors of the banks of the side where the island is formed. If the island be not formed on one side only, it belongs to the proprietors of the banks on both sides, divided by a line supposed to be drawn in the middle of the river," (Art. 425 C.C.).

Referring again to the three-chain reserve, it is important to mention the fact that the holders of location tickets or patents are tacitly allowed by the Crown to occupy these three chains, and, " if we flood them and destroy their improvements or their crops they would probably be successful in collecting damages from us before the Courts, not as owners, but merely as persons being occupants by sufferance and being entitled as such to the protection of the Courts against the acts of others having no better title than themselves. They are in possession, in fact, and if we disturb them they could proceed against us by possessory action and they could probably recover the damages caused them in their possession though they could not recover anything for injury to the land itself as there could be no claim for erosion of the soil," (Opinion from Mr. L. St. Laurent, K.C., Nov. 23rd, 1926).

This is a case which is often met with in log driving operations, and the situation is somewhat similar to that which prevailed in the lake St. John district, where the riparian proprietors owned only down to the high water mark, but because they were in fact occupants by sufferance between high water and low water marks, they had to be indemnified for the damages caused by permanent or semi-permanent flooding between these two points. Another typical example presented itself along the Little Discharge of lake St. John, when the mill pond at Riverbend was created by the construction of a dam which controls the water level permanently at the elevation reached by ordinary freshets, so that the lands included between high water and low water marks had to be practically purchased.

Water Powers

From the foregoing brief exposé of the principles and rules which form the backbone of the legal status in regard to our rivers, it will be understood that water powers are owned by the province, except those situated on non-navigable streams within the Seigniories and the townships where lots were sold or granted to individuals or companies prior to June 1st, 1884, or possibly February 9th, 1918. A number of water power sites in navigable waters and in unnavigable rivers alienated by the Crown since June 1st, 1884, are also privately owned as having been specially conceded by letters patent or notarial deeds of sale. No less than ninety grants were made in this manner and it may be interesting to note here that very important water powers are held in virtue of such titles, namely, the following: the power sites of the Saguenay river and Grand Discharge of lake St. John; several falls and rapids on the rivers St. Lawrence, Ottawa, Gatineau, St. Maurice, Quinze, Lievre, Chicoutimi, etc.

These concessions, in whichever form they were made in the past, were confirmed in 1916 by an enactment which is recorded in the Revised Statutes of Quebec of 1925 under section 1 of chapter 46 which reads, " 3—It has always been lawful, before the 16th of March, 1916, whatever may have been the system of government in force, for the authority which has had the control and administration of public lands in the territory now forming the province of Quebec, or any part thereof, to alienate or lease to such extent as was deemed advisable, the beds and banks of navigable rivers and lakes, the bed of the sea, the seashore and lands reclaimed from the sea, comprised within the said territory and forming part of the public domain.

From and after the 16th of March, 1916, every alienation or lease of one or more of the properties mentioned in the foregoing paragraph may be effected solely with the express authorization of the Lieutenant-Governor in Council, and on such conditions and under such restrictions as he may determine."

The practice of the government of selling outright water powers of importance has now been abandoned. Water powers are now generally granted by public auction, and the right and obligation to develop them are now combined in emphyteutic leases under the following main conditions:—

(1) The term of the lease varies from twenty to ninety-nine years. The most usual terms are fifty to seventy-five years.

(2) The annual rental to be charged for the use of Crown lands occupied, during the whole term of the lease, is in accordance with the accepted bid or tender.

(3) An annual royalty of 50 cents or more per horse power developed is charged based upon the installed capacity of the turbines, and, in some cases, an additional royalty of 50 cents or more per horse power is charged on the amount of power permitted to be exported out of the province.

(4) The royalty is to be revised, usually every ten years, and provision is made for a settlement of this matter in case of disagreement.

(5) A money guarantee must be deposited by the lessee, which is to be returned to him when the initial development is completed.

(6) A definite amount of power must be produced within a given time. Usually two years are allowed, within which the works are to be begun, and two years more for their completion.

(7) Conditions are provided for the sale of surplus power.

(8) A special tariff can be charged for the use of stored water in case reservoirs are created.

(9) The lease may be cancelled by the Lieutenant-Governor in Council, without legal proceedings, for non-payment of rental or royalties or for neglect or failure to carry out the conditions of the lease.

(10) When the lease terminates or is cancelled, the power and lands covered by the lease revert to the Crown, together with all works, buildings and immovable properties thereon, with or without compensation as the case may be. The lessee is to be given a reasonable time in which to remove his machinery, failing which, this also becomes the property of the Crown without compensation.

(11) Provision is also made for the filing of plans, inspection, maintenance, annual statement of operations, transfer of lease and the protection of other interests using the stream.

With reference to water powers in non-navigable rivers adjoining riparian lands conceded before June 1st, 1884, or February 9th, 1918, the right to develop these is given to the riparian owner in virtue of Art. 503 C.C. " He whose land borders on a running stream, not forming part of the public domain, may make use of it as it passes, for the utility of his land, but in such manner as not to prevent the exercise of the same right by those to whom it belongs, etc. He whose land is crossed by such stream may use it within the whole space of its course through the property, but subject to the obligation of allowing it to take its usual course when it leaves his land."

As to both navigable and non-navigable rivers and streams, the owner of the bed and banks thereof has always had the right to turn them to account by the construction of mills, manufactories, flood gates, flumes, dams, booms, dikes and the like, subject to the payment of all damages resulting from the construction and operation of his works, whether by excessive elevation of the flood gates or otherwise. (Div. 11, Ch. 46, R.S.Q. 1925.)

Of course, if these works mean building over or obstructing navigable waters, he has to have his plans approved by the Governor General in Council under Ch. 140, R.S.Q. 1927. Moreover, if works for the development of power are likely to affect public property or the property of third persons or public or private rights, he who wishes to erect them must have his plans approved by the Lieutenant-Governor in Council. Notice of the application for the approval of the plans is to be given and any party interested can be heard and the government may approve purely and simply the plans submitted, or give its approval subject to such modifications and conditions as may be deemed useful or expedient. (Div. 11, Ch. 46, R.S.Q. 1925.)

As an example we may take the conditions under which approbation of the Lieutenant-Governor in Council was given for the erection, maintenance and operation of a power dam on the Chicoutimi river owned by Price Brothers and Company, Ltd.

(1) The authorization is given without prejudice to the right of any third parties who may be affected prejudicially by the said works.

(2) The present authorization shall be valid for fifty years to be computed from December 1st, 1923, and subject to a fee of $100 to be paid to the Department of Lands and Forests before January 1st, 1924.

(3) The applicant shall be responsible for all damages resulting from the erection, operation and maintenance of the said works, and he shall perform his operations at all times in such a way as to conciliate the different interested parties having the right to utilize the said river.

(4) The applicant shall, if requested by the competent authority, erect and maintain in good condition the proper fishways, and he shall also erect and maintain suitable log-slides and sluiceways in the dam, to meet the requirements of all interested parties.

(5) The present authorization is subject to the federal and provincial laws and regulations concerning the navigation, floating of logs, mines and fisheries.

In this case the power site was held in fee simple in virtue of Letters Patent.

The Floating of Logs

There is in all rivers and streams, as was mentioned, in favour of whomsoever may have occasion to use them, a general right of floating logs and timber, either in rafts or loosely, (a buches perdues). This right is subject to payment by him who exercises it of such damages as he may cause in doing so, " except in regard to such as cannot be avoided by the exercise of reasonable care and skill, and those in respect of which the riparian proprietor himself may have contributed or which have been occasioned by his own fault." (Dumont *vs.* Fraser, Supreme Court, 1913—48, S.C.R., p. 137.)

This right to use rivers and streams for floating and driving purposes would seem to be restricted to the spring, summer and autumn freshets in the wording of Art. 31 of Ch. 46, R.S.Q. 1925, but the jurisprudence of our courts is not established in that sense, and it may be construed that the right to drive timber could be exercised at all times when it was physically possible to exercise it.

As to whether or not artificial aids by means of storage reservoirs could be used at other times than during the spring, summer and autumn freshets, the Supreme Court were equally divided in the case of River Ouelle Pulp and Lumber Co. *vs.* The Ste. Anne Fish and Game Club in 1910. The Court below had held that the right to aid the floating of logs by artificial means authorized by the law, (Art. 32, Ch. 46, R.S.Q. 1925), may be exercised at all seasons of the year.

Since February 9th, 1918, (8 Geo. V. Ch. 69, now 33, Ch. 46, R.S.Q. 1925), no work or improvement of which the construction, execution or maintenance necessitates the taking possession or occupation of any public or private property, or prejudicially affects either of such properties, or any rights, public or private, either by the backing up of the water or otherwise, may be constructed, executed or maintained, unless the plan and specifications relating thereto have previously been approved by the Lieutenant-Governor in Council. If the construction and maintenance of any such work necessitates the taking possession, or occupation and/or the flooding of any public lands, or will affect any other rights of the province, it is necessary to obtain from the government a concession of such lands or public rights so affected.

We need not enter into the details of the procedure, (35 to 40 Ch. 46, R.S.Q. 1925), to be followed in order to obtain these authorizations and concessions which are made by notarial leases, for a term of usually twenty years and under certain general conditions. Let us note, however, that a small fee is charged for the authorization, $20 in ordinary cases, and that an annual rental must be paid for the use of the Crown lands or rights affected based on the following rates, in the case of driving dams: 25 cents per acre of lands flooded or subject to flooding plus 25 cents per million cubic feet of water of storage capacity.

The owner of river improvements for the driving of timber or logs, even if they stand on private property, does not have the exclusive right to the use of the river or of such works or improvements, but any other person may use them for the same purposes by paying to the proprietor of such constructions or improvements the tolls determined by order of the Lieutenant-Governor in Council upon a petition to that effect presented by the owner or other parties interested. (41, 42 Ch. 46, R.S.Q. 1925.)

Driving and booming companies are governed by a special act, (Ch. 47, R.S.Q. 1925).

Water Powers and Log Driving Depend on Co-existing Rights

Water power operators and log drivers have co-existing rights, but their interests may often conflict. A power dam is an obstruction to log driving to a certain extent, while the floating of logs and navigation have always been considered as outstanding public rights.

In the case of McBean *vs.* Carlisle, (19 J.P., p. 276), in 1874, the Court held that the dam owners in damming up the river for the purposes of their mill, " were bound to provide for and secure to the public facilities for the floating of their lumber equal to those which the natural flow of the river, before the erection of the dam, would have afforded them."

With reference to this judgment it will be interesting to many a power dam owner or operator to listen to the following opinion of Mr. L. St. Laurent, K.C.:—" I am of opinion that this language goes beyond what would now be required from the owners or lessees of power dams. I think that our Courts would now hold that when power dams are erected in accordance with plans approved by the government, and are provided with all the reasonable facilities which can be made to facilitate the driving of logs, the owners would not be responsible because the floating facilities were not equal to those which the natural flow of the stream before the erection of the dams would have afforded. I think it would be held that both power users and those having occasion to use the streams for driving purposes, have rights in common, and that each must use his rights in such a manner as to cause the least possible inconvenience to the other, and is responsible only if he is making an unreasonable use of this right which he thus has in common with others. I think the Courts would now assimilate this common right to those which all enjoy in the public highway. Everyone is entitled to use the public highway, but he cannot complain if somebody else is using it in a reasonable way at the same time he is. It may be inconvenient to him not to have the free use of it alone. He may be delayed because of the congestion of other traffic, but if the others are not making an unreasonable use of it, he cannot recover from them the damages he may suffer by being thus subjected to some delay."

In case of disagreement between users as to the manner in which they should both exercise their rights, the Public Service Commission has jurisdiction to decide between them. (Ch. 17, R.S.Q. 1925, Art. 28, Sub-sec. 10.) The terms of the provincial authorization, in this particular respect, are ordinarily as follows:—

" If so requested by competent authority, the lessees shall erect and maintain in good condition the proper fishways and they shall also erect and maintain suitable log slides and sluices in the dam to meet the requirements of all interested parties." (Chicoutimi Power Dam, Price Brothers and Co., Ltd.)

A dam owner is not supposed, apparently, to furnish any booms to direct the logs to the sluiceways, but piers and other permanent structures required to hold these booms in position are generally considered as falling to his lot, according to the interpretation of the provincial hydraulic service. However, when authorization must be obtained from the federal authorities under the " Navigable Waters Protection Act," the owner of the dam is often obliged to supply the necessary booms and other requisites.

Storage Reservoirs

It is only since 1918 that we have had a definite law concerning the creation, maintenance and operation of reservoirs, the use of which serves " to impound and to keep stored up, in all seasons, the waters of lakes, ponds, rivers and streams, with the object of conserving them so as to regulate their flow, either by their natural outlets or by a deviation therefrom, and thus to ensure a uniform supply to water works systems and mills and a constancy of hydraulic power." (Div. VI. Ch. 46, R.S.Q. 1925.)

This law provides for the authorization of the works required for the purpose of storing water, as well as for the acquisition of the necessary lands and rights and for the establishment of a tariff of tolls where several parties benefit by the regulation of the flow.

Where the lake or reservoir is on Crown land it is the policy of the government, as in the case of water powers, to grant the applicant the necessary lands and privileges by emphyteutic leases, for a term of fifty years and under certain conditions, amongst which it may be interesting to note the following:—

An annual rental is charged, based on the area of the lands affected, at the rate of 25 cents per acre per annum in ordinary cases.

A supplementary charge or royalty must also be paid over and above the rental mentioned which is calculated at the rate of 50 cents or more per additional horse power year resulting from the water of the storage reservoir at the power plants benefitting by the regulated flow. This royalty is subject to revision every ten years. The government reserves the right to expropriate the works within the term of the lease.

It is useless to even mention the fact that storage reservoirs are of the utmost importance in many respects. It may be pointed out, however, that they afford the means of legally diverting water from its natural course to a certain extent at least, and they therefore permit of operating flumes, for instance, for the transportation of logs and timber from one watershed to another.

Conclusion

This sketch of the work, salient legal principles and requirements affecting the rivers of the province of Quebec, is necessarily incomplete. May it suffice to show that although legal rules are based as common sense, a variety of particular circumstances often renders this application complicated and that, in problems dealing with the utilization of natural forces, legal difficulties as well as physical ones are within the scope of the work of the engineer lest the success of the enterprise may be economically handicapped.

Discussion of Paper on Some Engineering Aspects of the Bridge River Project by E. E. Carpenter, M.E.I.C.[1]

A. C. R. Yuill,[2] M.E.I.C., enquired as to the purpose of the depression at the foot of the surge chamber which he had noticed.

The author, in reply, explained that this was to act as a sump for the purpose of collecting rock fragments eroded from the floor and walls of the unlined tunnel, and preventing them from entering the penstock. At intervals, it would be necessary to clear this sump out, for which purpose an orange peel or clamshell bucket would normally be used.

H. B. Muckleston,[3] M.E.I.C., remarked that in the diversion dam, which was placed 500 feet upstream from the final dam, he noticed that the space or apron had been filled with concrete in squares. Had a puddle blanket of clay been considered for this purpose? From his experience he would fear that the concrete might open up. In a case known to him in India, with about 60 feet head upon the dam, a blanket of 15 feet of clay had been used with success. This was in Jaipur, Rajputana.

The author, in reply, remarked that in the case under consideration the head was considerably greater than that spoken of by Mr. Muckleston, being 160 feet, but he believed that clay would have answered the purpose very well had it been possible to obtain a supply of suitable material within reasonable distance. An hydraulic fill dam would have been suitable for this location, but it had been felt that with this type of structure the control of flood conditions during the construction period would be too difficult, and the cut-off problems too hard to solve.

Col. J. C. MacDonald,[4] M.E.I.C., remarked that the British Columbia Electric had just let contracts for a 100,000 hp. steam plant, and enquired what relation the operation of this plant would have to that of the Bridge river installation.

The author replied that the steam plant would be used for taking care of a certain amount of seasonal peak load, but in its principal function would be that of a regular operation standby plant to take up load in case of interruption to the hydro service. Dean R. W. Brock,[5] M.E.I.C., asked whether tests had been made regarding the hot weather flow of the river and the probable evaporation losses from the lakes used for storage. Mr. Webb observed that information regarding this matter was not yet available. The Provincial Water Rights Branch had established two evaporation test stations on which observations were being made. Investigations made recently at Vernon had indicated that the summer average loss in the arid belt was approximately one-eighth of an inch per day.

Dean Brock remarked that the views shown by the author indicated valleys of a form typical of those which had carried large glaciers. During the period of glaciation, the transverse valleys in many cases had filled with ice, which had formed a bridge over which the main ice sheet had passed. Later, the action of the ice had resulted in the conversion of the normal V-shaped valley into one of a U section. At the points where transverse valleys entered the main valleys, this had resulted in the formation of depressions or even of lake basins in the valley floor, such deepenings being characteristic of the junction between tributary valleys and main valleys. Such ice-conditions belonged, of course, to a comparatively recent geological age. He would ask the author what kind of material had been found under the clay bed of which Mr. Carpenter had spoken.

The author replied that the clay was underlain not by sand, but by fragments of granite, ranging in size from that of a pea down to sand grains. This material was tolerably watertight. Similar material had also been found when drifts had been run into the talus slopes at the sides of the valleys when exploring for a suitable dam site.

A. E. Foreman,[6] M.E.I.C., remarked that he had observed no provision for removing silt and asked why scouring valves had not been installed.

The author, in reply, pointed out that any silt brought in would probably be deposited at the upper end of the lake, in which case scouring valves at the dam would not be of much use. In his experience, the use of scouring valves had proved disappointing, because even when silt was deposited in their vicinity, it was only removed locally in the immediate proximity of the valves, the main body of the silt remaining in situ.

C. E. Cartwright,[7] M.E.I.C., enquired whether the silt in the Bridge river was not largely due to volcanic ash. The author replied that this was possibly the case, since many of the upper hillsides were covered with ash.

On the conclusion of the discussion, a very hearty vote of thanks was accorded to Mr. Carpenter.

(1) This paper was presented at the Western Professional Meeting of The Engineering Institute of Canada, at Vancouver, B.C., June 7th to 9th, 1928, and published in The Engineering Journal, July 1928.

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(3) Consulting engineer, Vancouver, B.C.

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The Forest Products Laboratory of Vancouver

The Value of Forest Products in Canada; the Work of the Vancouver Laboratory and Results Attained

J. B. Alexander,
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Paper presented before the Vancouver Branch of The Engineering Institute of Canada, January 18th, 1928

In order to give a proper setting for the subject, it is desirable to review the economic importance of forest products in the Dominion and in British Columbia, confining it entirely to official statistics compiled and released by federal and provincial departments.

The Economic Importance of Forest Products

There are four great primary industries or occupations: agriculture, lumbering, mining and fishing. In practically every country in the world agriculture far outranks any of the other three, both in value of its product and in the number of its employees. For Canada as a unit that is true. Comparative statistics for 1925, the latest available, show agricultural production valued at more than one and one-eighth billion dollars, with exports, chiefly to Great Britain, of $562,000,000. Ranking next in value, the forests of this Dominion produced material to the value of more than $1,000,000 per day, a total for the year of $368,000,000.

After supplying all her own needs in domestic woods, in 1926 Canada exported lumber, pulp and paper, and other wood products to the value of more than $284,000,000, or 22.7 per cent of the total export trade.

The United States received agricultural products, including animals and animal products, to the value of nearly $145,000,000, while she received forest products to the value of more than $242,000,000.

Since Confederation, 18.5 per cent, in value, of all Canadian exports have been of forest origin. Every fifth railway freight car loaded in Canada contains wood or wood products.

Let us examine briefly the situation in British Columbia. Here the ranking of the four basic industries is: lumber, 1926 valuation, $85,000,000; agriculture, $71,000,000; mining, $67,000,000; fishing, $27,000,000. So, at the outset, it can be seen that lumbering occupies the premier position. To her magnificent forests more than to any other resource, either natural or industrial, the people of British Columbia look for their livelihood.

Logging, sawmills, lath, shingle, pulp and paper mills, veneer mills, box factories, and allied primary wood-working industries employ about 40,000 men, roughly one-third the total working male population of the province, and return in wages more than $43,000,000 annually.

Last year, by boat, more than 1,000,000 tons of sawed lumber left British Columbia, 40 full cargoes for the biggest boat on the Pacific, the Empress of Canada; 75 per cent as much tonnage went out in the log, some by cargo, more in raft; 187,000 tons of pulp and paper required shipment and partial trans-shipment. The Canadian National, Canadian Pacific, and Great Northern railways moved more than 2,000,000 tons of export forest material. Every second railway freight car loaded in the province contains material originating in the forests.

These forests contribute annually one-fifth of the total provincial revenue; in 1926 more than $4,000,000.

These facts substantiate the previous statement that to the forests of British Columbia more than to any other resource, either natural or industrial, the citizens of the province look for their livelihood.

Early Investigations

From the earliest times a few basic facts were undeniably known by experience. It was known, for example, that stone was stronger than wood in compression, and, later, that metals are still stronger. No quantitative results appear to have been determined and recorded until about the middle of the eighteenth century.

Galileo, in 1638, experimented upon beam failures, but regarded all fibres as inextensible. It was another hundred years before tests of the strength of bars were made, and these tests were with regard to ultimate load only, the elastic limit being unknown. In 1678, Hook, in England, announced the theory of "springy bodies," stating that "elongation is proportional to force."

Early in the nineteenth century, Young introduced the Modulus of Elasticity, quite commonly called Young's Modulus, in his book "Lectures on Natural Philosophy," but he does not mention that it can be deduced and applied only to stresses below the elastic limit. Tredgold and Barlow a few years later, in conducting a series of experiments on cast iron bars, noted a permanent set.

It was not until about 1830, when metallic bridges came into demand by reason of railway building, that exhaustive tests were made and recorded and definite conclusions drawn with respect to ultimate load and factors of safety, having especial reference to wrought and cast iron.

With rapid expansion in railway, highway, and building construction, imperative demands arose for accurate determination of strength values for all structural materials. Societies, national and international, governments, steelworks and universities, established testing laboratories and vied with one another in experimental work and compilation of results, until today the literature dealing with experimental results is of enormous volume and corresponding value, while the end is not yet. As a matter of fact, there will be no end so long as this world endures.

The Establishment and Work of the Vancouver Laboratory

The Forest Products Laboratory at Vancouver is a product of the Great War. As you all know, Britain and her allies were almost wholly dependent upon the Sitka spruce forests of the Pacific coast, more particularly those of the Queen Charlotte islands, for airplane material. Only the very highest quality of spruce was acceptable, so that an inspection service was instituted at Vancouver to cull out all material having the slightest blemish, in order to conserve cargo space.

In 1918, testing machinery was installed and comprehensive research work begun on Sitka spruce under the direction of the Forestry Branch, Department of Interior. From the outset the value of the laboratory was recognized by progressive lumbermen, and when the war closed representations were made at Ottawa citing the desirability of continuing its operation as an outpost of the central laboratory, then situated at Montreal, (the central laboratory, by the way, has just been removed to Ottawa, with the exception of the pulp and paper division which remains at McGill University in a building erected by the Canadian Pulp and Paper Association for this division, for the Department of Cellulose Chemistry of McGill University and for its own general offices).

Recognition of the peculiar problems facing the lumber industry in the province of British Columbia, with its 40 per cent of Canada's timber reserve, 70 per cent of Canada's saw-log material, and the great advantage accruing to manufacturer and consumer alike from the establishment of a technical investigative service locally, led to the decision to continue the laboratory as a unit in the Forestry Branch of the Department of the Interior. It is now located at the University of British Columbia, Point Grey, under a working agreement with the university, whereby the university supplies accommodation, while the personnel and equipment are provided by the Forestry Branch. The testing equipment is at the disposal of the Faculty of Applied Science of the University of British Columbia for instruction of students in engineering during their laboratory periods in construction materials.

The laboratory is housed in three buildings, the main building containing the executive offices, photographic dark room, pathological laboratory, testing laboratory, and carpenter shop, with dry kiln and air drying shed in separate buildings adjoining.

Equipment, at present, comprises two 30,000-pound Olsen universal testing machines; a 200,000-pound Olsen universal testing machine capable of testing sections up to 16 feet in length, either in end compression or cross bending; a Turner-Hatt impact testing machine; electric drying ovens; auxiliary apparatus for complete timber tests; tools for machine driving and pulling nails, and for pulling screws.

The purpose of the Forest Products Laboratory might be defined in some way such as this: "To conserve Canadian forests by developing the most economical methods of converting standing trees into finished products; to make the growing of timber more profitable by increasing the possibilities of utilization of both used and unused species, to find new uses for old materials and new materials for old uses." In other words, the object is to give practical assistance to both manufacturer and user of wood and wood products, and, in conjunction with them, to promote forest conservation.

Every Canadian industry and class of citizen that grows wood or uses it, or any of its derived products, may thus directly benefit by the research of the laboratory, and the value of the laboratory to any wood-using industry, class of consumer, engineer, or architect, depends almost wholly upon the use any of them makes of it. Any citizen of Canada has perfect freedom to correspond with the laboratory about particular problems dealing with utilization of wood, and will receive prompt answers, based upon whatever information is available upon the subject.

The laboratory is in charge of a superintendent, an assistant engineer, and staff. The work of the laboratory is distributed between two technical sections:—*Timber mechanics*, strength of wood and manufactured articles, computation; *timber products*, experimental and practical kiln drying, physical properties, mill studies, industrial investigations, pathology of timber products.

In addition, there is the section which handles accounts, photography, records and supplies. It is thus evident that the laboratory is well organized to render effective service to those requiring aid in the solution of problems coming within the range of its organization, and any lying outside its range will be immediately transmitted to the central laboratory at Ottawa, which has a very much larger number of technical sections.

Each year shows a very greatly increased total of requests for technical information over the preceding year, and it is to be expected that very shortly the entire time of one technical man will be required to attend to answers to these requests.

Timber Products

The timber products section of the laboratory operates the dry kiln, prepares kiln drying schedules for different species and thicknesses of stock, and offers expert advice upon the operation of commercial dry kilns. The necessity for this advice was recognized after a study of kiln drying losses in the dry kilns on the lower mainland in Victoria and at Nanoose, where the average loss in degrade and destroyed lumber was shown to be $2.62 per thousand feet board measure of lumber run through the kiln, representing in this area a yearly loss, (much of it preventable), of about $1,250,000. Mill studies of degrade, due to injuries in manufacture, and of methods of reduction or elimination, have been made. The resulting information placed at the disposal of local mills has materially reduced losses from the various causes.

Studies of absorption of moisture, and of piling methods for air seasoning, have also been carried out with resulting improvement in storage after kiln drying, and better piling methods. When all is said and done, only about 35 per cent of the wood in a forest emerges as rough lumber on the grading table at the mills, so that it behooves any lumber manufacturer to stop every leak within his power where such stoppage shows increased financial returns.

There is a huge undertaking ahead in developing ways and means of reducing to a minimum the losses in logging and milling and in discovering fields for profitable utilization of low-grade material.

Pathology

Cultures, of stains, moulds and wood-destroying fungi, are constantly being made and the organisms identified. Advice as to the control of these harmful organisms is frequently sought and supplied. There is a tremendous field ahead for research in these problems. Dry rot alone is responsible for losses running into millions annually.

Tree Growth

For an intelligent discussion of the physical and mechanical properties of wood, some slight knowledge of tree growth and structure are essential. Wood is a complicated structure, built more or less irregularly by the tree to serve the tree's ends; irregularly, because there are dozens of variable factors affecting the tree over which it has no control. A tree must grow where the seed germinates, or it must die there through lack of suitable growth conditions. Sun and wind, heat and frost, abundant moisture and drought, rich soil and poor, high and low altitude, all these and many other factors influence the character of the structure and leave legible records which they, who understand, may read.

In the light of the preceding statement, it is easy to see why there is such an infinite variety of wood and why there is such variation in quality between trees of the same species, even great variation between different logs cut from one tree and between different cuts from one log.

A tree has three major divisions: root system, trunk, and branches. The root system serves to anchor the tree in place and to collect from the soil the slight quantities of mineral matter, together with the large quantities of moisture, essential to tree growth. Incidentally, it contains the lightest wood in the tree, for its only stresses are tensile or compressive, in which wood has high strength values. The trunk supports the crown, conveys the raw sap, sent forward by the roots to the leaves, and serves as a store-house for food manufactured in excess of current needs. The branches are merely leaf bearers.

The majority of people think of a tree as a product of the soil. In a sense it is, but mainly it is not. Burn a piece of wood; on an average about one per cent by volume remains as ash. That is mineral matter which, with the moisture in the tree, represents the entire contribution of the soil to tree structure. The main source of food supply is the air from which the tree obtains carbon in the form of carbon dioxide. Growth takes place at the tips of roots, stem and branch, and at their circumferences under the bark. Wood formed previous to the current year does not increase in volume. Its only change, in normal growth, is a gradual one from sapwood to heartwood, as successive annual layers are laid on.

Heartwood is really dead wood. The only living cells in a tree are in the sapwood, and of these few are active. These cells or fibres are roughly either circular or rectangular in cross-section, and in length from twenty-five to several hundred times their diameter. The average length of fibre in our Pacific coast softwoods is about one-eighth of an inch. Hardwood fibres are much shorter. There is an almost incredible number of them in a cubic foot of wood. A single sheet of newspaper contains enough of them, if laid end to end, to reach from Vancouver to well beyond Kamloops.

The age of a tree can be determined by counting the rings in a cross-section. Each ring consists of two parts, a band of thin-walled weak cells grown in the spring and early summer, known as spring wood, and a band of thick-walled very much stronger cells grown in the late summer and early fall, called summerwood. Summerwood gives strength and hardness to any wood and, other factors being equal, is a direct indication of the strength of a piece of timber. The higher the percentage of summerwood shown in a cross-section, the stronger the specimen. This fact is so well recognized that specifications for the highest quality of structural material for Douglas fir and southern yellow pine contain definite statements of the percentages of summerwood required, 33 1/3 per cent for timbers having between six and twenty-five annual rings per inch, and 50 per cent for timbers having less than six rings per inch.

Timber Mechanics

Knowledge of the mechanical properties of woods and wood products is essential for their intelligent and economic use, whether in the factory, in the home, on the railroad, in the mine, or in the air. Thus, development of the airplane and progress along many other lines depend to a great degree upon accurate information as to the strength, toughness, elasticity, and other mechanical properties which determine the suitability of different woods for different purposes. There is a right wood for every use and a right use for every wood. One would hardly use cedar for handles, or oak for shingles. Uses of certain woods for specific purposes have frequently resulted from unreasoning prejudice or from custom handed down from one generation to the succeeding one. For example, it was long held that hickory heartwood was much inferior to sapwood for handle stock, an opinion based solely upon appearance without a vestige of truth for foundation, as mechanical tests showed.

Tests may be made either upon small clear specimens, or upon structural sized timbers. In the first case, the strength value of the wood itself is obtained, free from any defect which would vitiate the results as values directly comparable for different species. In the second case, every defect exerts a weakening influence upon the specimen and thus the total effect of knots, shakes, checks, pitch pockets, cross-grain, and other defects, natural or of manufacture, or of any of them, can be determined.

There are ten standardized tests of small clear specimens used today in determining the mechanical and physical properties of wood:—

(1) Static bending;
(2) Impact bending;
(3) Compression parallel to grain;
(4) Compression perpendicular to grain;
(5) Hardness;
(6) Shear;
(7) Cleavage;
(8) Tension;
(9) Shrinkage—radial, tangential and volumetric;
(10) Specific gravity.

These standardized tests are in use by government laboratories in the United States, Great Britain, Canada, India, Australia, and New Zealand, so that values obtained in any of these countries are directly comparable with those obtained in any other country.

Publications of the Vancouver laboratory are now in circulation dealing with Douglas fir, Sitka spruce, western hemlock, western yellow pine, western larch, Englemann spruce, amabilis fir, western red cedar. It is not intended to launch a discussion on these standardized tests, but it is desired to go somewhat fully into the discussion of moisture in wood and its effect.

The structure of a tree is built by the tree to serve its own ends. The tree wants its wood wet; man wants it dry. It is quite within his power to produce dry lumber, but he must exercise care in its production, or inevitably much material is spoiled in the process.

It is popularly supposed that trees contain a much larger quantity of moisture in spring and summer than in winter. One hears constantly the expressions "when the sap is up" and "when the sap is down." Such expressions have no meaning whatever, for actual tests on many different specimens from different localities have shown no appreciable differences in moisture content at any season of the year. A very simple analogy to the water service-pipes of a house will give a good illustration. Like the water pipes, the tree can contain only a certain maximum amount of water, (according to Tiemann, for wood of a given specific gravity there is a definite maximum moisture content). When the water taps are opened, circulation begins, and more and more water passes through in a given time as the taps are opened wider and wider. So with the tree. As the warmth of sun and wind wakens it from winter's dormancy and the leaves are opened, sap circulation starts and speeds up. More and more water passes through the tree in a given time without increasing measurably the quantity present at any given instant.

Moisture in a piece of green wood saturates the cell walls and fills, or partially fills, the cell cavities. As you are aware from observation, a piece of dry wood is much stronger than the same piece when green. It will support a greater load when used as a beam or as a column, and will withstand a greater shock. Also as wood dries, it shrinks. This increase in strength does not commence, nor does any shrinkage take place until the cell cavities have been emptied of moisture and the cell walls have begun to dry out. From this point, known as "fibre saturation point," increases in strength is rapid.

In dealing with wood, there is only one moisture content that can be definitely fixed. That is the condition which we call "oven dry," which is defined as being the weight that remains constant when held in an oven at 212°F. That weight can always be exactly determined and all moisture percentages, when dealing with wood, are expressed in terms of this "oven dry" weight.

Moisture in a tree is exceedingly variable. It varies from point to point along the trunk, and from pith to bark, the sapwood having the greatest quantity. Many specimens have shown, at the Forest Products Laboratory, moisture content in excess of 200 per cent. That is, the weight of water evaporated at 212°F. has been more than double the weight of the dry wood.

There are two critical moisture percentages, green and air-dry, green being defined as any percentage higher than fibre saturation point, which varies slightly for different species and lies between 20 and 30 per cent for all British Columbia species so far determined.

Air-dry condition varies slightly from month to month; an average for Canada for the summer months would be about 12 per cent, while for winter it would stand higher at 14 or 15 per cent.

Now the method of determination of "fibre saturation point" may prove of interest. It is probably not susceptible of absolute fixation, but may be closely approximated. Standard specimens are tested in static bending and compression parallel to grain at a predetermined range of moisture content; say, from 20 to 30 per cent, by one degree intervals. The rough green sticks are weighed and their moisture content determined from a moisture disc. Then the weights of the sticks at the assigned moisture contents are computed, marked on the sticks, and the sticks carefully air-dried. From time to time these are check-weighed, until they come to the computed weights. They are then dressed to standard size, and the moisture content of the dressed test pieces re-determined. The weight of each test piece and its computed weight at the assigned moisture content are compared. If they agree, the specimen is immediately tested. If they do not, it is brought to the correct moisture content by drying or adding moisture, as may be necessary, and tested when in the series of check-weighings it shows the computed weight at the assigned moisture content. Moisture discs are then taken from each test piece and its moisture content accurately determined.

Typical moisture strength curves for western larch, western hemlock, western yellow pine, Sitka spruce, and Engelmann spruce, as determined by the Forest Products Laboratory, Vancouver; the first is for the static bending and the second for compression parallel to grain. These curves are subject to minor corrections as more trees are tested, and the values derived enter into the averages from which these curves have been plotted. It will be noted that the strength remains constant until a moisture content of, roughly, 25 per cent is reached, when a sudden and sharp increase in strength occurs. This is the "fibre saturation point." It may also be fixed by plotting shrinkage—moisture curves.

When analyzing the results, obtained experimentally, for strength values of small clear wood specimens, one cannot fail to be impressed by the fact that strength and stiffness depend very largely upon the moisture content of the wood. In general terms, strength is the ability to sustain loads without failure, while stiffness is the ability to resist distortion.

It is apparent that these experimental values hold only for the percentage of moisture content at which the tests were made. As such a comparatively weak wood as Engelmann spruce shows much higher strength values at 12 per cent moisture content, (air-dry), than green Douglas fir in fibre stress at elastic limit and in modulus of rupture, static bending, in crushing strength, compression parallel to grain, and in fibre stress at elastic limit impact bending, it is obvious that tables of strength values are of no use for comparison unless they show the corresponding moisture percentages.

It is not feasible, indeed it is not possible, to bring test specimens to an exact, pre-determined moisture content. The three moisture percentages particularly of interest in the laboratory are green—any percentage above the fibre saturation point; air-dry—roughly 12 per cent; and oven-dry—about 0.5 per cent. Comparison of strength values for different trees of one species at any one of these moisture contents is a very simple matter. But when a specimen is tested and its moisture content, as determined, lies somewhere in the range between oven-dry and green, an immediate difficulty arises in making comparison, and some adjustment is necessary to reduce the observed value to an equivalent value at a standard percentage, usually 12 per cent.

The problem is to find some mathematical law connecting strength value and moisture content. Moisture strength curves, plotted upon cross-section paper, are smooth curves, very regular in form. A study of these curves has resulted in an empirical formula, the so-called "exponential formula," by means of which, given the moisture percentage at fibre saturation point, the green strength and the strength and corresponding moisture content anywhere in the range from oven-dry to green, the strength at any other moisture content can be closely approximated.

As an indication of how the results of research sometimes find immediate application three recent instances are cited. During the past year the results of tests on western hemlock, conducted in the Vancouver laboratory, were largely responsible for defeating a proposed ordinance against the use of western hemlock for certain types of construction in some of the boroughs of New York City. The outcome of the investigation, conducted by New York engineers on the Pacific coast, was that instead of lowering the former rating, the new rating showed a material increase in allowable stresses and a large and valuable market for western hemlock thereby established.

A report was made recently that the Japanese market was inclined to believe that Washington and Oregon hemlock exceeded British Columbia hemlock in strength. Strength values determined by the Vancouver laboratory showed that the reverse is true and their presentation to the Japanese dealers through the Canadian Trade Commissioner in Japan successfully held the Canadian market there.

Some three years ago an enquiry came to the laboratory from the district forest inspector's office at Kamloops as to the relative strength of green-cut and fire-killed cedar, and as to whether the complete exclusion of fire-killed poles from acceptance under the current pole specifications had sufficient justification. As frequently happens, an enquiry of this kind opened up unexpected phases. It was found that the provincial Forest Service was greatly concerned on this matter. Information came in to the effect that in some districts at least one-half the cedar of pole size had been fire-killed.

Enquiry at the United States Forest Products Laboratory at Madison, Wisconsin, elicited the reply that such tests as had been made there on fire-killed material did not include western red cedar. However, a working plan for tests of this species had been prepared, and, in a very generous spirit of co-operation, this working plan, together with valuable suggestions for improvements in testing methods, was supplied to the Vancouver laboratory.

Two shipments of poles, one from near Cloverdale and one from near Kamloops, were secured for investigation.

Each shipment was composed of four groups of fifteen each:—

(1) 15 green-cut poles of merchantable grade.
(2) 15 poles fire-killed less than two years.
(3) 15 poles fire-killed from five to ten years.
(4) 15 poles fire-killed more than fifteen years.

When this project was initiated, the sole purpose was to establish the relative strengths of green-cut and fire-killed material. But now an unexpected phase developed. The research division of the Western Red Cedar Association at Chicago, vitally interested in any investigation relative to cedar, drew the attention of the laboratory to the fact that the Engineering Standards Association had a committee at work for the purpose of recommending allowable fibre stresses in pole line design for white cedar, western red cedar, southern yellow pine, and chestnut, and that the American Telegraph and Telephone Company had carried out a series of tests on full-sized poles of all species.

It soon became evident that the members of the Engineering Standards Committee were not of one opinion as to the methods to be adopted in reaching a decision. Some of the members were inclined to base permissible stress on the strength values shown by standard tests on green material cut from mature trees. Others were of the opinion that these tests from mature trees did not show as high strength values as would be shown by tests on specimens from pole-sized trees. This laboratory held the latter view, and the difference of opinion led to a decision to postpone recommendation of the allowable fibre stress until the completion of the tests at Vancouver. These tests, both upon full-sized poles and upon small clear standard test pieces, confirmed the contention that higher allowable stresses were practicable for pole-sized than for mature timber. It is expected that the figure now under consideration will be finally adopted. This figure, which is still confidential, will be very satisfactory to the Vancouver Forest Products Laboratory.

An analysis of results of the investigation of the relative strength of green-cut and fire-killed poles shows:—

(1) Rigid inspection of fire-killed poles is a necessity.

(2) A large percentage of standing fire-killed poles may be safely marketed under rigid inspection service.

(3) Fire-killed poles, acceptable under the commercial specifications for green-cut poles, show a maximum reduction in strength of 8 per cent as compared with green-cut. In one group of poles, fire-killed thirteen months, the modulus of rupture showed a higher value than for green-cut. Another group, fire-killed six years, showed only two-tenths of one per cent lower modulus of rupture than the green-cut poles.

There have been rumors of coming shortage of lumber. It is freely predicted that the first shortage to be felt will be in poles, and that this shortage will be noticeable within the next fifteen years. Meanwhile, any modification of specifications so as to permit the use of found fire-killed poles will help materially to postpone this anticipated shortage.

Projects on Hand

Projects under investigation at the present time include "The holding power of nails in wood," "The holding power of screws in wood," and "Deterioration of black cottonwood in storage, both in the air and in water." These have not progressed sufficiently to render any report possible at present. The above covers fairly well the routine work of the laboratory. The laboratory is continually conducting special industrial investigations such as: strength of wooden containers, strength of plywood, strength of glued joints, moisture content of kiln dried woods.

Now it will be quite in order to indicate a matter that will eventually, perhaps even almost immediately, require extensive and exhaustive enquiry. This is in connection with standardized building codes with which lumber grades are inseparably linked. It will involve an extensive programme of tests of structural sized timbers covering all grades and all structural species. A working plan has been prepared and can be put into immediate operation as soon as authority is granted.

An examination of the allowable stresses for timber of different species shown by the building codes of various cities reveals wide variations in these values. So far as structural safety is concerned, the purpose of a building code is, or ought to be, to provide for safe, allowable stresses, and also to maintain a reasonable economy in costs. Manifestly the maximum safe stresses are desirable. It is upon this point that variations occur; but the stress that is safe in one city is certainly safe in another city, for the same loading conditions, and there seems no sufficient reason to prevent the adoption of a uniform set of values.

With finishing lumber, appearance is the dominant factor, but with structural material the criteria are size, position, and number of defects. For example, in a beam, a knot on the underside at the centre of the span is in the worst possible position, and the larger the knot the greater the weakening; so, too, the knot has less weakening effect as it approaches the neutral axis of the beam.

A few years ago the city of Vancouver made certain changes in its building code. This laboratory was asked to recommend allowable stresses for Douglas fir, western hemlock, western red cedar, and Sitka spruce. Considerable criticism has been directed against the values adopted for Douglas fir, more particularly that of 1,500 pounds per square inch for extreme fibre stress in bending, which has been considered too low.

Lumber in British Columbia mills is graded according to the grading rules of the British Columbia Lumber and Shingle Manufacturers' Association, whose highest grade in structural material is "Selected Common." This grade is slightly lower than the "Structural" grade of the West Coast Lumbermen's Association, for which the United States Forest Products Laboratory recommends an allowable stress of 1,600 pounds per square inch. There is a higher grade recognized than this, "Dense Structural," for which the recommended stress is 1,800 pounds per square inch in extreme fibre stress. Now these two higher grades are selected from material falling in the "Selected Common" grade of British Columbia. It would be a manifest absurdity to specify 1,800 pounds per square inch for "Selected Common" grade and run the certain risk of material barely passing this grade being incorporated in an important structure.

A very grave defect in structural timber is spiral or diagonal grain. C. J. Hogue, field manager, West Coast Lumber Trade Extension Bureau, referring to structural material, states: "There is not much reduction in strength from cross-grain until an angle of 1 in 40 is reached. From that slope, in a beam, an angle of grain of 1 in 20 reduces the strength about one-eighth; 1 in 15, about one-fourth; 1 in 11, three-eighths; and 1 in 8, one-half. In a post or column this reduction is about one-eighth for an angle of 1 in 15; one-fourth for 1 in 11; three-eighths for 1 in 8, and one-half for 1 in 6." These conclusions are based upon experimental data determined by the United States Forest Products Laboratory, Madison, Wisconsin.

Defects in structural timber, their effect upon its mechanical properties, and safe allowable stresses for recognized grades of structural species, open up an alluring field for discussion which it is hoped may be entered upon at some future date when these subjects may be given consideration under the general caption of "Structural Timber."

Public Address Systems

A General Outline of the Principle, Equipment and Application of such a System

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The public address system is a development of the communication art. It has been developed in order to enable a speaker to address an audience of much greater size than possible without artificial means of increasing the volume of his voice.

In a small hall of poor acoustic properties, it is probable that not more than two or three hundred people could hear the speaker. With the aid of the public address system, an indoor gathering of 15,000 people have been able to hear the speaker. Ordinarily, it is difficult to speak to more than 5,000 people, either indoors or outdoors, and be heard, but by artificial means this audience can be enlarged to crowds of over 100,000, the outskirts of which may be 1,000 feet from the speaker.

Besides the public address system proper, and its general or most common use, it may be used in stations for announcing the departure of trains; on battleships for centralized fire control; in telephone work to assist the wire chief in clearing troubles in the terminal room, and in connection with wire telephony on the toll lines to enable a speaker to address audiences at distance points.

The requirements of such a system can be divided into three main parts—the " pick up " of a speaker's voice, the amplification of the " picked up " voice and projection of the amplified " pick up," so that the speaker may be easily heard by a much larger audience than otherwise possible.

The " picking up " of some of the energy from the speaker's voice in such a way that his usual actions are not unduly hampered is the first consideration. This " picked up " energy must then be converted into electrical energy of the same characteristics as that of the voice. The instrument used to perform this work of converting sound waves into electrical waves is called the microphone or transmitter.

The small amount of energy " picked up " by the microphone or transmitter must now be greatly amplified and this is done by the amplifying unit and associated equipment.

The amplified electrical energy must now be properly directed and controlled so as to be projected in the form of sound waves in such a way that the entire audience can distinctly hear what the speaker is saying and so that there will be no interference experienced by those who are near to the speaker and hear him distinctly. This is accomplished by means of loud speaking receivers and projectors, properly distributed, the function of these receivers being to convert the electric waves into sound waves.

The Transmitter or Microphone

A high quality transmitter has now been developed which permits of excellent quality speech sounds being reproduced. This transmitter consists of two carbon buttons, one on each side of the diaphragm. Distortion in one button is counteracted by distortion in the other. The diaphragm is stretched so that its natural frequency is above the range of frequencies encountered in speech and music. It is less efficient from a volume point of view than the ordinary transmitter of a subscriber's telephone set, but produces far better quality of speech or music.

The transmitter mounting consists of a drum shaped cage perforated on all sides and covered with a fine brass wire mesh. Inside are four hooks from which the transmitter is suspended by means of coil springs. Sometimes a felt lined wooden box is used for holding one or two transmitters, the transmitters being suspended in the same manner from hooks by means of coil springs. The face of the box of course has one or two openings.

Adjustable pedestals are sometimes used in connection with the transmitted mountings. The transmitter has a very uniform efficiency over the entire voice range of frequencies, i.e., from about 200 to 2,000 cycles; and it is also quite efficient as high as 5,000 cycles, which is about the practical limit required for good reproduction of musical instruments. Distortion of the voice waves is reduced considerably by the " push-pull " effect of the two carbon buttons.

The Amplifier

The usual input impedance of an amplifier may be around 200 ohms with an output impedance of 500 ohms or 2,000 ohms, depending on where the output is to be directed. If the amplifier is used in connection with long lines, an output impedance of 500 ohms will usually be required. If directly connected to three or four receivers or projectors, then a 2,000-ohm output impedance is more desirable. There are several types of amplifiers suitable for various purposes, but their general principles are the same. Large systems or systems used in connection with radio broadcasting have also transmitter control, volume indicator and volume control apparatus, in addition to the amplifier unit.

One type of three stage amplifier used in connection with a high quality microphone is capable of a maximum energy amplification of one hundred million and a minimum of one hundred. Power amplifiers used in connection with this three stage amplifier are capable of increasing the energy an additional twenty-five times. This amplification would be suitable for a large auditorium.

For large out-door gatherings a power amplifier capable of increasing the energy of the three stage amplifier three hundred times could be used.

The 32-A amplifier used in the Western Electric No. 4-A public address system consists of four stages of audio amplification. The first three stages consist of resistance coupled amplification using No. 231-D vacuum tubes. The fourth stage of amplification is obtained with the use of a transformer coupled No. 250-D vacuum tube. The filament current for the first three stages is supplied from a 12-volt storage battery or No. 6 dry cells; these tubes require only 60 milliamperes at 3.3 volts. The filament current of the fourth stage is supplied from a step-down transformer connection to the 110-volt lighting circuit. Plate current is supplied to all the stages by means of half wave rectification of the 110-volt lighting circuit and using a No. 205-D vacuum tube for this purpose, the filament of which is supplied from the alternating current source. The gain of the amplifier is controlled by means of a potentiometer which may be varied in steps of 3 T.U.* for each of the twenty-two steps. The input of the amplifier is of 200 ohms impedance while the output impedance can be made 500 ohms or 2,000 ohms.

Projectors and Receivers

A projector consists of a receiver, receiver housing and horn of one design or another, depending on what the conditions require. The amplified electrical waves are converted into sound waves by means of a receiver consisting of magnets, armature and diaphragm. The magnet and armature of this receiver combine to give a "push-pull" effect to the vibrating of the diaphragm, thus tending to minimize distortion in the wave shape and giving maximum amplitude of vibration.

The horns most commonly used for auditoriums and for small out-of-door gatherings are usually of wood fibre, about 3 feet in length and about 1½ feet at large end. Horns for large out-of-door audiences are sometimes 10 feet long and 2 feet at the large end.

The cone type loud speaker lacks the directive effect of the horn of a projector and is never used except for monitoring.

Power Equipment

For large installations, more or less permanent and elaborate means of control and power supply equipment are utilized.

Sound Transmission and Acoustics

Sound is transmitted through the air by waves and only part of the sound reaches the listener directly from the original source. The remainder comes by reflection from the walls, ceilings or other bodies in the room. In some cases this reflected sound is very small, due to the direct sound waves being absorbed by the reflecting surface. This happens when the reflecting surface is soft and yielding. If the reflection comes from a hard smooth surface this energy will form quite a large part of the total received by the listener.

An overlapping of reflections in a room or auditorium is called reverberation, while the lagging of reflections cause echoes. Some rooms have both reverberation and echo effects and in order to reduce or overcome these annoying conditions it was usually necessary to pad the room with absorbent material. Sometimes a large audience will have the same result.

Reverberation and echoes can be eliminated by the use of the public address system. The speaker can lower his voice and there is not the same opportunity for producing reverberation and echoes. The sound is carried directly where it is needed and where it will be absorbed most efficiently by the audience.

Operation

The success of a system largely depends upon the operation of the apparatus and suitable location of all units.

A local programme will probably be direct from the transmitter to the amplifier, to the projectors. For a programme from some distant point the input to the amplifier will be from a wire line. Local inputs may be picked up by means of transmitters located at different points, a means of switching to the desired transmitter being available.

Transmitters must be properly located. This is best determined by trial. They should be placed 2 to 6 feet from the source of sound in the case of speakers or soloists; facing the piano and for piano music, a little to one side of the keyboard; suspended over an orchestra and to the front, somewhat in a position nearer to the stringed instruments and bass than to others; diagonally in front of phonographs, and in all cases so placed that it will not have the sound from a projector directed toward it. Sounds from projectors entering a transmitter will cause the transmitter to "howl" or "sing."

Above all things, the audience must not experience anything unnatural in the quality of sound from the speaker. The system must operate so successfully that the audience will not realize that hearing is being mechanically aided.

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*The transmission unit, abbreviated T.U., is an arbitrarily selected unit which is used to measure gain and loss. For practical purposes it may be considered that a gain of 3 T.U. indicates that the output power at speech frequencies is approximately twice the input power at speech frequencies, a gain of 6 T.U. four times the input power, a gain of 9 T.U. eight times, etc. Conversely, a loss of 3 T.U. indicates that the output power is approximately one-half the input power, a loss of 6 T.U. one-quarter the power, a loss of 9 T.U. one-eighth, etc.

THE ENGINEERING JOURNAL

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Success and Education

From the time of its original formation as The Canadian Society of Civil Engineers, The Engineering Institute of Canada has laid stress on the importance of educational qualification as a condition for admission to its membership. Further, our records and publications, like those of other engineering societies, contain many papers, discussions and articles on Engineering Education, and there are, in fact, societies which have for their main purpose the promotion of engineering education. It is thus evident that engineers, as a body, appreciate the importance of the subject, and it is natural to inquire whether the results obtained in the way of material success are commensurate with the expense and time involved in obtaining a professional education of the highest class.

The laborious investigations of the Society for the Promotion of Engineering Education have provided us with a mass of data, from which, however, it is difficult for a reader, who is not himself an educational authority, to judge how far our present system of engineering education is really satisfactory. The individual naturally asks whether his own training has been effective in securing his present success. The employer, often a large corporation employing engineers' services, would like to ascertain whether it is worth while to give the preference to engineers who have taken an adequate professional course, or have distinguished themselves during their undergraduate career.

An interesting analysis of the situation recently appeared in Harper's Magazine, May 1928, from the point of view of the president of one of the largest industrial companies in the United States, under the title, "Does Business Want Scholars?" the information used in the article being based on the university records of over four thousand graduates from over a hundred colleges, and their success or otherwise in the company's service. These men were, of course, not all engineers, but it is interesting to note that the proportional results for the engineering graduates taken by themselves were almost exactly the same as those for the whole group studied, or for the graduates in Arts and other faculties taken separately.

In default of a better criterion, success was taken to be measured by salary, which is perhaps the best, if not the only possible gauge to be applied in studying a body of men who all work in the same business organization. The writer points out the tendency, so noticeable in the present-day undergraduate, for the student to think that his athletic or social activities, and his work on the college paper or in the dramatic club, for example, are a better training for the future than his academic course, and this is an opinion which is also held by many outside of university circles. It is, therefore, a very live question as to whether industry should seek students who have a high academic record, or should give the preference to those who have distinguished themselves at the university in athletic or social activities, and the results of the inquiry certainly have some bearing on this point. There is no question that in Law or Medicine those who have stood well in their professional classes are more likely to attain high standing in their professional work in later years, but does this hold good to the same extent in industrial or business life, and particularly in the work of engineers?

The data so far available from other sources are largely confirmed by the results of the inquiry now referred to, and there seems no doubt that it is not so much the special knowledge acquired by the men of high academic standing which makes them valuable when they leave the professional school, but the fact that they have acquired the "habit of successful mental accomplishment."

It is well known that many graduates of our engineering schools do not take up engineering after graduation, but deliberately elect to follow a non-technical or business career, and it is for this reason that Mr. Gifford's inquiry has particular interest for us. It is true that a great number of the higher positions in the Bell organization are held by men who have not gone to college, and the inquiry has not yet been extended to the scholastic and business records of these men. The conclusions drawn should, therefore, be applied only to those who have received a college education. In general it was found that the men who had taken high standing in their university courses had been correspondingly successful in the company's work, and in fact that "men in the first third of their college classes are most likely to be found in the highest third of their group in salary, those in the middle third in scholarship to be in the middle third in salary, and those in the lowest third in scholarship to be in the lowest third in salary." This applied to graduates in the service who had been over five years out of college. Further, it was found that "the longer the best students are in business the more rapidly their earnings rise. The longer the poorer students are in business, the slower their earnings rise."

"If studies by others," says Mr. Gifford, "corroborate the result of this study in the Bell System, and it becomes clear that the mind well trained in youth has the best chance to succeed in any business it may choose, then scholarship as a measure of mental equipment is of importance both to business and to business men."

Recent Progress in Oil- and Gas-Power Engineering

Twenty years ago the small power user naturally turned his thoughts to the four cycle gas-engine, often using producer gas, but the manufacture of such small and medium sized gas-engines has largely lost its relative importance since the development of gasoline and Diesel type engines. The large gas-engine holds its own where industrial gas is available as a by-product of blast furnace or steel-mill operation, and such engines under these circumstances are still the most economical generators of power, particularly in the larger sizes up to 4,000 h.p. capacity.

Of recent years the tendency of oil-engine development has been towards the increase of compression pressures, not only with the aim for higher output, but also for the sake of convenience in starting cold, and economy in operation. In gasoline engines progress in this direction has also taken place but has been limited by detonation troubles, and the problem has not yet been fully solved, even when fuels containing lead ethyl and other anti-knock compounds have been used. Higher rotative speeds are being employed, and the satisfactory results thus obtained have been largely rendered possible by the experience gained with high speed automotive and aircraft engines. It is thus probable that we are only at the beginning of a period of development of higher speed internal combustion engines.

The use of higher compression pressures has been particularly noticeable in oil-engine practice, and as a result the importance of the low compression or semi-Diesel-engine has distinctly diminished during the last few years. Much, however, remains to be done before the heavy oil-engine will become as supreme in the automotive field as it is for stationary and marine work. Perhaps the greatest progress has taken place in connection with the Diesel-locomotive, on which a great deal of work has been done in Europe, where no less than nineteen companies are engaged in the construction of Diesel-engine locomotives and railway cars. Amongst others, the Canadian National Railways have been pioneers in this line of work, and it is understood that very satisfactory operating results have been obtained from the Beardmore engines with electric transmission as fitted in their cars.

Of the many different systems of transmission which are being tried for oil-engine locomotives, the electric drive has so far had the best opportunity to prove its success, and operating experience gained in the last two years shows that the Diesel-locomotive is capable of high economy in its particular field. Considerable progress has been made in the successful employment of Diesel-engines for automotive work, largely in connection with trucks, and great efforts are being made by various governments to develop the heavy-oil compression-ignition engine so that its engine weights may be brought down to figures comparing favourably with those of gasoline engines; success in this direction will mean much to the aircraft and automobile designer. It is understood that heavy-oil engines are being used in one of the two great airships of five million cubic feet capacity now being constructed by the British Government.

In high power Diesel-engines, the principal field of employment is now at sea, Lloyd's figures for last year showing over 1,000,000 h.p. of oil-engines under construction, as against about 900,000 h.p. of steam machinery. The largest cylinder output so far obtained, (from an experimental one-cylinder engine), is 2,900 indicated h.p., but in multi-cylinder engines several are working successfully while developing 1,200 h.p. per cylinder.

It seems an established fact that unless favoured by local conditions the Diesel-engine cannot compete with steam and water turbines for large power generating units. Their combination, however, with steam and water power for peak use offers decided advantages.

The successful operation of Diesel-engines depends so largely on good design, and particularly on accurate workmanship of a high grade, that it is not surprising to find more and more engineering skill applied to their production. Careful and elaborate finishing methods are found to bring good results, and such expensive operations as the grinding and honing of cylinders and lapping of pump plungers and valve seats have proved worth while.

As in the case of aircraft and automobile work it has been necessary to devise and manufacture a number of special accessories, and the development of the heavy-oil engine has accordingly led to the construction of satisfactory air and oil filters, supercharging blowers, distant-reading thermometers, and high-speed indicators. The development of supercharging has been a particularly interesting feature, in some cases the rating of a four-cycle engine being increased no less than fifty per cent by the adoption of this device.

So far as economy is concerned, considerable progress is to be noted, a fuel consumption of less than four-tenths of a pound of oil per B.H.P. per hour having been recorded.

One of the principal handicaps to the successful use of heavy-oil high-compression engines for commercial work is being gradually removed owing to the availability of more trained men. A skilled operator, familiar with Diesel work and practice, is just as necessary for success as a competent man would be in a steam-plant. There seems every reason to anticipate further continued and satisfactory development in heavy-oil power engineering.

OBITUARIES

Alexander Charles Dogherty, A.M.E.I.C.

It is with regret that we record the accidental death by drowning on August 10th, 1928, of Alexander Charles Dogherty, A.M.E.I.C., in Brome lake, Quebec, where he was spending his vacation with his family.

The late Mr. Dogherty was born in Montreal on September 6th, 1891. At the age of seventeen he entered the employ of the Northern Electric and Manufacturing Company and spent two years in their shops and drafting room. This was followed by a year with the Allis-Chalmers Bullock Company at Rockfield, Que., on the erection and drafting connected with switch-boards. During his early years he successfully completed a course in electrical engineering with the International Correspondence Schools at Scranton, Pa.

In February 1911 he joined the staff of T. Pringle and Son, Limited, of Montreal, engineers and architects, with whom he was connected until the time of his death, with the exception of the years he spent overseas with the C.E.F. and part of 1918 in Three Rivers, Que., when his services had been loaned to the Wayagamack Pulp and Paper Company for the reorganization of their electrical equipment.

In 1914 he designed and supervised the construction of pumping and electrical equipment for the Corby Distillery Company at Corbyville, Ont. Towards the end of the year he enlisted in the C.E.F. and in 1915 went overseas with the 27th Battery, C.F.A. Severely wounded at the battle of the Somme in 1916 he underwent thirteen operations before being returned to Canada in 1917. Upon resuming his connection with T. Pringle and Son, Limited, he spent eight months as resident engineer for them on an hydro-electric development at Coaticook, Que., for Penmans Limited. From 1919 until the time of his death he had charge of the electrical, mechanical, heating and ventilation work for this firm.

Mr. Dogherty joined The Institute as an Associate Member in May 1925. The news of his untimely end will be learned with regret by his many friends and business associates by whom he was held in the highest regard.

Hugh David Lumsden, M.E.I.C.

The death of Hugh David Lumsden, M.E.I.C., at Orillia, Ontario, on Wednesday, August 29th, 1928, at the age of eighty-four, takes from among us a prominent member of the band of engineers who, in the seventies and eighties, did the pioneer work on the great railway transportation systems of this country. With the exception of Prince Edward Island there is not a province in Canada in which he did not contribute to the upbuilding of the country.

Born on September 7th, 1844, at Belhelvie Lodge, Aberdeenshire, the youngest son of Colonel Thomas Lumsden, C.B., he belonged to a family whose members distinguished themselves in many parts of the world and in many spheres of activity. In India his eldest brother, General Sir Harry Lumsden, raised the Queen's Own Corps of Guides, (Lumsden's Guides), in 1846 for service on the North West Frontier, and clothed that famous corps in khaki, introducing for the first time the uniform which was later adopted throughout the Indian Army and in almost every army in the world. Another brother, General Sir Peter Lumsden, rendered important services on the Afghan Boundary; another, William, was killed at the gates of Delhi during the Indian Mutiny. Another, John Lumsden, came to Canada, settling at Galt, of which city he was mayor, and represented that constituency in the old Legislature of Upper Canada.

HUGH DAVID LUMSDEN, M.E.I.C.

Hugh David Lumsden received his early education in Aberdeen and at Wimbledon, coming to Canada in 1861. He served his time as Provincial Land Surveyor at Woodville, Ontario, and was admitted to practice as such in January 1866. From 1866 to 1870 he was in private practice as a Provincial Land Surveyor at Woodville.

In 1870 he was elected Reeve of the township of Eldon in Victoria County. In 1871, under Edmond Wragge, M.E.I.C., he had charge of the location of the Toronto and Nipissing Railway, through Orillia, Gravenhurst and northward. From this time onward he was almost continuously employed in the location or construction of railways. To mention but a few of these: Portions of the Credit Valley Railway; Toronto, Grey and Bruce; the Georgian Bay Branch of the Canadian Pacific Railway; location and construction of the Ontario and Quebec Railway; Toronto to Perth; and the Canadian Pacific Railway, Smith's Falls to Vaudreuil, St. Johns, Que., to Lennoxville, Holeb to Mattawamkeag, and Rigaud to Ottawa. In the west he was for a short time on some of the first surveys for the Canadian Pacific Railway. Later he was supervising engineer for the location and construction of the Qu'Appelle, Long Lake and Saskatchewan Railway; the Calgary to Edmonton Railways; and was locating engineer on the Crow's Nest Pass Railway, Kootenay Landing to Lethbridge.

On the commencement of the National Transcontinental Railway in 1904, he was appointed chief engineer, which position he held until 1910. By this date the location and much of the construction was completed, but being unable to agree with the policy of the commission of that time, he resigned. He carried on some consulting practice for a number of years, but after 1914 did little active engineering work. In this connection it is of interest to note that from 1861 up to the day of his death, he never failed to write up his diary. Throughout his life he was a keen fisherman and an excellent shot. He also made a hobby of photography, and many of his pictures of the west in the early days are of historical interest.

In 1887 he joined The Canadian Society of Civil Engineers, now The Engineering Institute of Canada, serving on the Council for some years, becoming a vice-president in 1898 and president in 1906. He was for many years a Member of the Institution of Civil Engineers (Great Britain).

In 1885 he married Mary Whitney, of Toronto, who died in 1926. He leaves four sons, the eldest, Hugh Allan, being County Engineer of Wentworth; Harry Bruce, Assistant Director of Development, Canadian Pacific Railway, Winnipeg; Gordon Leith, with Robins Ltd., Toronto; and Peter Vernon, in Bagdad, Mesopotamia.

Hugh David Lumsden was almost the last survivor of the engineers who were responsible for the original formation of The Canadian Society of Civil Engineers, of which he was a charter member. In addition to great technical skill in his profession, he was characterized by a keen sense of honour, and a markedly independent spirit. The loss of such a man leaves a vacant place in the ranks of The Institute which cannot readily be filled.

PERSONALS

C. A. W. Grierson, S.E.I.C., has accepted a position with the Bell Laboratories, Inc., in New York City. Mr. Grierson, who formerly resided at Weymouth, N.S., is a graduate of Dalhousie University of the year 1925.

W. C. Macdonald, A.M.E.I.C., secretary-treasurer of La Societe Generale de Ponts et Chaussees, Limitee, at Montreal, is at present located at the company's office at Kingston, Jamaica.

V. E. North, S.E.I.C., is at present attached to the apparatus sales department of the Canadian General Electric Company, Limited, at Toronto. Mr. North was formerly attached to the company's Montreal office.

B. H. Zwicker, S.E.I.C., has joined the students' course of the Canadian General Electric Company, at Peterborough, Ont. Mr. Zwicker graduated from the Nova Scotia Technical College with the degree of B.Sc. this spring.

G. W. Babbitt, S.E.I.C., formerly of Fredericton, N.B., is at present located at Peterborough, where he is taking the students' course at the plant of the Canadian General Electric Company. Mr. Babbitt graduated from the University of New Brunswick in 1928, with the degree of B.Sc.

Cecil Brain, S.E.I.C., who graduated from McGill University in the spring of this year with the degree of B.Sc., is now a member of the staff of the International Paper Company at Corner Brook, Newfoundland.

L. McGill Allan, A.M.E.I.C., who has been local manager for Wells and Gray, Limited, general contractors, Windsor, Ontario, for the past fifteen years, has organized a company to carry on a similar business, with Charles Earl, under the name of Allan and Earl Limited.

Sheldon W. Coleman, S.E.I.C., formerly of Montpelier, Vermont, is at present located in Montreal, having joined the staff of John S. Metcalf Company, Limited. Mr. Coleman graduated from McGill University in the spring of this year, with the degree of B.Sc.

R. P. Freeman, A.M.E.I.C., who was construction engineer with the International Paper Company at Three Rivers, Que., is now at Dalhousie, N.B., where he will be located with the International Paper Company for a year or more.

C. A. Wakeham, S.E.I.C., is now taking a student course with the Canadian Westinghouse Company at Hamilton, Ontario. Mr. Wakeham graduated from the University of New Brunswick in the spring of this year with the degree of B.Sc.

George F. Binns, S.E.I.C., has been appointed to the engineering staff of the Canada Starch Company, Limited, Montreal. Mr. Binns is a graduate of McGill University of the year 1923, and was until lately mechanical draughtsman with the Laurentide Company, Limited, at Grand'Mere, Que.

C. C. Langstroth, A.M.E.I.C., has been appointed flying instructor for the Saint John, N.B., Aero Club. Mr. Langstroth, who is on the staff of the Atlantic Sugar Refineries Limited, and a graduate of McGill University of the year 1921, has had considerable previous experience in flying while instructor at one of the training schools of the Royal Flying Corps, in England, during the War.

W. L. Mackenzie, A.M.E.I.C., has resigned his position as assistant engineer on the Welland ship canal at St. Catharines, Ont., to become designing engineer on the new Hudson Bay terminus which the Department of Railways and Canals is erecting at Fort Churchill, Man. Mr. Mackenzie, who is a graduate of McGill University of the year 1917, had been on the staff of the Welland ship canal since 1921, first as senior draughtsman and from 1923 to the present time as assistant engineer.

John Lee, A.M.E.I.C., has been appointed works manager of the Winnipeg shops of the Canadian Pacific Railway Company. Mr. Lee has been connected with the Canadian Pacific Railway Company since 1911, when he joined the staff as assistant foreman. He became assistant shop engineer, and later shop engineer, and in 1920 was promoted to the position of engineer of tests and chief draughtsman at the Canadian Pacific Railway depot, mechanical department, at Winnipeg, which post he has held up to the present time.

K. O. Elderkin, Jr.E.I.C., is now chief engineer of the new Mersey Paper Company at Liverpool, N.S. Following his graduation from McGill University in 1920, Mr. Elderkin joined the staff of the Nova Scotia Steel and Coal Company Limited, New Glasgow, N.S., as draughtsman, later being on the staffs of the St. Lawrence Paper Mills at Three Rivers, Que., and of Price Brothers and Company Limited at Kenogami, Que. In 1925 he accepted the position of assistant chief engineer with the Abitibi Power and Paper Company at Iroquois Falls, Ont., with which firm he remained up to the time of his present appointment.

Wing Commander L. S. Breadner, A.M.E.I.C., has returned from London, England, where he was attached to the Royal Canadian Air Force at the Air Ministry, and is at present in Ottawa at the headquarters of the R.C.A.F. During the Great War he served continuously in the Royal Naval Air Service and the Royal Air Force, having joined the former as Flight Sub-Lieutenant. He was discharged with the rank of Major in April 1919, and was appointed to the Air Board in Canada in April 1920 and has been with the Air Board and Royal Canadian Air Force since that date.

J. A. MacGillivray, A.M.E.I.C., until recently resident engineer for the Manitoba Power Company, Limited, at Great Falls, Man., is now construction engineer at Point du Bois, Man. Mr. MacGillivray was previously located at New Glasgow, N.S., but was also for a number of years in Manitoba on various engineering works, including sewer construction, bridge work in connection with the highways system of the province and power house construction for the city of Winnipeg. He was later on the staff of the Manitoba Public Utilities Valuation Board, engaged on work in connection with the Winnipeg Electric Railway.

Frank O. White, M.E.I.C., who, since the establishment of the St. Lawrence Paper Mills in 1922, had been chief engineer of the plant in Three Rivers, Que., left on September 1st to assume the duties of chief engineer for the Fraser Companies, having his headquarters at Edmundston, N.B. Mr. White, who is a graduate of the University of Maine of the year 1905, was formerly chief engineer of the Kipawa Company, Limited, at Temiskaming, Que., and of the Brompton Pulp and Paper Company, Limited, at East Angus, Que., and prior to his accepting the appointment with the St. Lawrence Paper Mills in 1922, was located at Orone, Maine.

G. H. Burchill, Jr.E.I.C., is leaving the employ of the Canadian General Electric Company, at Peterborough, Ont., to assume the position of assistant professor of electrical engineering at the Nova Scotia Technical College, Halifax, N.S. Mr. Burchill has been connected with the Canadian General Electric Company since he graduated from the Nova Scotia Technical College with the degree of B.Sc., in 1923, being attached to the testing department during 1923 and 1924, and assistant engineer in the alternating current engineering department from 1924 to the present time. Mr. Burchill was overseas with the Canadian Artillery from May 1917 to May 1919.

N. H. Kearns, A.M.E.I.C., is now connected with the International Nickel Company at Copper Cliff, Ont. On graduation from the University of Toronto in 1919, Mr. Kearns became assistant to the city engineer of Niagara Falls, Ont. In 1920 he went to Brazil as field and office engineer with the Sao Paulo Electric Company at Sorocaba Falls on the erection of a 50,000-h.p. hydro-electric plant, and later became construction engineer in charge of construction of an additon to the same plant. In May 1925 he became attached to the Chile Exploration Company at Chuquicamata, Chile, where he was first assistant superintendent of construction and later general superintendent of construction on a $15,000,000 extension to the reduction plant of the company.

G. Alan Johnson, A.M.E.I.C., joins Sawyer-Massey

G. Alan Johnson, A.M.E.I.C., has been appointed recently to the staff of the Sawyer-Massey Company. On graduating from McGill University in 1912, Mr. Johnson was for a time employed on the design of hydro-electric power developments in Ottawa, and 1913-14 he was resident engineer on the construction of a dam and log slide at High Falls on the Lievre river near Buckingham, Que. The following year Mr. Johnson was resident engineer for the Amburson Hydraulic Construction Company on a storage dam built for the Hydro-Electric Power Commission of Ontario at Eugenia Falls, Ont. In 1915 he was employed by the Robert Mitchell Company Limited for the equipping and manufacturing of 4.5 shell parts, gauges, etc., and from 1916 to 1918 he was with the C.E.F. as a lieutenant in the 11th Field Company, Canadian Engineers. From March 1918 up to the present time Mr. Johnson has been factory manager for the Robert Mitchell Company, Limited.

H. L. Cairns, A.M.E.I.C., now connected with Canadian Pacific Railway Company

H. L. Cairns, A.M.E.I.C., who was formerly engaged in private practice at Shaunavon, Sask., is at present resident engineer on construction with the Canadian Pacific Railway Company at Cardston, Alta. Mr. Cairns came to this country from Scotland in 1910 and from that time to 1915 he was connected with the Canadian Pacific Railway Company as topographer and draughtsman on location and draughtsman and instrumentman on construction. In 1915, he enlisted as a sapper in the Royal Engineers, was commissioned in 1916, served in France with the 205th and 83rd Field Companies, and in 1918 was an instructor in military engineering to N.C.O. classes, and O.C. training D Company, Royal Engineers, Newark Training Centre. From September 1918 to July 1919, Mr. Cairns was with the North Russian Expeditionary Force on construction and maintenance of roads and bridges, and for two months was Acting O.C. with the Royal Engineers, (Dvina Force). On his return to Canada in 1920 he again became connected with the Canadian Pacific Railway Company.

J. A. H. WHITFORD, Jr.E.I C.

J. A. H. Whitford, Jr.E.I.C., Awarded Prize

J. A. H. Whitford, Jr.E.I.C., architectural draughtsman with the Canadian National Railways, Moncton, has been advised that he is a prize winner in the competition offered by Lord Beaverbrook to architects submitting the best designs for the new Lady Beaverbrook Residency at the University of New Brunswick, Fredericton. This contest was open to architects from Halifax to Vancouver, many of whom competed for the substantial cash prizes offered. Mr. Whitford, together with a well-known firm of Saint John architects, was bracketed for second prize, and his success is all the more remarkable in that his design was prepared entirely during spare time.

A. I. Cunningham, A.M.E.I.C., becomes Resident Engineer, N.B. International Paper Company

A. I. Cunningham, A.M.E.I.C., has recently accepted the position of resident engineer with the New Brunswick International Paper Company at Dalhousie, N.B. On graduation from McGill University in 1914, Mr. Cunningham was for a year with the Bathurst Lumber Company as instrumentman, following which he was on the staff of the Grand Trunk Railway on surveys and design of car sheds at Port Huron, Mich., 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, Que., 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 became attached to the Moreau Manufacturing Corporation, 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 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.

Charles A. Magrath, M.E.I.C., reappointed Chairman of the Canadian Section of the International Joint Commission

Charles A. Magrath, M.E.I.C., has been reappointed chairman of the Canadian section of the International Joint Commission. Mr. Magrath will retain the chairmanship of the Ontario Hydro-Electric Power Commission, to which office he was appointed in 1925 in succession to the late Sir Adam Beck. Mr. Magrath's professional experience has been varied and to a marked degree of a public nature. In early days he practised the profession of land surveyor in the North West Territories, holding the titles of Provincial and Dominion Land Surveyor and Dominion Topographical Surveyor. He was land agent for the Alberta Railway and Coal Company and later played an important part in the development of the sub-arid districts of Southern Alberta as manager of the Canadian North West Irrigation Company. Mr. Magrath entered politics in 1891 as member for Lethbridge, holding the post of minister without portfolio in the Haultain Ministry in Saskatchewan from 1898 to 1901. He also represented Medicine Hat in the House of Commons from 1908 to 1911. From 1911 to the present date Mr. Magrath has occupied with distinction the chairmanship of the Canadian section of the International Joint Commission. This body, which has dealt with many important international questions, such as the Lake of the Woods levels and the St. Lawrence deep waterways schemes, owes much to his indefatigable energy and executive ability.

Norman D. Wilson, M.E.I.C., receives Appointment with Advisory Town Planning Commission, Toronto

Norman D. Wilson, M.E.I.C., has been appointed general director of the Advisory Town Planning Commission for Toronto. Mr. Wilson, who is a member of the firm of Wilson, Bunnell and Borgstrom, Limited, consulting engineers and town planners, Toronto, is a graduate of the University of Toronto of the year 1904. After graduation Mr. Wilson spent four years on railway location and construction and Dominion land surveys, but in 1908 he formed a partnership with Mr. J. C. Gardner at Niagara Falls, Ontario, and for a time was engaged in municipal work in the Niagara peninsula. From 1910 to 1912 he was engaged in private practice as a land surveyor in Toronto, and in February 1912 he was appointed engineer of surveys and lands for the Toronto Harbour Commission, which position he held until 1923. In 1915 Mr. Wilson was on the staff of the Civic Transportation Committee in its study of the general transportation in the city, particularly with regard to the question of radial entrances into the city. When the Toronto Transportation Commission was formed in 1920, Mr. Wilson's services were requested to assist in the investigation preliminary to taking over the Toronto Railway, later being appointed engineer of traffic study. In June 1923, when he resigned from the Harbour Commission, he joined A. E. K. Bunnell, M.E.I.C., in partnership as engineers and city planning consultants, and two years later the firm became Wilson, Bunnell and Borgstrom, Limited.

Additional Vice-Presidents for Canadian Westinghouse

H. U. Hart, M.E.I.C., has been appointed vice-president and chief engineer, and George R. Kerr, vice-president and treasurer, of the Canadian Westinghouse Company Limited, according to an announcement made by Paul J. Myler, president of the company.

In 1893 Mr. Hart enrolled as a student-apprentice of the Westinghouse Electric and Manufacturing Company at Pittsburgh. His advancement in the different branches of the works and engineering department was rapid, and in 1899 he was sent to the French Westinghouse Company as designing electrical engineer, and was later appointed chief engineer. During this period Mr. Hart had charge of the design of some very large generators then being built for water power developments in France and Italy.

H. U. HART, M.E.I.C.

In 1905 he was secured by the Canadian Westinghouse Company as chief engineer, which position he has held for the past twenty-three years, where his guidance in engineering and manufacturing has contributed to the remarkable growth of this organization.

Mr. Hart's executive ability resulted in his appointment as general manager in 1923. He has established many new lines of manufacture, such as radio, electric ranges and improvements and larger ratings of generators, motors, transformers and other applications of electricity to various industries.

Mr. Hart is a Fellow of the American Institute of Electrical Engineers.

Mr. George R. Kerr was one of the original members of the Westinghouse Manufacturing Company Limited, manufacturers of air brakes, and destined to hold later on one of the most important positions in the entire electrical industry. When the Canadian Westinghouse Company Limited was organized in 1903, Mr. Kerr was placed in charge of the accounting end of the business and has been identified with the remarkable progress made by this company since its inception.

Mr. Kerr's appointment as treasurer dates back upwards of ten years, and throughout that period his advice and insight into the future possibilities of Canadian electrical development and prosperity have undoubtedly had a great influence on the enterprise and leadership for which the Canadian Westinghouse Company is famous.

During his service as an officer of the company vast amounts of capital have been required for the undertakings of this large industry, and his foresight, executive ability and control of the assets and finances have contributed much to the fact that the Canadian Westinghouse Company Limited experienced no financial difficulties during the post war period and finds itself today one of the largest and most successful enterprises in the Dominion.

Meeting of Council

Meeting of September 11th, 1928

A meeting of Council was held at 8 o'clock p.m. on Tuesday, September 11th, 1928, Past-President A. R. Decary, M.E.I.C., in the Chair, and six other members of Council being present.

The minutes of the meeting held on June 15th, 1928, were taken as read and approved.

The Financial Statement of The Institute for the period ending August 31st, 1928, was submitted and approved.

The Nominating Committee's report was presented, and was held over for consideration at the Plenary Meeting of Council.

The membership of the Gzowski Medal Committee was approved as follows: W. G. Mitchell, M.E.I.C., Chairman; Messrs. O. O. Lefebvre, M.E.I.C., F. C. Laberge, M.E.I.C., Ernest Brown, M.E.I.C., and W. C. Adams, M.E.I.C.

The attention of Council was drawn to the desirability of further publicity with regard to the new regulations for the Past-Presidents' Prize, and the Secretary was directed to make a further announcement regarding this matter in the publications of The Institute, and also to draw the attention of all members to the fact that the subject selected for the first award of the prize for 1928-1929 is Engineering Education.

It was noted that S. G. Porter, M.E.I.C., has accepted the chairmanship of the Committee on the Relations of The Institute with the Provincial Professional Associations, and that an interim report from this committee may be expected in time for the Plenary Meeting of Council. A resolution passed at the last meeting of the Association of Professional Engineers of the Province of Alberta was communicated to the Council and the appointment of a committee by that Association to study this question was noted with appreciation.

P. L. Pratley, M.E.I.C., chairman of the Committee on Standard Forms for Construction Contracts, presented an interim report, and a resolution passed by the Royal Architectural Institute of Canada regarding this matter was also presented and noted.

A tender and preliminary design for the Sir John Kennedy Medal was submitted and the design approved.

Council noted with deep regret the death of Hugh David Lumsden, a Charter Member, which took place on August 29th, 1928, and the following resoution was unanimously passed:—

"The death of Hugh David Lumsden removes from the membership list of The Engineering Institute of Canada almost the last of those whose efforts resulted in the formation of the Canadian Society of Civil Engineers in January 1887.

For many years a member of Council, he was President in 1906, and took a prominent part, not only in the affairs of The Institute, but also in the construction and development of the railways of the Dominion.

His professional eminence and the wealth of experience acquired during his long life indicate the loss which The Institute now sustains, and the Council desires to place on record its deep regret, and to convey to the members of his family its condolence with them on their bereavement."

A letter was read from Hugh A. Lumsden, M.E.I.C., expressing appreciation to Council for the floral tribute received.

J. B. McRae, A.M.E.I.C., reported that he had represented The Institute at the C.E.S.A. conference on the Standardization of Fire Hose Connections, at which meeting it was unanimously decided that a C.E.S.A. committee be appointed to go into the question. The Council approved this decision, thanked Mr. McRae, and will welcome any progress made towards standardization of fire hose connections in Canada.

A complimentary copy of a brief history of the Institution of Civil Engineers, with an account of the Charter Centenary Celebrations of June 1928, was received, and the Secretary was directed to acknowledge receipt of this to the President and Council of the Institution.

A letter was received from the Administrator of the House of Chemistry, Paris, erected as a monument to the honour of the illustrious chemist, Marcelin Berthelot, requesting that The Engineering Journal and the publications of The Institute might be given for the Library which is being established in connection with this House of Chemistry; it was unanimously resolved that this request be granted.

A letter was submitted from Colonel Leonard's secretary expressing to Council his appreciation of the honour conferred upon him in the award of the Sir John Kennedy Medal.

Eight special cases were dealt with, six resignations accepted, and one reinstatement was effected.

The committee appointed to open the ballot on July 18th, 1928, reported that it had been duly opened and the following elections and transfers effected:—

Elections		Transfers	
Members	1	Student to Assoc. Member	1
Associate Members	2	Student to Junior	3
Juniors	2		
Affiliate	1		

Twelve students were admitted.

Twenty-four applications for admission and transfer were scrutinized and classified for the ballot returnable October 15th, 1928.

The Council rose at 10:45 o'clock p.m.

BOOK REVIEWS

Probability and Its Engineering Uses

By T. C. Fry, D. Van Nostrand Company, New York, 1928, buckram, 6½ x 9¼ in., 500 pp., diagrs., $7.50.

The word probability suggests to most of us the kind of question primarily interesting to gamblers rather than engineers—how likely is it that a certain event will occur when coins are tossed, dice are thrown, or cards dealt. To the uninitiated it is a revelation to find that the subject has wide ramifications, and that its mathematical treatment has an important practical bearing on many phases of our daily life and industry, a fact amply demonstrated by Dr. Fry's book. The work is not one designed for the casual reader, and its scope may be judged from some of the topics mentioned in its problems and section headings. The design of locks for master-key systems, the probable percentage of defective lamps in a shipment, only a portion of which have been inspected (and many other questions concerning the testing of factory output), the distribution of velocities in the molecules of a gas, the amount of dog-biscuit (or other given commodity) which a store should stock on Monday mornings in order not to lose more than one sale per hundred during the week, the results to be expected from advertising, are examples taken at random.

An important section deals with problems of congestion, particularly as regards telephone exchange operation and telephone engineering. Dr. Fry's book was, in fact, the outgrowth of the mathematical work he has carried out for the Bell Telephone Laboratories, for telephone service requires the solution of many problems for which the theory of probability and its applications must be employed.

For the engineer of sufficient mathematical training the volume can be recommended as a mine of information on a somewhat abstruse but important subject.

Solubilities of Inorganic and Organic Compounds

A. Seidell, Volume 2, D. Van Nostrand Company, New York, 1928, buckram, 6 x 9½ in., 1,569 pp., tables, $8.00.

This volume forms a supplement to the second edition and contains data published during the years 1917-1926. It is essentially a work of reference, and contains a large amount of clearly tabulated data regarding the solubilities of all the familiar chemical compounds and many of the more unusual ones. The sources of information are stated in each case, and there is an index of authors as well as a subject index.

American Chemistry

By Harrison Hale, Second Edition, D. Van Nostrand Company, 1928, buckram, 5½ x 8 in., 255 pp., plates, $2.50.

The author's principal object has been to call attention to the fundamental importance of chemistry in the development of the world today, particularly referring to the "record of the American chemist." The book is not a lengthy one, and is intended for students in science as well as for the general reader. Topics such as sanitation, food, fertilizers, textiles, fuels, paints and varnishes, rubber, electrochemistry, and others are succinctly treated, each chapter being followed by a list of references for more extended study. The work can be recommended as a source of general information and an incentive to further enquiry on the part of the reader.

Théorie Calcul et Construction des Cheminées D'usine

By E. Lefon, Librairie Polytechnique Ch. Béranger, Paris, 1928, Buckram, 6 x 9½ in., 176 pp., diagrs., $2.25.

The author has written many papers on the design of chimneys, either as contributions to scientific reviews or to technical societies, and the present book is a development of his previous studies.

The treatise begins with a brief review of the various empirical formulæ, points out their deficiencies in neglecting important factors and suggests that although they were sufficiently accurate for small and simple grates, the industrial developments of today require a better analysis of the phenomena.

After a general exposition of the principles upon which the design of chimneys should be based, the author proceeds to analyze the various theories of design that have been put forward, seven chapters being devoted to the analysis of as many theories. He then continues by expounding his own theory, which takes into consideration both the maximum velocity and the temperature of gases. The whole problem lies in the determination of the maximum possible velocity of the gases.

Chimneys of the same capacity may vary widely according to the formulæ used, and the author discusses an example of chimneys used for 50-ton Martin furnaces, varying in the ratio of 3½ to 1 in section. Such errors have led to the use of forced draft, which uses about one per cent of the coal burnt on the grates.

Boilers with numerous changes of direction of gases are detrimental to good draft. The ideal boiler would provide a straight path to the gases with an increasing velocity towards the stack. In practice all the variations of section and of direction should be smooth and gradual. Sections of flues should not be constant, the velocity varying with the distance from the grate.

The next chapter deals with the stability of chimneys. The effect of wind and also earthquakes is considered, and the regulations in force in France and Germany are discussed.

Practical details of the building of chimneys are next given. Materials used in their construction are compared as to cost, durability, stability, maintenance, etc.

A comparative study of the merits of natural and mechanical drafts is presented at the end of the book, and the author believes in the superiority of the natural draft.

This book gives good and easy methods of chimney construction, based on scientific principles and on good practice. It should prove valuable to the student who wishes to acquire a general knowledge of the methods used in designing chimneys. It is equally interesting to the technician who wants a practical and sound method of economical construction.

Armand Circé,
Professor of Strength of Materials,
Ecole Polytechnique, Montreal.

Ice Engineering

By Howard T. Barnes, M.E.I.C., Renouf Publishing Company, Montreal, 1928, buckram, 6 x 9½ in., 364 pp., figs., tables, diagrs., $5.00.

This work may be regarded as an amplification of the author's former book on Ice Formation, with the addition of accounts of his more recent work and investigations on river and sea ice. It treats of a multitude of topics connected with the formation and destruction of various types of ice, and the difficulties to which they give rise in connection with the engineering work and navigation on our streams and lakes and at sea.

Some of the material presented has been previously published in various technical papers, but Dr. Barnes now gives collected accounts of the various methods which he has employed in his so-called "ice remedial work." The later portion of the book contains a statement of his views in connection with the conservation of heat in lakes and rivers for ice prevention, and the possible employment of this principle for the improvement of navigation in such channels as the St. Lawrence, above Montreal.

The volume includes much useful information on the physical constants of ice and water, and on the tests which have been made on the physical strength and structure of various types of naturally formed ice.

Those interested in ice navigation will find collected in chapter VIII many particulars connected with the dimensions, design and operation of ice-breaking steamers. A full and detailed bibliography adds to the utility of the work.

The Geology of Petroleum and Natural Gas

By E. R. Lilley, D. Van Nostrand Company, New York, 1928, buckram, 6 x 9½ in., 524 pp., figs., tables, diagrs., $6.00.

Interest in this subject has recently increased greatly in Canada, owing to the development of the Alberta oil fields, and the commencement of commercial production in the Turney valley. Much of the information available regarding the geology of petroleum and natural gas is scattered and contained in technical papers and reports, and is therefore not in an easily accessible form for reference. A book like the volume under review is therefore welcome, for it not only presents basic information on the properties of petroleum and its allied products, and the theories regarding the origin of petroleum, but covers the essential geological conditions limiting the occurrence of oil.

Geologic history and the occurrence of oil, the various types of folded and faulted structures, salt core structures, and the effects of sedimentation and folding are adequately treated, and the utility of the book is greatly increased by the inclusion at the end of each chapter of a selected bibliography stating the sources of additional information, should this be desired in connection with any particular point.

The book can be recommended as a useful reference work for engineers and others connected with the petroleum industry.

A Treatise on Chemical Engineering

By G. Martin, Crosby, Lockwood & Son, London, 1928, buckram, 7 x 10 in., 448 pp., figs., tables, diagrs., $15.75.

This book represents a serious attempt to gather into one volume a large amount of data and information regarding the flow of fluids. It will receive a real welcome from those who, having had to deal with the problem of handling large volumes of gases on a works scale, have had difficulty in locating quickly the necessary formulæ and, what is more important, in reconciling divergent results.

The book commences with a series of calculations of volumes of air supply to cement kilns as an example of many similar industrial operations. A series of tables relating to the pressures and volumes of various gases are given.

Chapters II to VI deal with the measurement and calculations of the speed and quantities of gases. A very complete description with illustrations is given of the Pitot tube method for determining these factors.

Chapters VII to XIV deal with viscosity and friction, and include a discussion on the behaviour of gases flowing in pipes at different speeds.

Chapters XV and XVI give details of pressure heads and calculations of horse-power as an introduction to several chapters on Bernoulli's theorem followed by a description of Venturi meters.

The remainder of the book contains chapters on the discharge and flow of gases, etc., a description of the various meters in ordinary use, a series of tables of the volumes and weights of gases, and a discussion of the rate of fall of particles in moving fluids. The last chapter is devoted to calculations on the pneumatic transport of granular materials.

As will be seen, the book is comprehensive and is probably the first to gather into one volume such a large mass of theoretical and practical data. One criticism might be offered in connection with the tables in chapter XXIX, which do not include figures for sulphur dioxide. In view of the extensive use of this gas in the chemical industry, it might well be included in future editions.

Of interest to Canada is the dedication of the book to Sir Percy Girouard, a Canadian and an Honorary Member of The Institute.

W. H. DeBlois, M.E.I.C.,
Engineer, Chemical Division,
The Mond Nickel Company, Limited.

Recent Additions to the Library

Proceedings, Transactions, etc.

Presented by the Societies:
- The Mining Institute of Scotland: Transactions, 1928.
- The American Concrete Institute: Proceedings, 1928.
- The American Institute of Electrical Engineers: Transactions, 1928.
- The South of Wales Institute of Engineers: Proceedings, 1928.
- The Society of Naval Architects and Marine Engineers: Transactions, 1927.
- The Society of Engineers: List of Members, 1928.
- The Brooklyn Engineers' Club: Proceedings, 1928.
- The Institution of Civil Engineers of Ireland: Transactions, 1926-27.
- The Liverpool Engineering Society: Transactions, 1928.
- The Institution of Mechanical Engineers: List of Members, 1928.
- The Corporation of Professional Engineers of Quebec: List of Members, 1928.
- The American Railway Engineering Association: Proceedings, 1928.
- The Institution of Mining and Metallurgy: Transactions, 1926-27.
- The Royal Society of Canada: Transactions, 1928.

Reports, etc.

Department of Trade and Commerce, Canada:
- Bureau of Statistics: Census of Industry, 1926; Summary of Trade in Canada; the Canada Year Book, 1927-28.

Department of Labour, Canada:
- Report on Organization in Industry, Commerce and the Professions in Canada, 1928.

Department of the Interior, Canada:
- Dominion Water Power Branch: Interim Report of the Special International Niagara Board.

Hydro-Electric Power Commission, Ontario:
- Its Origin, Administration and Achievements; Annual Report, 1927.

Department of Mines, Ontario:
- Annual Report, 1927; Bull. No. 65, Mineral Production of Ontario, 1928.

Association of Land Surveyors, Ontario:
- Annual Report, 1928.

Department of Public Works and Labour, Quebec:
- Legislation and Regulations Respecting Industrial Establishments in the Province of Quebec.

Department of Lands, British Columbia:
- Practical Information on Irrigation for British Columbia Water Users.

Vancouver Harbour Commission, British Columbia:
- Annual Report, 1927.

Quebec Harbour Commission, Quebec:
- Annual Report, 1927.

Montreal Harbour Commission, Montreal:
- Annual Report, 1927.

Department of Commerce, United States:
- Bureau of Standards: No. 1, Journal of Research.
- Bureau of Mines: Mineral Resources of the United States, 1925.

Ohio State University Studies:
- Engineering Series: Bull. No. 41, Transmissive Power and Stretch of Belting; Bull. No. 39, Highway Subsoil Investigation in Ohio.

Sewerage and Water Board, New Orleans:
- Semi-Annual Report, 1927.

Technical Books, etc.

Presented by the Author:
- Ice Engineering, by H. T. Barnes.

Presented by D. Van Nostrand Company:
- Fixation of Atmospheric Nitrogen, by F. A. Ernst.
- Geology of Petroleum and Natural Gas, by E. R. Lilley.
- Storage Batteries, by Morton Arendt.
- Chemical Encyclopedia, by C. T. Kingzett.
- The Falls of Niagara, by G. C. Forrester.
- Mechanics for Engineers, by J. C. Smallwood, F. W. Kouwenhoven.
- Electrical Conductivity of the Atmosphere and Its Causes, by V. F. Hess.
- Practical Television, by E. T. Larner.
- Solubilities of Inorganic and Organic Compounds, by A. Seidell.
- American Chemistry, by Harrison Hale.

Presented by E. & F. N. Spon, Ltd.:
- Brassfounders Alloys, by J. F. Buchanan.
- Practical Hydraulics, 17th ed., by Thomas Box.
- Slide Rule, by G. A. Gunn.
- Warming Buildings by Hot Water, by Frederick Dye.
- Rational Mechanics, by Richard de Villamil.

Presented by Chapman & Hall, Ltd.:
- Impurities in Metals, by C. J. Smithells.

Presented by Crosby, Lockwood & Sons:
- Reinforced Concrete Bridges, by W. L. Scott.
- A Treatise on Chemical Engineering, by G. Martin.

Presented by the Librairie Polytechnique:
- Exemples de Calculs de Construction en Béton Armé, by Leon Cosyn.
- Théorie Calcul et Construction des Cheminées D'usine, by E. Lefon.

BRANCH NEWS

Winnipeg Branch

E. W. M. James, A.M.E.I.C., Secretary-Treasurer.

International Meeting at Winnipeg

At a meeting of the executive of the Winnipeg Branch on May 1st, it was decided to invite the Minnesota Federation of Architectural and Engineering Societies and other technical groups to attend an international meeting in Winnipeg during the summer of 1928. In furtherance of this a general committee was formed composed of two members from each of the following bodies:—

- Winnipeg Branch of The Engineering Institute of Canada.
- Association of Professional Engineers, province of Manitoba.
- Manitoba Electrical Association.
- Association of Manitoba Land Surveyors.
- Manitoba Association of Architects.

The dates set by the committee were August 24th and 25th. The programme decided upon and which was carried out was as follows:—

- Registration at the Royal Alexandra hotel, Friday morning, August 24th.
- Civic luncheon at Kildonan park, at 12.30 p.m. Friday, when there were 250 present.
- Technical session, 3.00 p.m. Friday.

Papers

"**Highways,**" by C. M. Babcock, commissioner of State Highways, Minnesota.

"**Steam Power Development in Minnesota,**" by J. A. Colvin, superintendent of generation, Northern States Power Co., Minneapolis.

"**International Relationships,**" by Prof. F. W. Kerr, Manitoba College.

"**An Adequate Wire Installation,**" by F. A. Cambridge, city electrician, Winnipeg.

During the technical session, the ladies of the group were entertained at tea at historic lower Fort Garry on the banks of the Red river. Some eighty ladies were present at this function.

Dinner-dance at the Royal Alexandra hotel at 8.30 p.m. Friday, August 24th, at which there were 250 present.

On Saturday morning a special train conveyed the party to Great Falls, on the Winnipeg river, where those present were the guests at luncheon and tea of the Manitoba Power Company, and where they had an opportunity of inspecting the 168,000 h.p. hydro-electric plant of the company, and saw the installation of the fifth and sixth units, each of 28,000 h.p.

Interest was added to the Saturday programme by the arrival in Winnipeg of some ninety members of the American Society of Mechanical Engineers from the eastern states, who spent Saturday and Sunday in Winnipeg as guests of the branch, and many of whom took advantage of the trip to Great Falls. On the return of the train to Winnipeg, an impromptu supper-dance was held at the Royal Alexandra hotel, which was attended by many members of the American Society of Mechanical Engineers. These visitors proceeded at 6.00 p.m. Sunday, August 26th, to St. Paul, in which city the Annual Convention of the society was to be held on August 27th to 30th.

Montreal Branch

C. K. McLeod, A.M.E.I.C., Secretary-Treasurer.

A Letter from the Chairman

To the members of the Montreal Branch of The Engineering Institute of Canada:

Gentlemen:—

It is a pleasure to extend to every member of the Montreal Branch a special invitation to attend and take part in the various activities of the branch during the coming season.

The papers, which have been arranged for by your committee for presentation at our meetings, deal with a variety of subjects and I feel sure that these will be of considerable interest to the members.

These papers are prepared by engineers, each of whom is a specialist in his own particular field, and the members of the branch should welcome the opportunity of acquiring further knowledge of recent developments within the profession.

These meetings afford an excellent opportunity for each member to become acquainted with his confreres, which in itself is perhaps one of the most valuable functions of an institute such as ours.

The efforts of your executive on behalf of the branch are deserving of your fullest support, and it is sincerely hoped that the meetings this year will be largely attended.

I have the honour to be,

Yours very truly,

(Signed) F. C. Laberge, B.A.Sc., M.E.I.C.,
Chairman Montreal Branch.

Television

Reported by A. B. Rogers, A.M.E.I.C.

A vivid description of the principles underlying recent improvements in the practice of "Television" formed the background for a fascinating address, when on April 12th last Dr. Robert W. King, assistant director of Bell Telephone Laboratories' Publications, in discussing possible applications of this interesting development before the Montreal Branch dispelled some of the popular misconceptions surrounding its probable utilization.

Referring to prevailing anticipation looking toward the speedy adaptation of television for home use in conjunction with residence phones, the speaker pointed out that the quantity, intricacy and cost of even such equipment as would be required to present crude reproduction of distant views, made the realization but a remote possibility. Notwithstanding the limitations, it was possible, however, to conceive of using the means for simultaneous presentation before large gatherings assembled in distant stadiums or auditoriums of popular sporting events.

Diagrams and illustrations supporting these illuminating conclusions were splendidly produced on slides and films, while the principle governing the essential action of the neon tube was beautifully demonstrated with some simple equipment.

This latter tube, while corresponding in function to the photo-electric cell as a medium for conversion between electricity and light, responds in exactly the reverse order, for whereas the photo-electric cell interprets the intensity of the light falling upon it in terms of a varying current frequency the latter glows bright or dim with an intensity proportioned to the varying frequency of the controlling current.

Possessing then the means for readily transforming light intensities into variable current frequencies it is now only necessary to scan with this sensitive cell the picture or object to be transmitted, unit by unit in regular sequence to record a series of light gradations representative of the definite form viewed.

For the purpose the picture may most conveniently be divided into some 2,500 units, while additional units are desirable for clarity of definition, but the cost of the apparatus would thereby be greatly augmented. On the other hand, fewer units would obscure the reproduction. On selecting therefore 2,500 equal units, each must then be scanned in regular rotation to register a current frequency representative of the light intensity reflected from its surface. As a result a sequence or series of 2,500 light registrations will be available for transmission by the carrying circuit.

Arriving at the receiving end suitably strengthened by amplifiers each series of light gradations is rapidly reproduced and regrouped into a replica of the original scene. This is accomplished by apparatus reversing the process utilized in the scanning device with its photo-electric cell. Whereas in this instance a neon tube is employed to interpret current in terms of light.

The important apparatus required first to scan the scene and later to reverse the process for presentation at the distant studio was realistically demonstrated in principle by a cleverly contrived model. This consisted of a small metal disc accurately perforated by a series of minute holes, arranged in spiral form around its outer edge.

A portrait of a man was then projected upon the screen, and the scanning disc placed before it to cut off all but a small spot of light emanating from a point directly behind the first hole. On the disc being turned slowly by hand the spot traversed the portrait from top to bottom, eventually passing off the picture at the lower right hand corner. At the same instant the second hole in the disc appeared as a spot at the upper edge, but slightly to the left of its predecessor. Thus the spots continued to move down across the portrait, one following the other in regular succession, till on the completion of one revolution the entire picture had been scanned unit by unit.

At this stage a characteristic of the human eye, known as persistence of vision, became an important advantage, for by its presence the observer is enabled to retain the visual sensations created by each spot in turn till a cycle has been completed. Thus it transpired that a rapid rotation of the disc was at once sufficient to produce the entire picture.

So in television the speed of the scanning disc may not only be adjusted to blend the many dots composing a picture into a distinct reproduction of the original, but may simultaneously be adjusted to present complete pictures in such rapid succession that the effect is the equivalent of a moving picture. As a consequence changes of expression and movement are transmitted with an ease approaching that of still subjects.

The function of the scanning disc at the sending end, therefore, consists in throwing the scene spot by spot upon the photo-electric cell, while that at the receiving end throws the light from the neon tube spot by spot to the eyes of the observer. However, in order that the reproduction may conform with the original, it is essential that both the discs be held at the same speed of rotation within very close limits. For this purpose a special synchronous motor has been designed to control their operation within one ten thousandth of a revolution.

The scene viewed through the disc of the receiver is necessarily small. Where large audiences are assembled to view the presentation enlargement becomes imperative. For this purpose a special neon lamp, prepared in the form of a long tube bent back and forth into parallel sections, is able to produce a picture some two feet square. Within the tube some 2,500 cathode elements, spaced at equal intervals, correspond to the elemental areas into which the scene is being split by the scanning disc. These elements are made to glow successively by a distributor driven in synchronism with the scanning disc at the sending end.

The synthesizing action of the observer's eyes is once again utilized to unite the elemental units into a replica of the original.

After a short discussion had ensued, J. T. Farmer, M.E.I.C., in well chosen remarks, moved a vote of thanks to the speaker, which was passed unanimously.

Councillor W. C. Adams, M.E.I.C., presided in the chair.

A new bulletin on electric steam generators has recently been published by the Canadian General Electric Company, Limited. This interesting publication, which is known as Bulletin ASD-4022, describes in detail the construction, control and application of electric steam generators as manufactured by the Canadian General Electric Company. Copies may be obtained upon request.

De Laval Steam Turbine Company, Trenton, N.J., has issued a leaflet known as bulletin E-1107, describing their centrifugal blowers and compressors as used in blast furnaces, steel plants and by-product coke oven plants. The bulletin contains a large number of illustrations of the installations of the company's equipment.

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

Supplies Engineer

Competent man familiar with up-to-date store keeping methods, to take complete charge stores department large public utility Brazil. Must be thoroughly experienced, good organizer, with sound knowledge material and equipment. Knowledge Portuguese or Spanish desirable but not essential; give full details education, experience and references. Apply Box No. 60-V.

Field Engineer

Recent graduate engineer wanted for laying out construction work and inspecting for large industrial and mining company in northern Quebec. Apply Box No. 61-V.

Electrical Engineer

Recent graduate required by a large electrical manufacturing concern for work on factory methods and manufacturing problems. Please state in first instance, education, full qualifications, references, salary required, age, and when available. Apply Box No. 69-V.

Assistant Distribution Engineer

Wanted by a large public utility in Brazil. Must be a university graduate with at least five years operating and construction experience after graduation, including underground and overhead light and power and tramway distribution combined with terminal station and substation operation. Apply, giving details of education, experience and salary, to Box No. 74-V.

Meter Engineer

Must be a graduate engineer with wide experience in various types of meters, particularly General Electric and Westinghouse, and competent to assume charge of meter department of a large utility in Brazil. Apply, giving details of education, experience and salary, to Box No. 75-V.

Town Engineer

Town engineer for a town in the Maritime Provinces. Applicants must give full particulars as to qualifications, experience and salary expected. Apply to Box No. 77-V.

Estimator and Designer

Largest Canadian firm manufacturing material handling machinery such as cranes and hoists, also a variety of heavy mechanical work, including sluice gates, has an opening for a man with experience in design and estimating along these lines. Apply to Box No. 80-V.

Designer and Draughtsman

Experienced designer and draughtsman on structural design, preferably in both concrete and steel building construction. Remuneration depends on capacity of applicant. Apply giving full particulars to Box No. 82-V.

Draughtsman

A firm of contractors in northern Ontario has an opening for a draughtsman, which would lead to instrumentman on field work. Apply to Box No. 83-V.

Situations Vacant

Sales Engineer

A large manufacturing company in Montreal has an opening for a graduate engineer on its sales staff. The company manufactures compressed air machinery. A man familiar with pneumatic tools, portable compressors is one whose application will be given most serious consideration. Apply to Box No. 84-V.

Sales Engineer

A large manufacturing company in Montreal has an opening for a graduate engineer on its engineering sales staff. The company manufactures compressed air mining machinery and oil engines. Preference will be given to those having some experience in these lines. Apply with full particulars to Box No. 85-V.

Sales Engineers

Two graduates of two or three years for sales and demonstration of construction of (road) machinery. Would be given experience and instruction on operation. Apply Box No. 86-V.

Industrial Designers and Draughtsman

College graduates with three or four years experience in pulp and paper industry. Salary $200 a month. Apply to Box No. 88-V.

Junior Engineer

Preferably college graduate, as assistant to field engineer, for a large paper mill in the province of Quebec. Salary $150 a month. Apply to Box No. 89-V.

Superintendent of Construction

A large paper mill in the province of Quebec has an opening for a thoroughly competent engineer for machinery installation. Preferably Canadian or one familiar with Canadian construction practice and labour conditions. Must be able to supervise installation of equipment and produce accurate work at lowest cost. Apply to Box No. 90-V.

Sales Engineer

A well known building supplies sales organization in Montreal has an opening on their sales staff for a recent graduate in engineering, to specialize in a particular branch of the company's work. Apply to Box No. 92-V.

Promotion Engineer

A large Canadian industrial company, distributing a construction material from coast to coast, has an opening for a graduate engineer between the age of 25 and 30 to carry on promotional work in the western provinces from the head of the Great Lakes to British Columbia. Apply to Box No. 93-V.

Draughtsman and Junior Designer

Recent graduate in civil engineering for position as draughtsman and junior designing engineer on hydro-electric developments. One with experience preferred, but experience not essential. Give education, experience and reference and state salary required for engagement of one year. Location, Nova Scotia. Apply to Box 97-V.

Situations Vacant

Instrumentman

A pulp and paper company in northern Quebec wishes to secure the services of a graduate engineer for power surveys. Preferably one who has had hydrographic experience. Apply to Box No. 99-V.

Pulp and Paper Engineer

A pulp and paper company in Ontario ha an opening for a young mechanical enginee who has had pulp and paper mill experience Apply, giving full particulars of qualification and experience, to Box No. 100-V.

Junior Electrical Engineer

A recent graduate in electrical engineering i required by a pulp and paper company. Pre vious experience unnecessary. The positio offers excellent opportunities for advancemen Apply to Box No. 103-V.

Draughtsman

Draughtsman with some architectural expe rience required for municipal work. Applicar must state age, experience, salary expected an submit sample of drawing. Apply Box N 105-V.

Steam Plant Designer

A thoroughly experienced man familiar wi modern practice in the layout of boilers, tu bines, piping and the usual accessory equi ment. Apply giving full details of experien to Box No. 106-V.

Mechanical Designer

A man with several years' experience in t layout of mechanical equipment, shafting, pi ing and generally familiar with industrial pla practice. Apply giving full details of expe ence to Box No. 107-V.

Structural Designer

A man fully competent to design and det simple structures in steel, timber and reinforc concrete. Apply to Box No. 108-V.

Factory Manager

Required by progressive and growing Car dian company engaged in the manufacture a wide range of material handling machine factory manager capable of assuming entire sponsibility for maximum production at low cost. Position offers unlimited scope to am tious and energetic man. Apply giving det of training, experience, and salary required Box No. 109-V.

Electrical Engineer

An electrical draughtsman for maintena and construction design in a large steel pl University graduate preferred. State age, e cation, experience, and salary to Box No. 110

Electrical Designer

Electrical designer with at least five ye experience in designing electrical sub-stati s for power companies. Applicant must thoroughly familiar with latest types of swit board equipment. Give full detailed infor tion in first letter, including age, salary pected, names of references, recent photogra and samples of drawings made. Perman t work with good future for the right man w large power company in eastern Can Apply Box No. 111-V.

Industrial Designer and Draughtsman

Young engineer with electrical training, r an industrial firm in Montreal, preferably e with experience after graduation, on electr heating and ventilating layouts. Must b a good draughtsman. Remuneration depend n capacity of applicant. Apply, giving full ticulars, to Box No. 112-V.

Situations Vacant

JUNIOR DRAUGHTSMAN

Junior draughtsman, for a firm in western Ontario, with experience on structural steel. Apply to Box No. 113-V.

MECHANICAL DRAUGHTSMAN

Mechanical engineer and draughtsman, between twenty-five and thirty-five years of age, preferably experienced in paper mill engineering. Apply, stating past experience, education, married or single, salary expected and when services available, to Box No. 115-V.

Situations Wanted

RECENT GRADUATE

Graduate of Univ. of B.C. '28 with the following experience is open for a position: Instrumentman and designer on the construction of roads; resident engineer on construction of buildings; structural designer and inspector on construction of a concrete warehouse. Apply Box No. 49-W.

PULP AND PAPER MILL ENGINEER

A.M.E.I.C., R.P.E., Ontario, civil and mechanical branches, 28 years' experience in pulp and paper mill work, both operating and engineering; 16 years' engineering experience. Has successfully held position of chief engineer with large Canadian company. Good executive. Apply Box No. 53-W.

CIVIL ENGINEER

Young engineer, graduate of the Univ. Toronto '27, would like to secure a position. Experience includes field draughtsman and instrumentman on hydro-electric development, making plans, estimates on excavation and concrete required, progress reports, etc. At present in charge of survey party. Apply Box No. 54-W.

ELECTRICAL AND MECHANICAL ENGINEER

Canadian, 30 years of age, graduate engineer, at present located in New York city, wishes to return to Canada and is available for a position in research, testing or mechanical work, with an industrial company. Experience includes machine design and layout, and the preparation and executing of patent drawings in connection with mechanical and electrical apparatus. Apply to Box No. 57-W.

ELECTRICAL ENGINEER

Young electrical engineer with experience as efficiency engineer compiling reports on operation of newsprint, groundwood and sulphite mills, and steam plant; meter engineer, in charge of upkeep and installation of all meters and recording machines; and assistant control engineer, handling investigation, control of process and cost. Apply to Box No. 58-W.

Situations Wanted

CHEMICAL ENGINEER

Graduate of Mass. Inst. of Tech. '27, age 28 years, with experience in paper and paper size manufacture, and industrial plant layout and construction, desires a position with a pulp and paper company or other industrial organization, either on operation or as chemical, combustion or mechanical engineer. At present located near Montreal. Apply to Box No. 76-W.

MECHANICAL ENGINEER

A.M.E.I.C. experienced in drawing office, production and plant maintenance; four years as engineer-in-charge of works plant installation and maintenance, mechanical and electrical; three years as sales engineer; conversant with wide variety of machinery; recently mainly on pneumatic plant; having just returned from residence abroad is open for engagement in suitable capacity. Apply Box No. 84-W.

CIVIL ENGINEER

B.A.Sc. '23, D.L.S., with experience in railroad switch work, pipe lines, sewers, setting mill machinery, motors, pumps, layout of foundations and concrete form work for reinforced concrete, erection of steel reinforced concrete, brick and wooden structures, surveys and topographic surveys, at present in United States, would like to secure work in Canada. Apply Box 86-W.

CONSTRUCTION ENGINEER

A.M.E.I.C., with twenty-six years experience, including ten years railway construction and sixteen years on reinforced concrete bridge, as resident engineer in Canada and United States, desires position. Apply Box No. W. 93-W.

AIRPORT ENGINEER

Civil engineer with two years surveying and five years general construction wishes to join an engineering firm specializing in or wishing to commence a department for location, design and construction of airports. Location Montreal or in Ontario. Apply Box No. 99-W.

SPARE TIME WORK

Graduate of this year, at present employed in Montreal, wishes to secure some spare time employment in the city; either draughting or clerical work associated with engineering. Available three or four evenings each week. Apply Box No. 100-W.

ELECTRICAL ENGINEER

Graduate of N.S. Tech. Coll. '25, age 27, single, two years Westinghouse test course, one year assistant electrical superintendent of a large mining concern, desires position in public utility work. Available at reasonable notice. Apply Box No. 101-W.

Situations Wanted

CIVIL ENGINEER

A graduate of McGill Univ. '24, with some knowledge of French, wishes to return to Canada from the U.S.A. His experience includes instrumentman on railway construction, resident engineer on railway construction, instrumentman on general maintenance, and transitman on preliminary surveys. Apply to Box No. 103-W.

CIVIL ENGINEER

Civil Engineer, graduate of Toronto University '22. with experience in hydraulic work, buildings, roads, docks, open for engagement in executive or technical capacity; any locality, preferably Montreal. Excellent references. Apply to Box No. 109-W.

ELECTRICAL ENGINEER

University graduate, with seven years' experience in the design and application of all varieties of switching equipment, including the design and layout of power stations and substations, desires to become connected with operating or industrial company, or with a firm of consulting engineers. Apply to Box No. 113-W.

Tenders

SEALED TENDERS addressed to the undersigned, and endorsed "Tender for repairs to North Jetty, Steveston, B.C." will be received until **12 o'clock noon, Wednesday, October 24, 1928,** for repairs to Fourth Section of the North Jetty, at Steveston, Fraser River, New Westminster District, B.C.

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, Post Office Building, New Westminster, B.C.; Victoria Builders Exchange, 2509 Prior Street, Victoria, B.C.; The Building and Construction Industries Exchange, 615 West Hastings Street, Vancouver, B.C., also at the Post Office, Steveston, B.C.

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,

S. E. O'BRIEN,
Secretary.

Department of Public Works,
Ottawa, September 29, 1928.

Foster Wheeler Corporation has issued Superheater Catalogue No. 304. This catalogue consists largely of illustrations of notable superheater installations so that the reader may grasp the manner in which installations are made. Short statements are given covering the history of Foster superheaters and their application to many types of boilers. The types of superheaters particularly emphasized are convection, radiant heat, combination, separately fired, waste heat and portable. The catalogue is completed with a steam table extending up to 1,500 pounds absolute pressure and 300° superheat.

Power Corporation of Canada, Limited, Montreal, Que., has published an attractive booklet entitled "Power Corporation of Canada—What It Is and What It Does," describing its organization with particular reference to its engineering and construction service. The booklet contains illustrations of the plants of various companies in the Power Corporation group.

American Institute of Steel Construction, Inc., 285 Madison avenue, New York city, through a committee of engineers under its auspices, have prepared and published a specification for the fireproofing of structural steel plants. The specification is divided into seven sections:—1, Purpose and Scope; 2, Fires; 3, Fire Hazards; 4, Steel; 5, Fireproofing Materials; 6, Tests; 7, Safety Factor. Copies of this booklet may be obtained upon application to the American Institute of Steel Construction, Inc.

The Superheater Company has issued a new booklet entitled "The Elesco Superheater for Power Plants," which contains fifty-one pages and ninety-five illustrations describing the design, construction and application of the Elesco superheater to the power plants. Copies may be obtained from the company at 276 St. James street, Montreal, Que.

Institute Committees for 1928

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Preliminary Notice

of Applications for Admission and for Transfer

September 21st, 1928.

The By-laws now 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 election 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 1928.

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 or 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

ADLINGTON—WILFRED ERNEST, of Chambly Canton, Que., Born at Durban, Natal, South Africa, Nov. 6th, 1900; Educ., B.Sc., Mass. Inst. Tech., 1927; June 1918 to June 1919, Hope & Co., Johannesburg, S.A., install'n of elect'l equipment and various types of machines; June 1927 to date, chem. engr. with Bennett Ltd., Chambly Canton, Que., mfrs. of papermakers' size, papers and boards, operation and control of driers, design of equipment and layout of same, including electric motors, pumps, heating units and special machinery, design and plant for bldg. constrn., etc.

References: H. E. Pawson, H. B. Pope, G. M. Wynn, A. Plamondon, T. J. Lafreniere, E. P. Cameron.

FORTUNE—RONALD, of Peterborough, Ont., Born at Malta, Nov. 13th, 1897; Educ., 1919-22, three year course, Heriot Watt College, Edinburgh, Scot.; 1913-14, ap'ticed to Newington Motor Works; 1915-19, B.E.F., Army Transport; 1919 (July-Oct.), journeyman mechanic fitter, Newington Motor Works; 1920-21 (summers), engrg. pupil, Vickers Metropolitan Elect'l Works, Sheffield, and Kelty River Station, Fife Coal Co., Scotland; March 1923 to June 1924, gen. mill mtce. and erection, Canada Sugar Refinery Co., Ltd., Montreal; 1924-26, wood handling engr. and asst. to supt., also safety engr., Riordon Pulp Corporation, Ltd., Hawkesbury, Ont.; 1926-28, mech'l supt., McCallum Smith Co., Ltd., Montreal; March 1928 to date, engr. inspr., William Hamilton, Ltd., Peterborough, Ont.

References: R. C. Flitton, P. P. Westbye, C. B. Thorne, J. G. MacLaurin.

FULTON—EDWARD ARTHUR, of Atlanta, Ga., Born at Parrsboro, N.S., Dec. 31st, 1898; Educ., B.Sc. (C.E.), Univ. of Man., 1924; post graduate work in hydraulic engrg. at Mass. Inst. of Tech., leading to Master's degree, 1925-26; 1916-19, overseas, C.E.F.; 1920 (June-Sept.), and 1921-22, instr'man and dftsman. with reclam. service, Dept. of Interior, in So. Alta.; 1923 (May-Sept.), instr'man on mtce. of way, St. John Divn., Illinois Central Rld.; 1923-25, instr'man on prelim. investigation and survey, dftsman and designer on water filtration plant, res. engr. on constrn. of waterworks, sewers, etc., and asst. engr. on design and constrn. of waterworks, sewers, etc., for different firms of consltg. engrs. in U.S.A.; 1926-27, asst. engr. on design and constrn. of water purification plant, water distribution system, sewerage, etc., for the City of Fort Lauderdale, Florida, under Solomon, Norcross & Keis, Inc., consltg. engrs.; Aug. 1927 to date, asst. engr. with Wiedeman & Singleton, Inc., consltg. engrs., on waterworks, sewerage, investigations, etc.; at present res. engr. on constrn. of waterworks plant for the City of Kingsport, Tenn.

References: A. C. Wright, F. H. Peters, J. N. Finlayson, L. Pearse, W. G. Mawhinney, D. L. McLean, V. M. Meek.

INGLIN—JOSEPH, of 5249 Park Ave., Montreal, Que., Born at Schwyz, Switzerland, May 26th, 1898; Educ., Electr'l Engr., Swiss Federal College, Zurich, 1921; 1921-23, office work, export dept., Siemens works, Berlin, Germany; 1923-24, dftsman., Newfoundland Power & Paper Co., Montreal; 1924-26, designing work and check of install'n of lighting systems and motor power distribution, also testing, at Corner Brook paper mill, Nfld.; 1926-28, supt. of hydro-electric substation at Corner Brook mill, Newfoundland.

References: J. Stadler, F. T. Kaelin, C. Bang, H. C. Brown, D. Humphreys.

KELLY—SYDNEY FOSTER, of 275 Desmarchais Blvd., Verdun, Que., Born at Liverpool, Eng., Oct. 30th, 1899; Educ., I.C.S., England; 1914-20, indentured apprenticeship, E. T. Blakeley & Co., Birkenhead, Eng.; 1920-21, dfting., Kenyon Ironworks, St. Helens, Eng.; 1921-22, civil engrg. dept., Harland & Wolff, Belfast, Ireland, detailing steel for their new plant at Woolwich, Eng.; 1922 to date, with Dominion Bridge Company, Lachine, for three years to date checker, responsible for correctness of all drawings.

References: F. P. Shearwood, D. C. Tennant, A. Peden, R. M. Robertson, N. Cageorge.

MacMILLAN—KENNETH L., of Mount Royal, Que., Born at Belleville, Ont., March 9th, 1893; Educ., evening classes, Montreal Technical School, mech'l drawing, mach. design and reinforced concrete, I.C.S.; 1910-12, ap'ticeship, Garth Company, Montreal; 1912-13, junior dftsman., Canada Cement Co.; 1913-14, dftsman., J. S. Metcalf Co.; 1915-19, C.E.F.; 1919, dftsman., J. S. Metcalf Co. and Singer Sewing Machine Co.; 1919 to date, engrg. dftsman., Canada Cement Co., for the last five years in charge of design, estimating and checking of engineering work.

References: H. Rolph, S. Barr, W. G. H. Cam, F. A. Ritchie, L. Cunningham.

PLATOU—OTTO STOUD, of Montreal, Que., Born at Horten, Norway, July 31st, 1891; Educ., 1916-18, Technical University, Zurich, Switzerland; 1913-16, dftsman. with Norwegian Electric and Brown Boveri on struct'l steel work; 1918-21, asst. engr. with Maskim & Anlaegscompaniet, Bergen, Norway, on hydro-electric power developments; 1920-21, constrn. supt. for Vaag power plant on the Faroe Islands, and from Aug. 1921 to Apr. 1922, making maps of Vaag twp. for Vaag Municipal Board; 1922-23, inspr. for Oslo Municipal Electric power plant; 1923-24, engr. dftsman. with Fraser Brace Co., Ltd., Montreal, on work in connection with hydro-electric power plant in Nfld.; May 1924 to date, concrete designer, Southern Canada Power Company, and later Power Corporation of Canada on work on hydro-electric power plants.

References: V. R. Davies, T. C. Connell, F. F. Griffin, J. H. Trimingham, F. T. Gnaedinger.

REIBER—GEORGE WILLIAM, of 234 Lincoln Place, Brooklyn, N.Y., Born at Montreal, Que., July 6th, 1898; Educ., B.Sc., Cooper Union, New York, 1928; 1918-20 and 1923-24, machine layouts and details, Darling Bros., Montreal, and Garvin Machine Co., New York; 1924-25, design and layout of new machinery, American Can Co., Newark, N.J.; 1925 to date, preparation and execution of patent drawings requiring the design of mechanical and electrical apparatus, American Can Co., New York City.

References: J. A. Duchastel, E. Darling, J. B. Bladon, J. D. Hathaway, W. S. Vipond.

WEBSTER—ARTHUR A., of St. Catharines, Ont., Born at Stratford, Ont., Sept. 28th, 1895; Educ., B.Sc., Queen's Univ., 1920; 1913-14 (summers), rodman and dftsman., Grand Trunk R.R. and city engr.'s office, Stratford; 1914-19, overseas, Can. Engrs. and R.A.F.; 1919 (6 mos.), instr'man, Grand Trunk R.R., Stratford Divn.; 1921, instr'man i/c party, Queenston-Chippawa power development; 1920-28, with Bethlehem Steel Company—1920-22, detailing and checking, and 1922-28, field engr. for erection of steel bridges and bldgs., and work in erection dept., designing office in planning, designing, and detailing erection schemes and special erection equipment; Feb. 1928 to date, asst. structural engr. on design of movable bridges, Welland Ship Canal.

References: E. G. Cameron, M. B. Atkinson, W. S. Orr, W. L. Malcolm, A. B. Manson.

WRIGHT—GEORGE WILLIAM GRANT, of 2702 Victoria Ave., Regina, Sask., Born at Leicester, Eng., Aug. 21st, 1881; Educ., Leicester Technical College (specializing in electr'l engrg.), I.C.S. civil engrg.; 1912-13, asst. to constrn. engr., designing dftsman. and office engr., Regina Electric Street Rly.; 1914, dftsman. and checking townsite surveys, Sask. Government Surveys Branch; 1915-18, on active service; 1918, chief dftsman., then asst. to constrn. engr., locating and plotting long distance telephone routes; 1921-22, i/c of underground telephone systems, location and constrn. of same in cities of Moose Jaw and Battleford; 1923, designing dftsman. for telephone plant and bldgs., asst. to special engr. engaged on experiments in preparation of specifications and testing of materials and instruments and equipment; 1925 to date, office engr., engrg. branch, Sask. Govt., Telephone Dept., Regina, Sask.

References: L. A. Thornton, D. A. R. McCannel, J. W. D. Farrell, A. C. Garner, S. R. Parker, D. W. Houston, T. McGuinness, J. N. deStein.

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

MARR—NORMAN, of 81 Metcalfe Street, Ottawa, Ont., Born at Walkerton, Ont., June 29th, 1890; Educ., B.A.Sc. (C.E.), Univ. of Toronto, 1912; 1907-09 (summers), chaining, rodding, levelling on Dominion land surveys, rly. location and city waterworks extensions; 1910-11, instr'man constrn., Nat. Transcont. Rly.; 1912-13, asst. engr., C. H. & P. H. Mitchell, consltg. engrs., on constrn. of Lacolle Falls hydro-electric development for City of Prince Albert, Sask.; 1913-18, asst. engr., Dept. Rlys. and Canals, i/c constrn., sections 4 and 5, Trent Canal; 1918-26, senior hydraulic engr., and 1926 to date, chief hydraulic engr., Dom. Water Power and Reclamation Service, Dept. of Interior, Ottawa, Ont.

References: J. B. Challies, T. H. Hogg, J. T. Johnston, R. S. Lea, D. W. McLachlan, S. S. Scovil.

FOR TRANSFER FROM THE CLASS OF JUNIOR TO A HIGHER GRADE

GILBERT—EDGAR VALENTINE, of Montreal, Que., Born at Liverpool, Eng., Sept. 3rd, 1896; Educ., B.Sc., McGill Univ., 1923; 1915-19, sapper, Can. Engrs.; 1923-24, inspr., R. W. Hunt Co.; 1924-25, dftsman. and asst. field engr. at Hemmings Falls power house, and 1925-26, field engr. on constrn. of Drummondville power house, Southern Canada Power Co.; Feb. 1926 to date, with Foundation Co. of Canada, Ltd., as follows: Feb. 1926 to July 1927, asst. to dist. engr. and dist. engr. for Gatineau storage dams; July 1927 to April 1928, i/c of parties on exploration of dam sites on Desert and Trinity rivers, locating flume line and rly. at Trinity Bay, and April 1928 to date, engr. and works clerk on inclined tunnel, Thetford Mines, Que.

References: R. E. Chadwick, W. Griesbach, H. V. Serson, W. N. Cann, F. F. Griffin, T. C. Connell.

PROCTOR—WILLIAM DOUGLAS, of 32 Winnett Ave., Toronto 10, Ont., Born at Sarnia, Ont., July 25th, 1895; Educ., B.A.Sc., Univ. of Toronto, 1921; 1913-14 (summers), city engr.'s staff, Sarnia; June 1915 to Apr. 1916, on shell parts, Can. Inspection Co., Sarnia and London, Ont.; 1916-19, overseas, Lieut., Can. Engrs.; 1919 (summer), res. engr. on pavements at Strathroy, Ont., for James, Loudon & Hertzberg; 1920-21 (summers), res. engr. on Scarboro water system, for E. A. James & Co.; 1921-22, res. engr. on various constrn. works for James, Proctor & Redfern, Ltd.; 1923 (Jan.-July), struct'l detailer, McGregor-McIntyre, Ltd.; Sept. 1923 to date, with James, Proctor & Redfern, Ltd., as follows: 1923-24, on designing staff on reservoirs, etc.; 1925, res. engr., York Twp. sewage disposal plant; 1926-27, design and charge in field of constrn. of sewerage system for Village of Forest Hill, Ont.; at present, designing engr. in charge of dfting. room.

References: O. M. Falls, E. M. Proctor, O. L. Flanagan, W. B. Redfern, C. R. Young, P. Gillespie, A. R. Robertson, E. T. Bridges.

ROSE—HUGH GRANT, of 337 40th St., Fairfield, Ala., Born at Ottawa, Ont., Jan. 25th, 1898; Educ., M.A., Queen's Univ., 1920, B.A.Sc., Univ. of Toronto, 1923, D.L.S., 1921; 1916-20 (summers), asst. on geodetic survey parties; 1921 (summer), geod. engr., i/c party observing for Geod. Survey in Ont.; 1922 (summer), geod. engr. on reconnaissance in Quebec, and 1923 (summer), geod. engr. i/c party observing in Quebec for Geod. Survey of Canada; 1924-25, geod. engr. with R. H. Randall & Co., geod. and topographic engrs., making a topographic map of the city of Pittsburg; Aug. 1925 to date, field engr., Ensley Works, Tennessee Coal, Iron & Railroad Co., Birmingham, Ala., gen. industrial work, mtce. and constrn. in large steel plant.

References: J. L. Rannie, N. J. Ogilvie, W. M. Tobey, C. Brady, P. Gillespie, W. M. Dennis, W. C. Murdie.

WIMBERLEY—ARTHUR CECIL, of 116 Brighton Ave., Ottawa, Ont., Born at High Bluff, Man., July 5th, 1895; Educ., Toronto Matric., I.C.S. diploma, municipal engrg.; passed E.I.C. exam. for Junior, May 1922; 1912 (3 mos.), survey with Dept. of Militia; 1913-22 (except 1916-19, when overseas), dfting., etc., irrig. branch, Dept. of Interior, Ottawa; 1916-19, sgt., Can. Art'y, D.C.M.; 1923-26, junior engr., and 1927 to date, asst. engr., reclam. service, Dept. of Interior, Ottawa, Ont.

References: J. T. Johnston, V. M. Meek, G. F. Richan, M. F. Cochrane, J. S. Tempest, G. F. Horsey.

FOR TRANSFER FROM THE CLASS OF STUDENT TO A HIGHER GRADE

CLEVELAND—HARRY ROLAND, of Montreal, Que., Born at Danville, Que., Jan. 9th, 1899; Educ., B.Sc. (E.E.), McGill Univ., 1924; 1923 (summer), electr'n's helper, Canadian Johns-Manville Co.; Jan. 1926 to date, cable design and sales engrg., Northern Electric Company, Ltd., Montreal.

References: W. S. Vipond, N. L. Dann, T. Eardley-Wilmot, N. L. Morgan, C. V. Christie.

GRAHAM—WALTER WHITE, of 792 Decarie Blvd., Montreal, Que., Born at Glasgow, Scotland, Aug. 29th, 1901; Educ., B.Sc. (Mech.), McGill Univ., 1925; 1922 (summer), rodman on constrn., Intercol. and James Bay Rly., C.P.R. branch line; 1923 (summer), concrete inspr., Steel Co. of Canada, Montreal; 1924 (summer), install'n of H. V. disconnecting switches, motor operated, H.V. bus and lighting conduits, La Gabell dev., Shaw. Water & Power Co.; 1925 to date, with Power Engineering Co., on elect'l and hydro-electric design.

References: A. L. Patterson, J. A. McCrory, S. Svenningson, J. S. Brisbane, J. D. Stott, G. J. Dodd, A. B. Rogers.

KETCHEN—WILLIAM ARTHUR, of 49 Brock Ave., Montreal West, Que., Born at Montreal, Que., July 18th, 1903; Educ., B.Sc. (Chem.), McGill Univ., 1928; 1924 (summer), machinist, and 1925 (summer), millwright, B.C. Pulp and Paper Co., Port Alice, B.C.; 1926 (summer), asst. chemist, Niagara Ammonia Co., Niagara Falls, N.Y.; 1927 (summer), asst. chemist, Port Alice plant, B.C. Pulp and Paper Co.; at present, operator, Electro Products, Shawinigan Falls, Que.

References: H. M. MacKay, C. M. McKergow, G. A. Wallace, J. B. Bladon, W. L. Ketchen.

REAPER—CLARENCE PAUL, 3649 Durocher St., Montreal, Born at Montreal, June 15th, 1901; Educ., B.Sc., McGill Univ., 1924; 1923 (summer), pulp and paper testing, Abitibi Power & Paper Co.; 1924-26, with Newfoundland Power & Paper Co., as follows: 1924 (June-Dec.), dfting., Dec. 1924 to June 1925, supervising part of elect'l install'n in Nfld.; June 1925 to Feb. 1926, i/c of testing labs.; 1926 (Mar.-Dec.), field engr. i/c of erection of paper mill divn. at Port Alfred for H. S. Taylor, M.E.I.C.; Dec. 1926 to Jan. 1928, paper mill design, and Jan. to March 1928, installed testing labs. and started the service divn. at Lake St. John Power & Paper Co.; at present life underwriter with the Imperial Life Assurance Co., Montreal.

References: J. Stadler, H. S. Taylor, R. L. Weldon, H. C. Brown, J. C. Day, C. Bang.

SHIER—BRUCE BANKS, of Montreal, Que., Born at Westmount, Que., July 3rd, 1901; Educ., B.Sc. (E.E.), McGill Univ., 1923; 1920-22 (summers), timekpr., material clerk and inspr. with Shawinigan Engrg. Co.; 1923-24, graduate student course, Can. Westinghouse Co., Ltd., Hamilton, Ont.; 1924 to date, engr., inspection engrg. dept., Northern Electric Co., Ltd., Montreal.

References: W. C. Adams, A. J. Lawrence, W. C. M. Cropper, H. J. Vennes, N. L. Dann, N. L. Morgan.

SINCLAIR—ARCHIBALD BEAIRSTO, of Kenogami, Que., Born at Truro, N.S., Apr. 3rd, 1902; Educ., B.Sc. (E.E.), Univ. of Man., 1927; 1920 (May-Sept.), rodman, Reclam. Branch, Dept. Public Works, Man.; 1921 (May-Sept.), mechanician, Can. Aircraft Co., Winnipeg; May 1922-Sept. 1923, instr'man, Manitoba Power Co., Great Falls, Man.; 1924 (May-Sept.), electr'n, Foundation Co., Mishawaka, Ind.; 1925 (May-Sept.), storekeeper and material checker, Foundation Co., West Pittston, Pa.; 1926 (May-Sept.), dftsman., Western Engrg. Co., Winnipeg; May 1927-May 1928, student course, Canadian Westinghouse Co., Hamilton; June 1928 to date, asst. to gen. elect'l supt., Price Bros. & Co., Ltd., Kenogami, Que.

References: N. D. Paine, J. N. Finlayson, N. M. Hall, E. P. Fetherstonhaugh, B. S. McKenzie.

WELSH—DEAN THOMAS, of Hamilton, Ont., Born at Port Colborne, Ont., Sept. 26th, 1900; Educ., B.A.Sc., Univ. of Toronto, 1924; with city engr.'s dept., Hamilton, as follows: 1920 (summer), chainman and rodman; 1921 (May-Dec.), instr'man on bridge and pavements and concrete inspr. on sewer pipe; 1922 (Jan.-Aug.), instr'man and dftsman. on pavement surveys and constn.; 1923 (May-June), instr'man on pavements; May 1924-June 1926, instr'man and dftsman. on pavement surveys and constrn., also some sewer design; 1923 (Aug.-Sept.), asst. to Etobikoke Twp. engr., on watermains and sidewalks at Islington; June 1926 to date, with Dept. of Northern Development, Ontario Government, as follows: 1926 (June-Nov.), asst. engr. in Thunder Bay District on road location and bridge surveys; Dec. 1926-Oct. 1927, asst. to chief of party on Fort Francis-Kenora Road location survey; Oct. 1927-Mar. 1928, asst. engr. on re-location survey, Ferguson Highway, Severn Bridge to Burk's Falls; 1928 (Mar.-Aug.), res. engr., Ferguson Highway, Falkenburg-Huntsville Divn. (i/c of 5 miles); Aug. 1928 to date, res. engr. i/c of constrn. of Driftwood-Smooth Rock Falls Road (17 miles).

References: C. H. Fullerton, J. C. Meader, A. M. Mills, E. B. Allan, W. L. McFaul.

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ENGINEERING JOURNAL

THE JOURNAL OF
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November, 1928

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The Influence of Various Factors on the Power and Economy of a Gasoline Engine

E. A. Allcut, M.E.I.C.

Associate Professor of Mechanical Engineering, University of Toronto, Toronto.

Paper to be presented before the Annual General and General Professional Meeting of The Engineering Institute of Canada, Hamilton, Ont., February 13th-15th, 1929

The tests recorded in this paper were performed on a six-cylinder Durant Continental engine (No. 15-L-10045), equipped with Tillotson carburettor, and both hand and automatic spark advance. The bore and stroke were 2⅞ and 4¾ inches, respectively, the firing order 153624, and compression ratio 5.35. The cranks were 120 degrees apart, Nos. 1 and 6, 2 and 5, 3 and 4 being together. The speed range investigated was 850 to 2,800 revolutions per minute, and in each case the throttle was fully open and the ignition advance adjusted to give maximum power.

The engine was mounted on a frame, as shown in figures Nos. 1 and 2, and was connected through the gear box to a Froude water dynamometer, by means of which the power developed was calculated for each test. The speed was taken with a speed counter, the exhaust temperatures with a calibrated Chromel Copel thermocouple, and the exhaust pressures with a mercury gauge. The fuel consumption was observed by weight at intervals during each test, so that the time taken for the consumption of each pound of gasoline was accurately known, and no test was started until the conditions became constant. The cooling water was weighed and inlet and outlet temperatures were measured in each case.

The tests resolve themselves into four series:

(1) Tests made with the same fuel but different mixture strengths.

(2) Tests made with different fuels but the same carburettor setting.

(3) Tests made with different cooling water temperatures.

(4) Tests made with patent lubricants mixed with the fuels.

Variable Mixture Tests

In these tests the first series, (*A 1-5*), was made with the main jet needle open 2½ turns, so that the analysis of the exhaust gases showed a CO_2 content of approximately 8 per cent, (table No. 1), and a CO content of approximately 8 per cent. This corresponds to a fuel supply about 15 per cent in excess of that required for perfect combustion. The second series, (*A 8-12*), gave a CO_2 content of about 10.5 per cent, and CO approximately 3 per cent, (table No. 2). The third series, (*A 13-17*), was made with what was practically a correct mixture, the exhaust analysis being about 13 per cent CO_2 and 0.4 per cent free oxygen, (table No. 3).

The curves showing the results obtained at different speeds are given in figures Nos. 3-5. In some cases, (as in the power curve), the various lines are so close together that only one curve can be drawn.

The results, as far as power and economy are concerned, are given in figure No. 6. For the purpose of extending the mixture range, a set of points obtained with 15 per cent excess air on a similar engine, (No. 15-L 5057), is included, and it is evident that for all speeds, the most economical figures are obtained with about 2 per cent of free oxygen in the exhaust gas. This corresponds to about 9 per cent excess air in the mixture.

Many tests have been made, and several papers have been published dealing with the effect of mixture strength on power and economy. The experiments of Ricardo[1] indicate that with gasoline the minimum fuel consumption is obtained with 10-15 per cent of excess air in the mixture, and maximum power with about 20 per cent excess fuel.

Berry[2] shows similar curves with maximum economy at about 5 per cent excess air, and maximum power at about 16 per cent excess fuel. A paper read by H. M. Jacklin[3] includes a series of curves with different spark plug combinations, and the following figures are taken from the curves with one spark plug:—

(1) "The Internal Combustion Engine," Ricardo, vol. II, p. 46.

(2) "More Car Miles per Gallon of Fuel," Society of Automotive Engineers Jrl., August 1922.

(3) "Improving Engine Performance," Society of Automotive Engineers Jrl., March 1928.

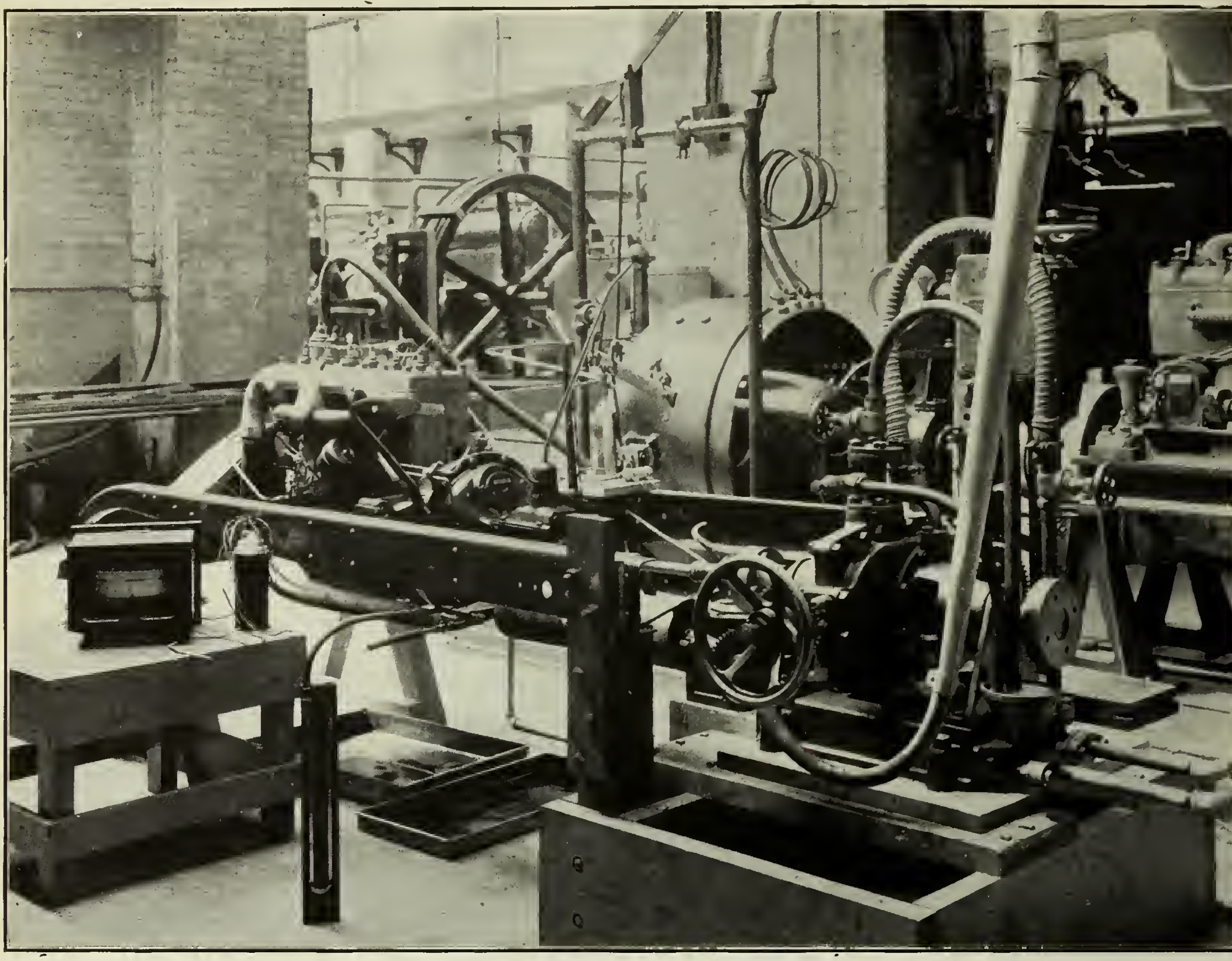


Figure No. 1.—Arrangement of Engine for Test.

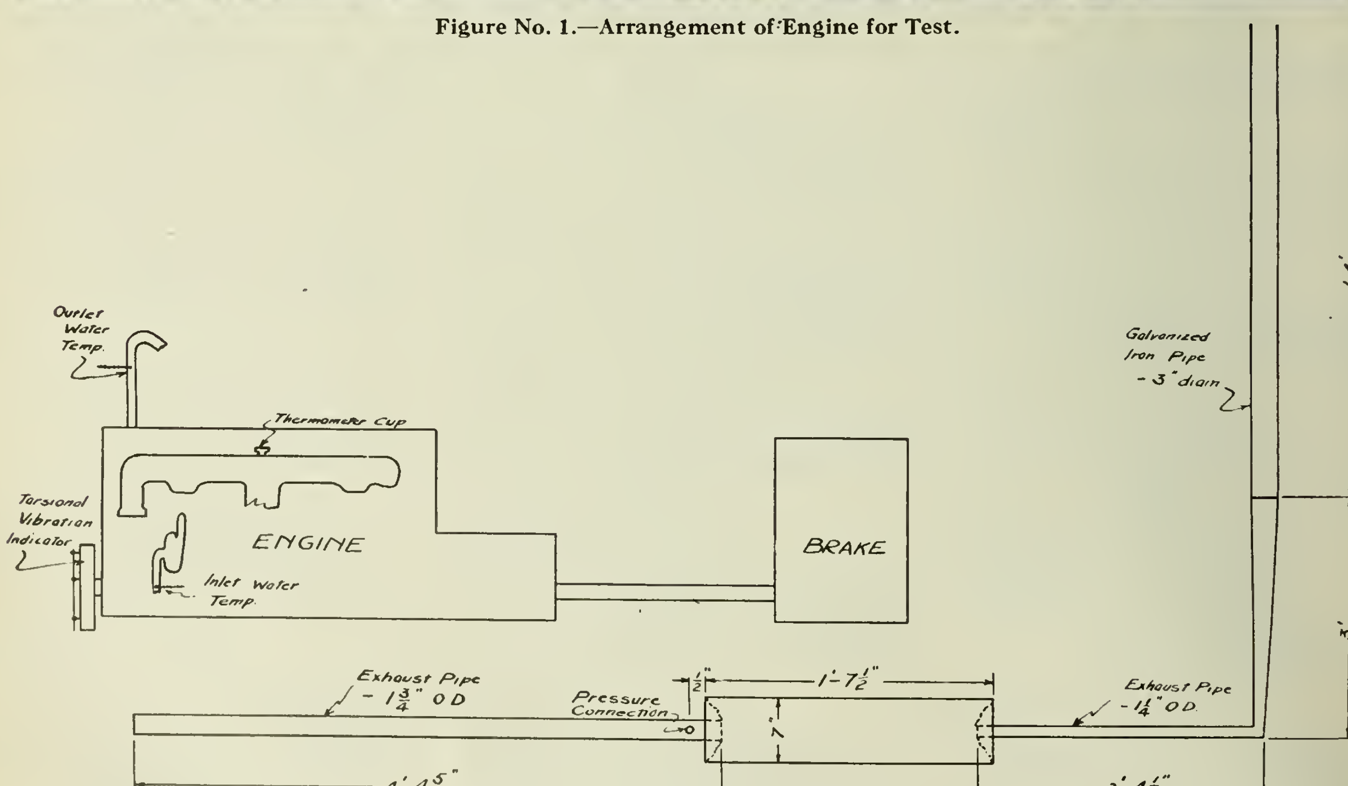


Figure No 2.—Diagram of Test Layout.

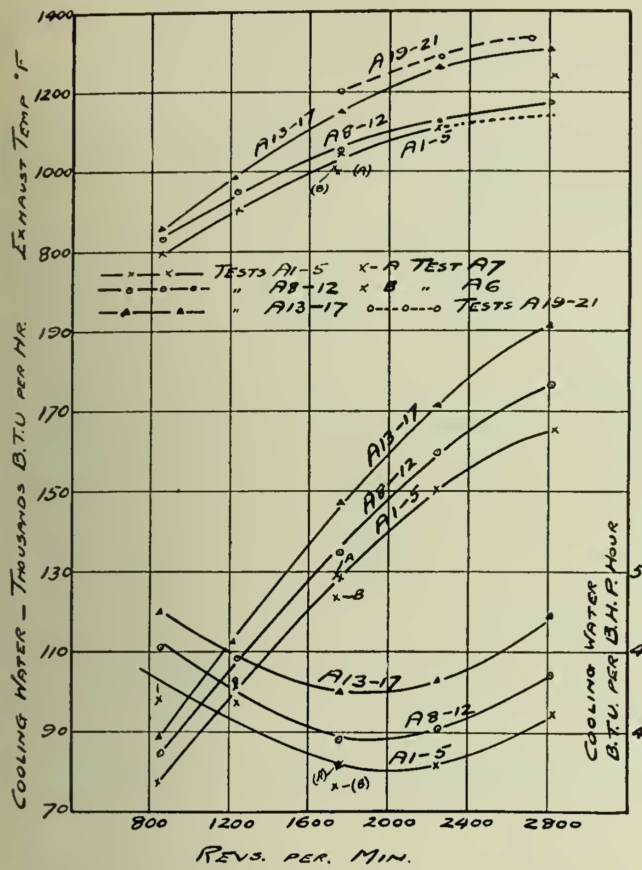


Figure No. 3.—Results of "A" Tests with Different Mixture Strengths.

Spark Advance	Max. B.H.P.	Mixture Ratio Air/Fuel	Max. I.H.P.	Mixture Ratio Air/Fuel
10°	1.14	14.5	1.92	14.0
20°	1.26	13.5	2.02	13.0
30°	1.21	10.5	1.97	12.5

Taking the correct mixture ratio for complete combustion as 15:1, it is evident that all of these maxima are obtained with rich mixtures. This paper also indicates a decrease of mechanical efficiency as the mixture increases in richness.

A summary of the situation, given by S. W. Sparrow,[4] points to the same conclusions, that the maximum economy is obtained with the leanest mixture upon which the engine will run regularly, and the maximum power with a mixture 10 to 20 per cent richer than that required for complete combustion.

The reason for the former is not far to seek. Excess air is required for maximum efficiency, because the air and fuel are never completely mixed in the cylinder, and therefore there must be sufficient oxygen present at all points to burn the fuel available, otherwise some incomplete combustion will result. With this conclusion the present series of results is in agreement.

The case of the power curve, however, is different. In the tests cited above, the power curve rises rapidly to a maximum on the rich side, and then slowly decreases as the quantity of fuel is increased. The present tests, (figure No. 6), indicate no appreciable difference in power over the range of mixtures investigated. It is reasonably certain that weaker mixtures than those given in figure No. 6 would show progressive decreases in power, but at each of the speeds indicated the power curves were practically flat, thus differing from those obtained in the experiments described above. In several of those cases, the engine experimented on was a single cylinder variable compression engine, and the question arises whether the results obtained on such engines are generally applicable to multi-cylinder engines. This series of tests, made on a six-cylinder engine manufactured under commercial conditions, indicates that there is some doubt on that point.

The fuel consumption curves are fairly flat, reaching a minimum in each case between 1,200 and 2,000 r.p.m.

In all cases the curves representing the percentage of CO_2 in the exhaust gases were very flat. It is notable that the tests made at 850 r.p.m. in all cases gave a lower percentage of CO_2 and more CO and O_2 than those made at higher speeds.

Warner[5] states that with 7 per cent of CO_2 in the exhaust gases, combustion is about 57.5 per cent complete, and with 14 per cent CO_2 combustion is 97 per cent complete. Between the two, (according to Fieldner and Jones), there is a straight line relationship. As in the present series, 13-14 per cent CO_2 was obtained in many tests, it is evident that the combustion efficiency was high.

(4) "Elements of Fuel Economy," Society of Automotive Engineers Jrl., June 1921.

(5) "Instruments for Automotive Research," Society of Automotive Engineers Jrl., June 1925.

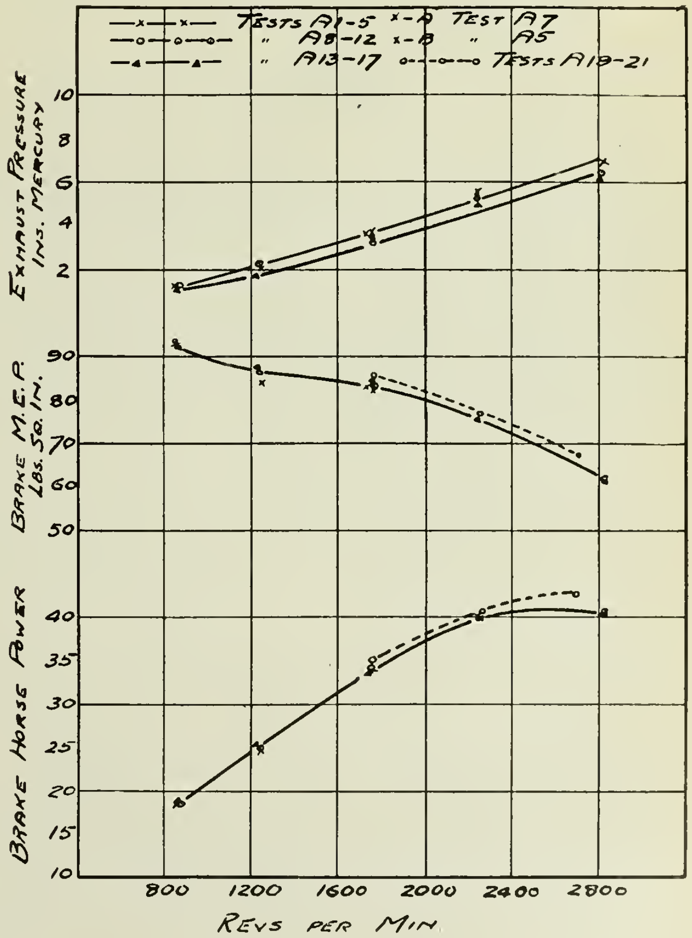


Figure No. 4.—Results of "A" Tests with Different Mixture Strengths.

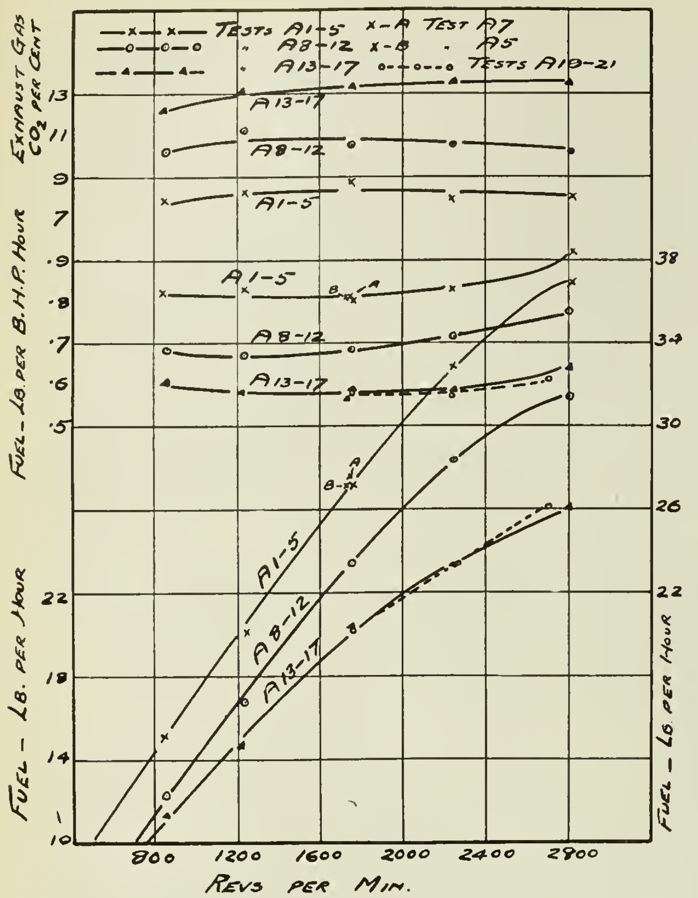


Figure No. 5.—Results of "A" Tests with Different Mixture Strengths.

The cooling water losses decreased as the speed increased, and increased as the mixture strength was decreased. That is to say, the weak mixtures which developed the highest exhaust temperatures also rejected to the cooling water approximately 40 per cent of the heat generated, as against 25 per cent in the case of the rich mixtures.

In all cases the thermal efficiencies were calculated on the higher calorific values of the fuels as obtained in the Parr calorimeter. In these tests, Blue Sunoco gasoline was used throughout, and brake thermal efficiencies up to 23 per cent were obtained. In a previous series made with engine No. 15-L 5057, efficiencies of over 24 per cent were obtained on several occasions.

A further series of tests was made on this engine to determine the effect of the muffler and air cleaner on the power and economy obtained. The air cleaner was removed and the muffler and tail pipe were replaced by 21 feet of 1½- to 1¾-inch exhaust piping. The carburettor setting was approximately that used in tests *A 13-17*, and the mixture was practically the same as indicated by the exhaust analyses for tests *A 19-21*, (table No. 13). At 1,760 r.p.m. the power was increased from 34.7 to 35.0 b.h.p. At 2,260 r.p.m. the increase was from 39.7 to 40.6, and at maximum speed the power was raised from 40.6 to 42.6 b.h.p. The economy was unaltered, but the exhaust temperatures were higher than those in the previous series. The results obtained are indicated by dotted lines in figures Nos. 3-6.

Advantage was taken of this opportunity to check the results obtained with different mixture strengths, and therefore tests *A 22* and *23* were performed under exactly the same conditions as test *A 21*, but with the main jet of the carburettor opened ¼ turn between each pair of tests.

Again, it is evident that the power is practically unaltered as the mixture is made richer than the chemically correct mixture.

Different Fuels

During the past ten years considerable attention has been paid to the nature of the fuel used in gasoline engines, and the various characteristics that conduce to satisfactory performance on the road.

The desirable features are:—

(a) Easy starting.
(b) Good acceleration.
(c) High anti-detonation, or anti-knocking value.

Easy starting from cold requires a comparatively large percentage of constituents with low boiling points. In this connection it was pointed out by Professor G. G. Brown[6] that fuels giving easy starting and having low boiling points are liable to vapourise in the carburettor under road conditions, and also that the mixture is liable to be superheated in the intake manifold in some cases. This causes a loss of power and economy, particularly at part throttle. Figures Nos. 7 and 8 give the distillation curves for the fuels under consideration. Figure No. 7 was taken from the Dominion Survey,[7] and figure No. 8 contains the actual distillation curves obtained from samples of the fuels used in the tests.

Detonation is a complex subject and has been the sub-

[6] "Present Tendencies in Motor Fuel Quality," Society of Automotive Engineers Jrl., May 1928.

[7] "Gasoline Survey for 1927," Rosewarne and Offord, Dept. of Mines, Ottawa, April 1928.

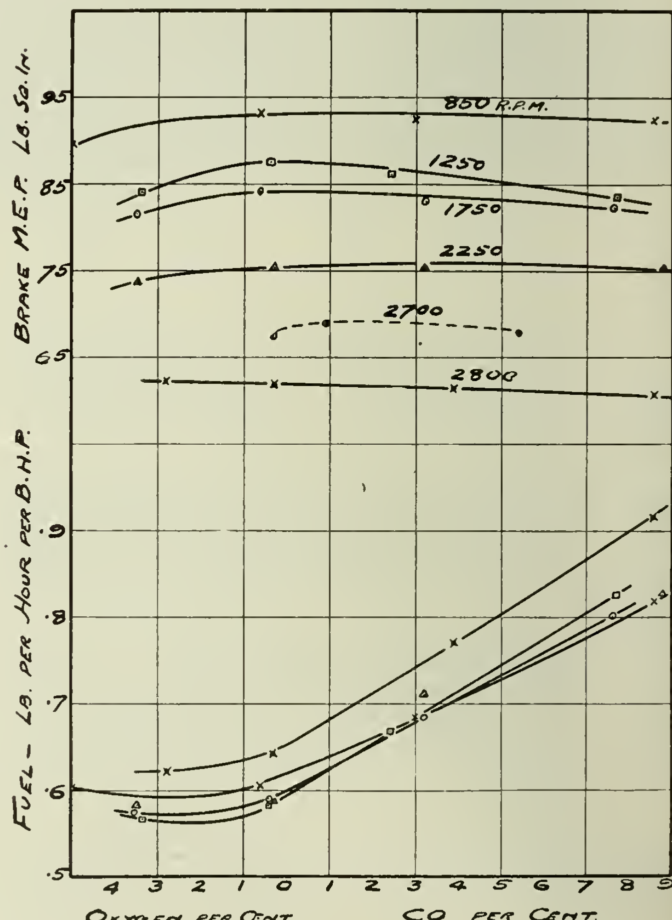


Figure No. 6.—Results of "A" Tests with Different Mixture Strengths.

ject of numerous papers: Brown[8] has investigated the relationship between volatility and detonating properties of fuels, and Ricardo has established the importance, from a detonation standpoint, of the relative proportions of paraffins, aromatics and naphthenes in the fuel. Numerous papers have appeared, and the Society of Automotive Engineers has held symposiums on volatility and detonation,[9] so that the subject has been well considered. However, there is no finality of opinion, either on the nature of detonation, or on the method of measuring it, so that these matters will not be considered here.

Anti-detonating fuels, however, are in common use, and various claims of increased power, economy and carbon removal are made for them. The advantage of ethyl and similar gasolines in increasing the possible compression ratio, (and therefore the power and economy of engines), may be conceded, but the question arises whether any benefit is derivable from their use in engines having compression ratios less than 5½ to 1, and well designed combustion spaces where detonation would not normally occur. The present engine, having a compression ratio of 5.35:1, was well suited to such an investigation, and the fuels were chosen with this idea in view.

In these tests the engine was run with the same carburettor setting throughout. The " A " series was run on Blue Sunoco gasoline, and the carburettor setting, (1½ turns), corresponding to tests *A 13-17*, was chosen as a standard, because the exhaust analysis showed that under

(8) "The Relation of Motor Fuel Characteristics to Engine Performance," University of Michigan Bulletin, May 1927.
(9) cf., Society of Automotive Engineers Jrl., April 1928.

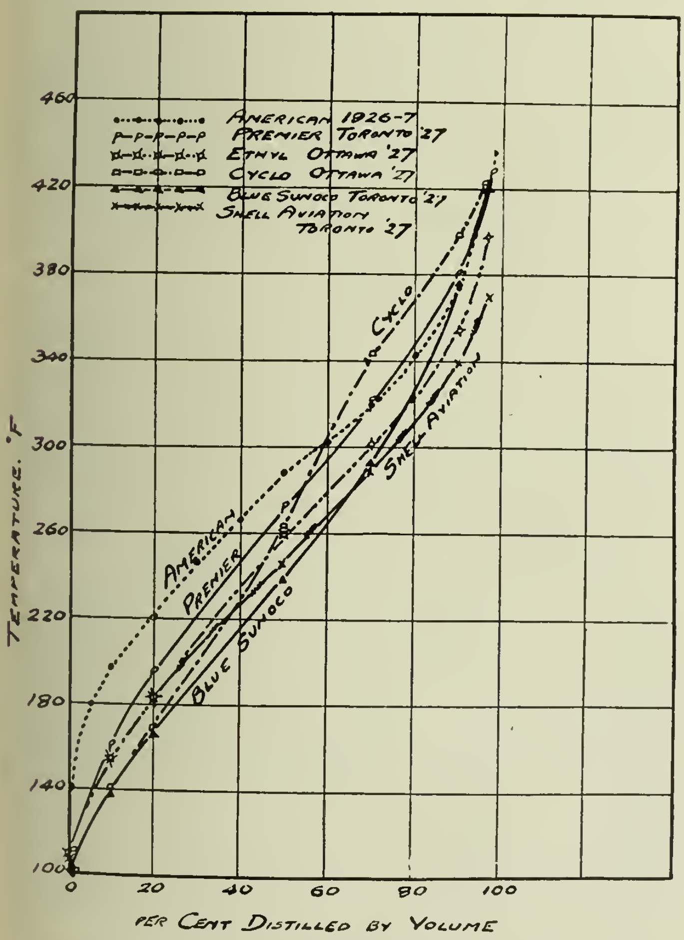


Figure No. 7.—Fractional Distillations for 1926-27 from Dominion Report.

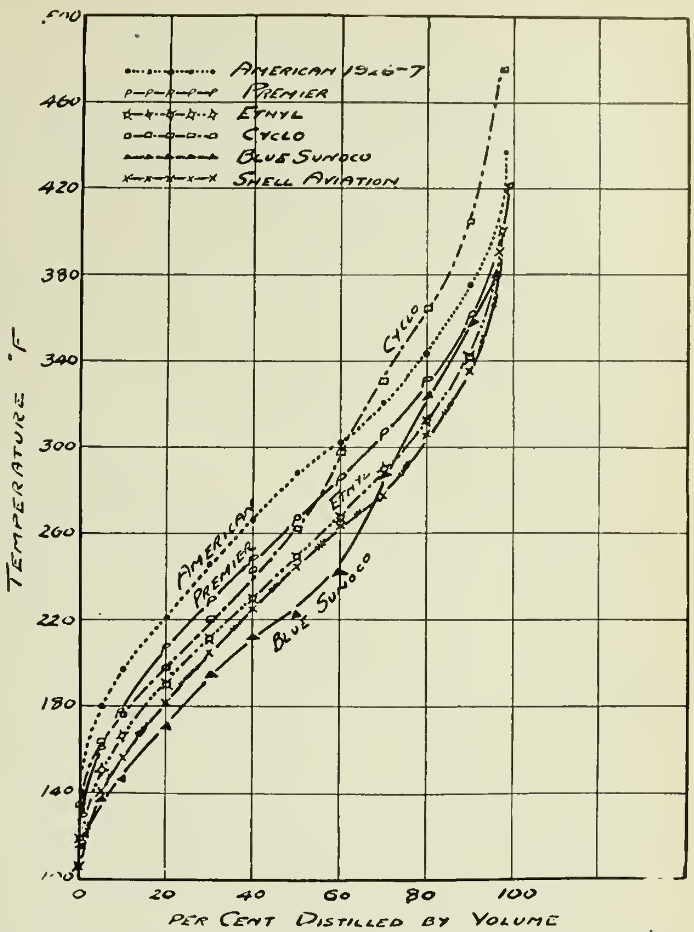


Figure No. 8.—Fractional Distillations of Samples Taken During Tests.

these conditions the mixture was very nearly chemically correct. Table No. 3 indicates that in this series there was no CO in the exhaust gases and the free oxygen content was about 0.4 per cent.

Tests *B 1-5* were made under the same conditions with Imperial ethyl gasoline, but it was found that the exhaust gases contained about 2.5 per cent of CO, (table No. 5). A further series of tests was then made with the carburettor jet closed ⅛ turn. The results obtained are given in table No. 6, (tests *B 8-12*), and under these conditions the fuel consumption at the most economical speed was cut down from .615 to .578 lbs. per b.h.p. hour.

Allowing for the slight difference in speed in tests *B-1* and *B-8*, respectively, the power of the engine again was not affected by the change of mixture. The lower and higher speeds in this case showed a slight loss of power with the leaner mixture.

Tests *C*, (table No. 7), with Shell Aviation, *D*, (table No. 8), with "Cyclo," and *E*, (table No. 9), with Premier gasoline, were all made under the same conditions as tests *A 13-17* and *B 1-5*. The results are plotted in figures Nos. 9, 10 and 11.

Figure No. 9 indicates that the minimum consumption in pounds per b.h.p. hour was obtained over the entire speed range with Blue Sunoco gasoline. The hourly consumption of Shell Aviation fuel was less with the same carburettor setting, but the power obtained was also less. Figure No. 12 gives the fuel consumption curves on a volumetric basis, as this is the condition under which each fuel is sold; and, taking into account the retail prices as on July 14th, 1928, table No. 10 shows in cents per b.h.p. hour the cost of running at 1,750 r.p.m., (35 miles per hour), and full load.

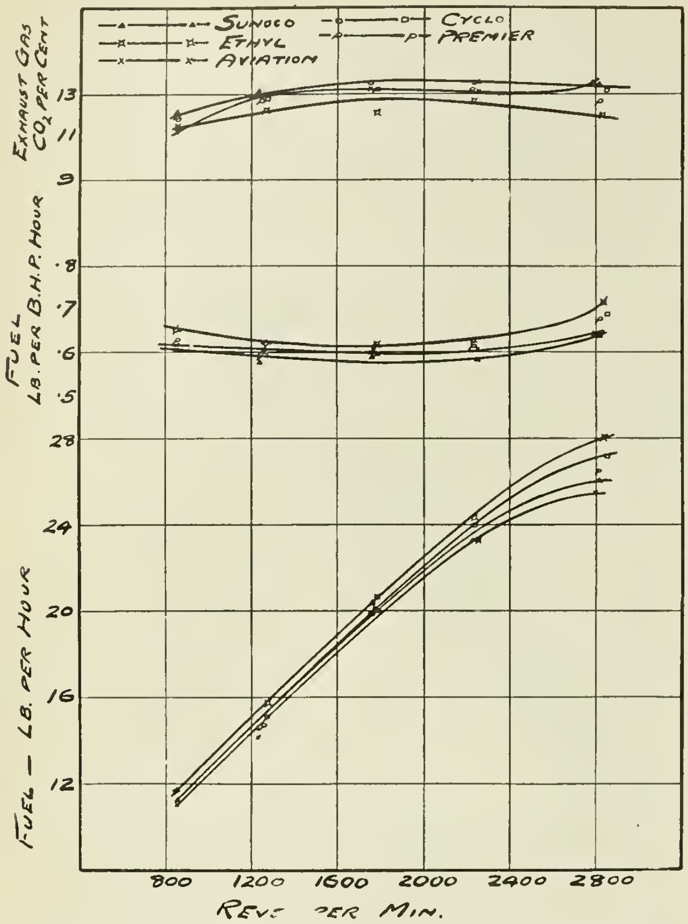


Figure No. 9.—Chart showing Results of Tests on Different Fuels.

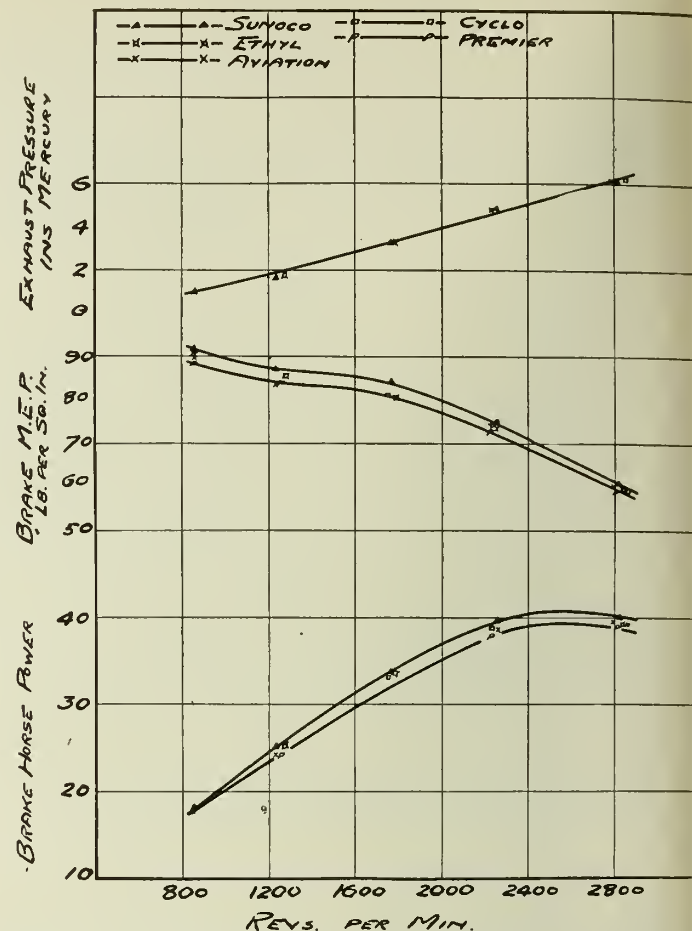


Figure No. 10.—Chart showing Results of Tests on Different Fuels.

This, of course, does not take into account variations in actual running conditions, but it is the only basis of comparison available. The minimum cost of running varies from 1.99 cents per b.h.p. hour on Blue Sunoco to 2.433 cents on Shell Aviation. The latter figure is due to the low specific gravity of this fuel, which is .717, as compared with .74 for most of the other gasolines tested. The cooling water losses do not vary very greatly for the different fuels. In each series the water outlet temperature was adjusted to 160-170°F., so that variations from this cause should not affect the results.

The general conclusion to be drawn from these figures is identical with that of Professor Brown,[10] who states that there is no economic advantage in buying anti-knock fuels at a 3-cent premium, (about 11 per cent on the selling price), if an engine having a compression ratio of 5½ to 1 can be operated satisfactorily on an ordinary gasoline.

Cooling Water Temperatures

At the end of each series of tests described above, further experiments were made with the maximum and minimum quantities of cooling water available, so that the influence of cooling water temperature on the power and economy of the engine might be studied at different speeds. The temperature range obtainable was not the same in each case, because the cooling water for the brake was taken off the same inlet pipe, and this could not be reduced below a certain quantity. However, the outlet temperature range in all cases was varied sufficiently to indicate any differences that might exist on this account.

The jacket temperature may be expected to influence five factors in engine economy and operation. These are:—

(a) Cooling loss during combustion.
(b) Volumetric efficiency.
(c) Piston friction.
(d) Crank case dilution.
(e) Starting difficulties.

Ricardo[11] states that in all cases the cooling water loss during the combustion period does not exceed about 13 per cent of the heat in the fuel, and therefore the saving achieved by using high water temperatures can only be a portion of this amount. Also, as the difference in temperature between the hot gases and water is in the neighbourhood of 3,500°F., the greatest possible difference in water temperature can only be small by comparison, and therefore the difference in (a) is probably negligible.

On the basis that the change in temperature of the entering gases is about 1/6 that of the cylinder walls, and that the power output is proportional to the absolute temperature of the gases, Ricardo also calculates an advantage of 2½ to 3½ per cent in power in favour of a low cooling water temperature. This is confirmed by Taub,[12] who found that with a water outlet temperature of 110-140°F., the volumetric efficiency of an engine was 81 per cent. From 140-180°F. the volumetric efficiency fell, until at 180-200°F. it was 77 per cent.

As the wall temperature rises, the viscosity of the lubricating oil falls, thus improving the mechanical efficiency,

[10] "Present Tendencies in Motor Fuel Quality," Society of Automotive Engineers Jrl., May 1928.

[11] "The Internal Combustion Engine," vol. II, p. 72.

[12] "High Average Operating Temperature," Society of Automotive Engineers Jrl., March 1926.

so that the power output may be increased as much as 3-8 per cent, due to this factor alone.

It follows, therefore, that factors (b) and (c) work in opposite directions, and according as the change in (c) is large or small, the use of high outlet temperatures may have a beneficial effect, or no effect at all, on the actual power produced.

It is certain, however, that a low cylinder temperature will increase crank case dilution. This is confirmed by Sparrow and Eisinger,[13] who indicate a reduction of dilution from 5 per cent to 0 as the jacket temperature increases from 50° to 212°F. Taub states that 16 per cent crank case dilution is necessary to facilitate starting with a cold engine, but this would appear to be dependent on the kind of oil used and its temperature.

Cold cylinder walls obviously make it more difficult to get sufficient fuel into the cylinder when starting the engine, on account of the precipitation of fuel in the liquid state.

The question of cylinder wall temperature and its influence on power and economy is important in connection with the proposed adoption of steam cooling, which produces a uniform temperature of 212°F. Numerous papers have been written on the advantages of this system to prove the benefits obtainable in practical operation, but steam cooling is advancing very slowly, if at all.[14]

In connection with this investigation a previous series of tests on a tractor engine had indicated little or no difference in power and economy when the cooling water outlet temperature was varied from 100 to 200°F. In the present case tests were made at 1,750, (*A* and *B* series), 1,250, (*C* series), 855, (*D* series), and 2,250 r.p.m., (*E* series), so that

[13] "Recent Co-operative Fuel Research Progress," Society of Automotive Engineers Jr., February 1925.

[14] Except in aircraft work. Steam cooling is being used on the "Tornado" engine used in the large British airship R-101 for Trans-Atlantic work. (Wing-Commander Cave-Browne-Cave, on "The Evaporative Cooling of Aircraft Engines."—British Association, Section G, September 10, 1928.

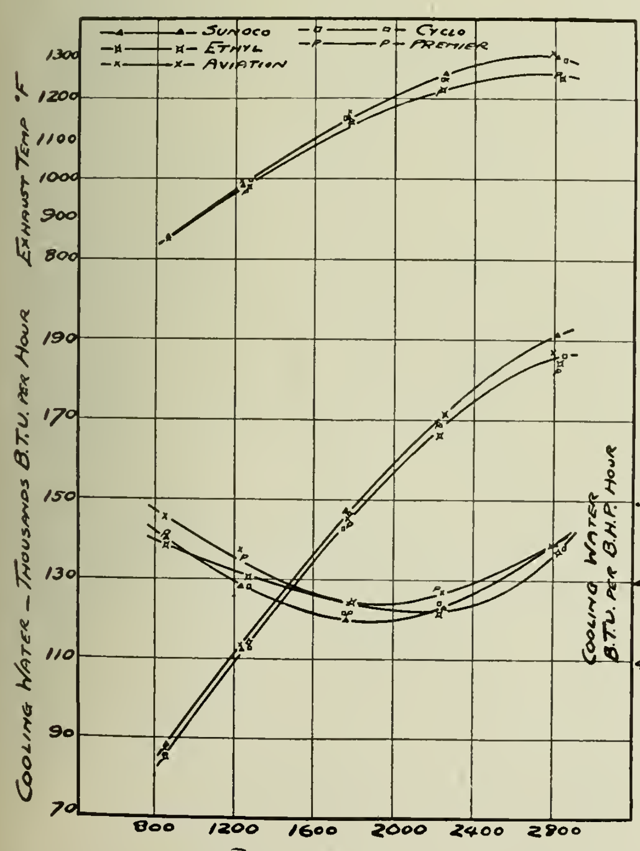


Figure No. 11.—Chart showing Results of Tests on Different Fuels.

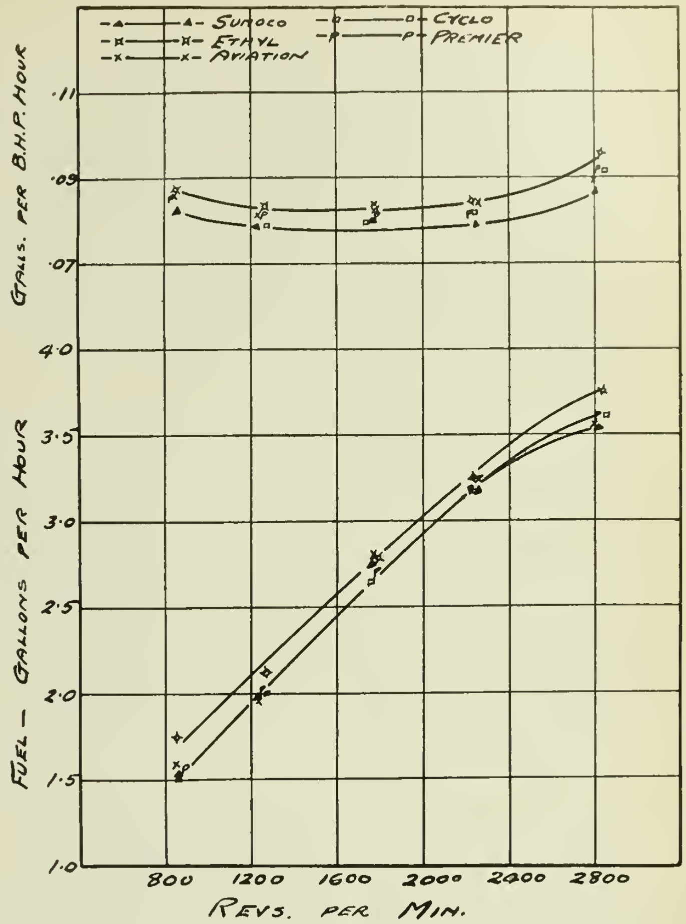


Figure No. 12.—Chart showing Results of Tests on Different Fuels (Volumetric Bas's).

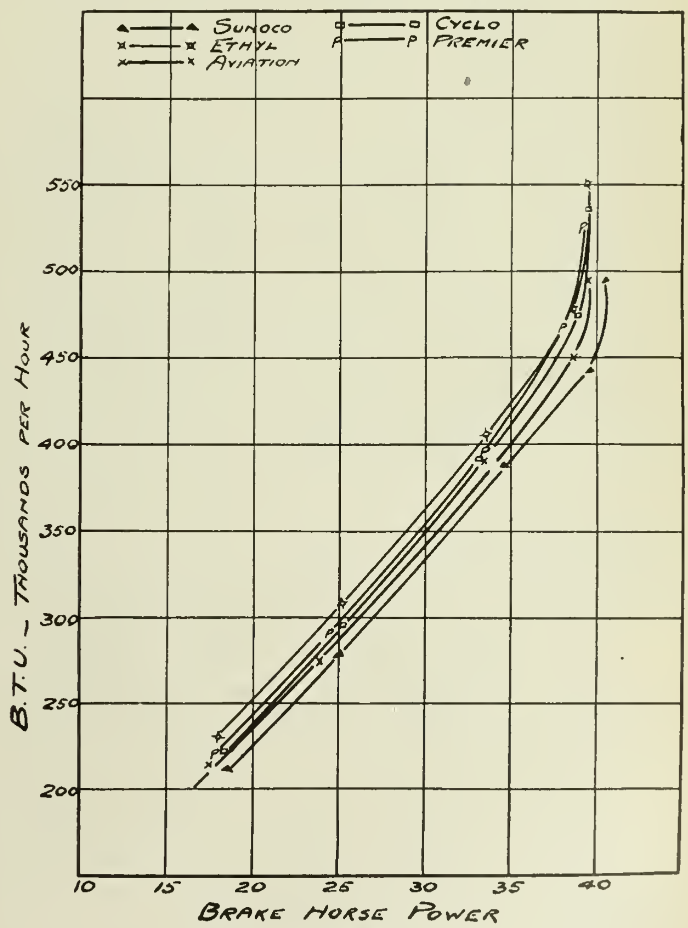


Figure No. 13.—Chart showing Hourly Heat Consumption of Different Fuels.

different fuels were investigated, as well as different speeds. The results are given in table No. 11.

In most cases a slight fall of power was observed at the higher temperatures, and at 855 and 2,250 r.p.m. there was a slight increase of economy, but this did not hold good for the other speeds, at which the economy was unaffected.

The total heat lost per hour to the cooling water decreased generally as the temperature increased, but the cooling loss expressed as a percentage of the total heat entering the engine remained very nearly constant, and did not show any progressive decrease. The figures are so close that it may be said that the cooling water temperature has no appreciable effect on the brake horse power, or on the brake thermal efficiency.

Special Lubricants in Fuel

Various special lubricants are now on the market, and it is claimed that if these are mixed with the fuel entering the carburettor, remarkable benefits in power, economy and mechanical running will be obtained. The *F* series, (table No. 12), was therefore devoted to an investigation of these claims. The running time was not sufficiently long to test the influence of these lubricants on the life or wear of the running surfaces, but it enabled the power and economy claims to be investigated.

Test *F-1* was run at nearly 1,800 r.p.m. with Premier gasoline, and at the end of this test the quantity of Mixtrol, prescribed in the instructions, was added to the fuel and the engine allowed to run for some time before test *F-2* was made. The power was unaltered, but there was a fall of about 2½ per cent in fuel consumption. The comparative costs are shown in table No. 10, from which it is seen that although the actual fuel cost per unit of power is reduced, the extra cost of the oil more than swamps the economy obtained.

A similar series, (*F-3* and *F-4*), with Aviation and Aviation + Mix-Ur-Oil, produced similar results. It would appear, therefore, that there is no gain in power or economy by using these lubricants, but there may possibly be beneficial results, as far as the running surfaces are concerned.

The thanks of the author are due to the Durant Company of Canada, who supplied the engine; to Messrs. G. H. Harlow, B.A.Sc., and R. A. Westervelt, B.A.Sc., who assisted in taking observations and making the necessary calculations; and to Mr. F. Hickey, who erected the test apparatus, and was in charge of the engine while the tests were in progress.

Table No. 1

Test No.	*A-1*	*A-2*	*A-3*	*A-4*	*A-5*
Date	June 11	June 11	June 11	June 11	June 11
Air temp. F	77	74	72.2	71.5	68
Exhaust temp. F	792	900	1,040	1,107	1,240
Fuel per hour, lbs	15.05	20.08	27.18	32.88	36.83
Cooling water per hour, lbs	632	913	1,105	1,273	1,472
Cooling water inlet temp., °F	50	49	49	49	50.7
Cooling water outlet temp., °F	172	160.1	165.4	167	162.9
Cooling water temp. rise, °F	122	111.1	116.4	118	112.2
Cooling water B t u. per hr	77,100	101,500	128,700	150,200	165,100
Brake load, net lbs	60.5	54.6	54.0	49.5	39.8
Brake M.E.P. lbs	92.3	83.6	82.4	75.6	60.8
Torque lbs.—ft	113.8	102.7	101.5	93.1	74.8
Speed, r.p.m	850	1,244	1,760	2,244	2,830
Brake horse power	18.35	24.3	33.9	39.7	40.2
Gasoline—S.G. (Sunoco)	....	....	.738	....	....
Cal. value	....	....	19,000 B.t.u. per lb.		
Fuel per b.h.p. hour—lbs.	0.82	0.827	0.801	0.829	0.917
Thermal eff. per cent	16.35	16.20	16.75	16.18	14.62
Cooling loss, B.t.u. per b.h.p. hour	4,200	4,175	3,795	3,785	4,110
Cooling loss, per cent	26.95	26.55	24.90	24.05	23.60
Exhaust and radiation, per cent	56.70	57.25	58.35	59.77	61.78
Ignition advance	14°	17°	20°	23°	28°
Throttle	....	....	Full open	....	....
Barometer, ins	29.83	29.83	29.83	29.83	29.85
Exhaust pressure, ins. mercury	1.2	2.1	3.7	5.5	6.9
Humidity, per cent	52	62	58	57	63
Exhaust analysis... CO_2	7.83	8.2	8.63	7.9	8.0
O	0.10	0.4	0.20	0.4	0.2
CO	8.63	7.7	7.63	8.8	8.6
N	83.44	83.7	83.54	82.9	83.2

Table No. 2

Test No.	*A-12*	*A-11*	*A 8*	*A 9*	*A 10*
Date	June 13	June 13	June 13	June 13	June 13
Air temp. F	77.5	75.7	71	73.5	74.5
Exhaust temp. F	830	947	1,050	1,125	1,170
Fuel per hour, lbs	12.73	16.68	23.43	28.35	31.38
Cooling water per hour, lbs	758	977	1,138	1,330	1,497
Cooling water inlet temp., °F	50	49	50.5	49.5	49
Cooling water outlet temp., °F	161	160.1	169	169.5	167
Cooling water temp. rise, °F	111	111.1	118.5	120	118
Cooling water B.t.u. per hr	84,200	108,400	134,800	159,600	176,700
Brake load, lbs	60.5	56.3	54.4	49.6	40.3
Brake M.E.P. lbs	92.5	86.1	83.1	75.6	61.6
Torque lbs.—ft	113.8	105.9	102.2	93.2	75.8
Speed, r.p.m	860	1,240	1,760	2,250	2,819
Brake horse power	18.6	24.95	34.2	39.8	40.6
Gasoline—S.G. (Sunoco)	....	....	.738	....	....
Cal. value	....	....	19,000 B.t.u. per lb.		
Fuel per b.h.p. hour—lbs.	0.684	0.668	0.685	0.712	0.772
Thermal eff per cent	19.55	20.05	19.45	18.8	17.35
Cooling loss, B.t.u. per b.h.p. hour	4,530	4,350	3,940	4,010	4,350
Cooling loss per cent	34.85	34.25	30.05	29.60	29.60
Exhaust and radiation, per cent	45.60	45.70	50.50	51.60	53.05
Ignition advance	18°	21°	25°	28°	32°
Throttle	....	....	Full open	....	....
Barometer, ins. mercury	29.61	29.61	29.62	29.62	29.62
Exhaust pressure, ins. mercury	1.2	1.9	3.4	5.2	6.4
Humidity, per cent	70	65	76	75	70
Exhaust analysis... CO_2	10.2	11.2	10.5	10.5	10.2
O	0.5	0.5	0.4	0.3	0.3
CO	3.0	2.4	3.2	3.2	3.9
N	86.3	85.9	85.9	86.0	85.6

Table No. 4

Engine speed r.p.m	850	1,250	1,750	2,250	2,800
Car speed—miles per hour	16.8	24.8	34.8	44.7	55.6

Table No. 3

Test No.	A 17	A-16	A-13	A-15	A-14	A-18
Date	June 15	June 15	June 15	June 15	June 15	July 6
Air temp. F.	75	74.5	69	73	71	81
Exhaust temp. F.	856	985	1,150	1,260	1,302	1,190
Fuel per hr. lbs.	11.29	14.64	20.43	23.28	26.08	17.75
Cooling water per hr., lbs.	757	955	1,303	1,330	1,430	1,329
Cooling water inlet temp., °F.	49	50	50	50	50	56
Cooling water outlet temp., °F.	166	167.5	163	179	184	160
Cooling water temp. rise, °F.	117	117.5	113	129	134	104
Cooling water B.t.u. per hr.	88,500	112,200	147,300	171,700	191,800	138,100
Brake load, lbs.	61.0	57.5	55.2	49.5	40.5	50.8
Brake M.E.P. lbs.	93.2	87.8	84.3	75.6	61.9	77.6
Torque lbs.—ft.	114.8	108.1	103.9	93.1	76.1	95.5
Speed, r.p.m.	855	1,225	1,760	2,247	2,807	1,734
Brake horse power	18.62	25.15	34.7	39.7	40.6	31.45
Gasoline—S.G. (Sunoco)	....	....	.738	....	....	....
Cal. value	....	....	19,000	B.t.u. p	er lb...	....
Fuel per b.h.p.hr.—lbs.	0.606	0.582	0.589	0.586	0.642	0.564
Thermal eff. per cent.	22.1	23.0	22.75	22.9	20.9	23.75
Cooling loss, B.t.u. per b h.p. hour	4,750	4,460	4,250	4,320	4,720	4,390
Cooling loss, per cent.	41.2	40.3	37.9	38.8	38.7	40.9
Exhaust and radiation, per cent	36.7	36.7	39.35	38.3	40.4	35.35
Ignition advance	16°	20°	22°	24°	29°	17°
Throttle	....	....	Full op	en.....	....	....
Barometer, ins. mercury	29.97	29.97	29.96	29.96	29.96	....
Exhaust pressure, ins. mercury	1.1	1.7	3.3	4.9	6.2	3.3
Humidity, per cent.	62	60	66	65	65	58
Exhaust analysis. . CO_2	12.2	13.1	13.3	13.6	13.5	13.75
O	0.6	0.4	0.4	0.3	0.3	0.65
CO	0	0	0	0	0	0.00
N	87.2	86.5	86.3	86.1	86.2	85.60

Table No. 5

Test No.	B-5	B-4	B-1	B-2	B-3
Date	June 25	June 25	June 25	June 25	June 25
Air temp. F.	80	77.5	75	76	77
Exhaust temp. F.	850	978	1,138	1,220	1,250
Fuel per hour, lbs.	11.73	15.72	20.68	24.35	28.06
Cooling water per hour lbs.	787	1,060	1,436	1,469	1,755
Cooling water inlet temp., °F.	56	55	55	54.5	55
Cooling water outlet temp., °F.	164	162.5	157	167.5	160
Cooling water temp. rise, °F.	108	107.5	102	113	105
Cooling water B.t.u. per hr.	85,000	114,000	146,400	166,000	184,300
Brake load, net lbs.	59.2	55.8	52.8	48.7	38.9
Brake M.E.P. lbs.	90.5	85.4	80.8	74.4	59.5
Torque lbs.-ft.	111.3	105	99.3	91.7	73.1
Speed, r.p.m.	851	1,267	1,780	2,226	2,837
Brake horse power	18.0	25.22	33.6	38.7	39.4
Gasoline—S.G. (Ethyl)	....	....	.744		
Cal. value	....	....	19,635	B.t.u.	per lb.
Fuel per b.h.p. hour-lbs.	0.652	0.622	0.615	0.629	0.713
Thermal eff. per cent.	19.9	20.82	21.1	20.6	18.2
Cooling loss, B.t.u. per b.h.p. hour	4,720	4,510	4,360	4,290	4,680
Cooling loss, per cent.	36.9	36.90	36.1	34.7	33.4
Exhaust and radiation, per cent	43.2	42.28	42.8	44.7	48.4
Throttle		Full	Open.		
Barometer, ins. mercury	29.40	29.40	29.40	29.40	29.40
Exhaust pressure, ins. mercury	1.1	1.8	3.3	4.8	6.2
Humidity, per cent.	69	72	73	71	71
Exhaust analysis. . . . CO_2	11.5	12.25	12.1	12.7	12.0
O	0.25	0.15	0.2	0.1	0.2
CO	3.45	2.60	2.4	2.30	3.1
N	84.80	85.00	85.3	85.9	84.7

Table No. 6

Test No.	B-12	B-11	B-8	B-10	B-9
Date	July 6	July 6	July 6	July 6	July 6
Air temp. F.	80	78.5	75	79	76
Exhaust temp. F.	897	1,011	1,183	1,282	1,327
Fuel per hour, lbs.	10.44	14.03	18.95	22.42	25.62
Cooling water per hour, lbs.	750	997	1,264	1,534	1,629
Cooling water inlet temp., °F.	56	56	57	55	56
Cooling water outlet temp., °F.	167	168.5	170	167	173
Cooling water temp. rise, °F.	111	112.5	113	112	117
Cooling water B.t.u. per hr.	83,200	112,100	142,900	171,900	190,600
Brake load, net lbs.	57.0	54.3	52.4	47.6	38.4
Brake M.E.P. lbs.	87.1	82.9	80.1	72.7	58.6
Torque lbs.-ft.	107.1	102.1	98.5	89.5	72.1
Speed, r.p.m.	844	1,268	1,752	2,244	2,842
Brake horse power	17.18	24.55	32.8	38.2	39.0
Gasoline—S.G. (Ethyl)	....	....	.744	....	....
Cal. value	....	....	19,635	B.t.u.	per lb.
Fuel per b.h.p. hour-lbs.	0.608	0.572	0.578	0.587	0.658
Thermal eff. per cent.	21.35	22.7	22.45	22.1	19.7
Cooling loss, B.t.u. per b.h.p. hr.	4,840	4,570	4,360	4,500	4,885
Cooling loss, per cent.	40.6	40.7	38.40	39.0	37.8
Exhaust and radiation, per cent	38.05	36.6	39.15	38.9	42.5
Ignition advance	7°	18°	17°	19°	21°
Throttle		Full	Open.		
Oil temp. in crank case, °F	175	....	214	260	276
Barometer, ins. mercury	29.8	29.8	29.76	29.76	29.76
Exhaust pressure, ins. mercury	1.0	1.8	3.3	4.8	6.3
Humidity, per cent.	58	61	65	57	63
Exhaust analysis. . . . CO_2	12.30	13.45	13 95	14.05	14.1
O	1.30	0.45	0.30	0.20	0.1
CO	0.35	0.00	0.00	0.00	0.0
N	86.05	86.10	85.75	85.75	85.8

Table No. 7

Test No.	C-7	C-4	C-1	C-3	C-2
Date	June 27	June 27	June 27	June 27	June 27
Air temp. F.	81	76.25	72	76.5	75.5
Exhaust temp. F.	851	992	1,165	1,243	1,313
Fuel per hour, lbs.	11.0	14.07	20.08	23.3	25.45
Cooling water per hour, lbs.	816	1,092	1,361	1,558	1,690
Cooling water inlet temp., °F.	54.5	53	55.5	53	53
Cooling water outlet temp., °F.	161.5	157	162.5	163	163.5
Cooling water temp. rise, °F.	107	104	107.0	110	110.5
Cooling water B.t.u. per hr.	87,300	113,700	145,700	171,300	186,800
Brake load, net lbs.	58.7	54.8	52.8	48.05	39.6
Brake M.E.P. lbs.	89.8	83.8	80.7	73.5	60.5
Torque lbs.-ft.	110.4	103	99.2	90.3	74.5
Speed r.p.m.	851	1,236	1,770	2,255	2,797
Brake horse power	17.85	24.2	33.4	38.7	39.6
Gasoline—S.G. (Aviation)	....	....	.717	....	....
Cal. Value	....	....	19,485	B.t.u.	per lb.
Fuel per b.h.p. hour-lbs.	0.616	0.581	0.601	0.602	0.643
Thermal eff. per cent.	21.2	22.5	21.8	21.7	20.35
Cooling loss, B.t.u. per b.h.p. hr.	4,890	4,695	4,360	4,430	4,720
Cooling loss, per cent.	40.7	41.4	37.2	37.8	37.75
Exhaust and radiation, per cent	38.1	36.1	41.0	40.5	41.90
Ignition advance	15°	20°	17°	24°	19°
Throttle		Full	Open.		
Oil temp. in crank case, °F	....	195	....	....	....
Barometer, ins. mercury	29.68	29.68	29.66	29.68	29.36
Exhaust pressure, ins. mercury	1.0	1.7	3.3	4.9	6.2
Humidity, per cent.	58	61	70	64	63
Exhaust analysis. . . . CO_2	11.38	12.95	13.28	13.1	13.6
O	0.10	0.35	0.15	0.05	0.0
CO	1.75	0.20	0.35	0.25	0.25
N	86.77	86.50	86.22	86.60	86.15

Table No. 8

Test No.	D 5	D 4	D-1	D 3	D-2
Date	June 29	June 29	June 29	June 29	June 29
Air temp. F	70	70.5	71.5	71.5	72
Exhaust temp. F	850	995	1,150	1,247	1,297
Fuel per hour, lbs	11.31	15.09	19.9	24.0	27.25
Cooling water per hour, lbs	837	1,029	1,251	1,561	1,754
Cooling water inlet temp., °F	51	50.5	51	50	50
Cooling water outlet temp., °F	153	160	165	158	156 156
Cooling water temp. rise, °F	102	109.5	114	108	106
Cooling water B.t.u. per hr	85,400	112,800	142,700	168,800	186,000
Brake load, net lbs	60.0	56.1	53.2	48.8	38.8
Brake M.E.P. lbs	91.8	85.6	81.4	74.6	59.4
Torque lbs.—ft	112.9	105.3	100.0	91.8	73.0
Speed, r.p.m	853	1,266	1,745	2,231	2,846
Brake horse power	18.28	25.35	33.2	38.9	39.45
Gasoline—S.G. (Cyclo)	....	....	.754	....	....
Cal. value	....	....	19,655	Bt.u.	per lb.
Fuel per b.h.p. hour—lbs.	0 618	0.595	0.599	0.617	0.690
Therm l eff. per cent	20.95	21.8	21.6	21.0	18.8
Cooling loss, B.t.u. per b.h.p. hr	4,670	4,445	4,295	4,340	4,710
Cooling loss, per cent	38.50	38.0	36.4	35.8	34.8
Exhaust and radiation, per cent	40.55	40.2	42.0	43.2	46.4
Throttle	....	....	Full ope	n.......	....
Oil temp. in crank case, °F	178	211	200	263	267
Barometer, ins. mercury	29.40	29.40	29.45	29.45	29.45
Exhaust pressure, ins. mercury	1.1	1.8	3.2	4.9	6.2
Humidity per cent	80	81	78	80	78
Exhaust analysis.... CO_2	11.9	12.8	13.55	13.5	13.18
O	0.35	0.1	0.15	0.0	0.0
CO	1.60	0.85	0.30	0.45	0.4
N	86.15	86.25	86.00	86.05	86.42

Table No. 9

Test No.	E 5	E-4	E 1	E 3	E 2
Date	July 4	July 4	July 4	July 4	July 4
Air temp. F	85	84.5	77	83	82
Exhaust temp. F	860	968	1,143	1,219	1,263
Fuel per hour lbs,	11.15	14.7	20.0	23.38	26.5
Cooling water per hour, lbs	799	1,126	1,271	1,552	1,663
Cooling water inlet temp., °F	57	56.5	57	56	57
Cooling water outlet temp., °F	163	157.5	170	165	167
Cooling water temp. rise, °F	106	101	113	109	110
Cooling water B.t.u. per hr	84,700	113,600	143,700	169 000	182,000
Brake load, net lbs	58.0	55.0	52.8	47.9	39.0
Brake M.E.P. lbs	88.6	84.0	80.7	73.2	59.6
Torque lbs.—f	109	103.4	99.3	90.1	73.3
Speed, r.p.m	855	1,245	1,777	2,220	2,807
Brake horse power	17.7	24.45	33.5	38.0	39.1
Gasol ne—S.G. (Premier)	....	....	.737	....	....
Cal. value	....	....	19,830	B.t.u.	per lb.
Fuel per b.h.p. hour—lbs.	0.630	0.601	0.597	0.615	0.678
Thermal eff. per cent	20.4	21.4	21.55	20.9	18.95
Cooling loss, B.t.u. per b.h.p. hour	4,780	4,640	4,290	4,450	4,680
Cooling loss, per cent	38.3	39.0	36.30	36.5	34.80
Exhaust and radiation, per cent	41.3	39.6	42.15	42.6	46.25
Throttle	....	....	Full	open	....
Oil temp. in crank case, °F	175	208	202	266	269
Barometer, ins. mercury.	29.65	29.59	29.59	29.59	29.59
Exhaust pressure, ins. mercury	1.1	1.8	3.3	4.8	6.0
Humidity, per cent	63	61	80	65	65
Exhaust analysis.... CO_2	12.00	12.75	13.2	13.25	12.7
O	0.45	0.30	0.2	0.20	0.1
CO	1.90	0.90	0.7	0.65	1.2
N	85.65	86.05	85.9	85.90	86.0

Table No. 10—Comparative Costs of Power from Different Fuels at 1,750 R.P.M.

Test No	A-13	A-18	B-7	B-8	C-1	D-1	E-1	F-1	F-2	F-3	F-4
Gasoline	Blue Sunoco	Blue Sunoco	Imp. Ethyl	Imp. Ethyl	Shell Aviation	Cyclo	Premier	Premier	Premier + Mixtrol	Shell Aviation	Aviation + Mix-Ur-Oil
Retail price cents per Imp gal	26	26	30	30	29	29	26	26	26	29	29
Imp. gal. per b.h.p. hr	0.0798	0.0764	0.0786	0.0777	0.0838	0.0794	0.081	0.0822	0.0799	0.082	0.0826
Gasoline cost cents per b.h.p. hr.	2.075	1.985	2.36	2.33	2.430	2.305	2.105	2.137	2.078	2.38	2.395
Date	June 15	July 6	June 25	July 6	June 27	June 29	July 4	July 9	July 9	July 9	July 9
Specific grav. gasoline	0.738	0.737	0.744	0.744	0.717	0.754	0.737	0.737	.....	0.717	.....
B.t.u. per Imp. gal	140,000	140,000	146,000	146,000	139,500	148,000	146,000	146,000	.....	139,500	....
Additional price per Imp. Gal. in cents	....	....	....	....	....	....	....	....	2	....	*0.362
Inclusive cents per b.h.p. hr.	....	....	....	....	....	....	....	....	2.238	....	2.423

*Wholesale price.

TABLE No. 11

Test No.	A-7	A-3	A-6	B-7	B-1	B-6	C 5	C 4	C 6	D-7	D-5	D 6	E-6	E-3	E-7
Date	June 11	June 11	June 11	June 25	June 25	June 25	June 27	June 27	June 27	June 29	June 29	June 29	July 4	July 4	July 4
Air temp. F	79	72.2	78.2	81.5	75	80	80	76.25	81	69	70	70	86	83	88
Exhaust temp. F	1,000	1,040	1,005	1,156	1,138	1,156	995	992	1,000	848	850	847	1,220	1,219	1,220
Fuel per hour, lbs	27.48	27.18	27.08	19.53	20.68	19.52	14.86	14.07	14.73	11.72	11.31	11.15	23.44	23.38	22.6
Cooling water per hour, lbs	1,594.5	1,105	856.5	2,586	1,436	960	2,017.5	1,092	762	2,800.5	837	547.5	2,812.5	1,552	1,132.5
Cooling water inlet temp., °F	50	49	50	56	55	56	54	53	54	50.5	51	51.5	57	56	56
Cooling water outlet temp., °F	130.8	165.4	194	110	157	202	113	157	202	82	153	198	118	165	202
Cooling water temp. rise, °F	80.8	116.4	144	54	102	146	59	104	148	31.5	102	146.5	61	109	146
Cooling water B.t.u. per hr	129,000	128,700	123,300	139,900	146,400	140,100	119,000	113,700	112,800	88,200	85,400	80,200	171,500	169,000	165,200
Brake load, net lbs	54.7	54.0	54.2	53.1	52.8	52.4	55.5	54.8	54.7	61.4	60.0	59.3	47.1	47.9	47.5
Brake M.E.P. lbs	83.6	82.4	82.9	81.1	80.8	80.1	85.0	83.8	83.6	94.1	91.8	90.6	72.0	73.2	72.6
Torque lbs.—ft	102.9	101.5	102	99.8	99.3	98.5	104.3	103	103	115.4	112.9	111.5	88.5	90.1	89.4
Speed, r.p.m	1,745	1,760	1,735	1,760	1,780	1,752	1,249	1,236	1,258	855	853	850	2,226	2,220	2,220
Brake horse power	34.1	33.9	33.6	33.4	33.6	32.8	24.8	24.2	24.6	18.8	18.28	18.0	37.5	38.0	37.7
Gasol ne—S.G	(Sunoco	) .738		(Ethyl)	.744		(Aviati	on)	.717	(Cyclo	) .754		(Prem	ier).737	
Approx cal. value	19,000	B.t.u.	per lb.	19,635	B.t.u.	per lb.	19,485	B.t.u. p	er lb.	19,655	B.t.u.	per lb.	19,830	B.t.u.	per lb.
Fuel per b.h p. hr.—lbs.	0.806	0.801	0.806	0.585	0.615	0.595	0.599	0.581	0.599	0.624	0.618	0.619	0.626	0.615	0.595
Thermal eff. per cent.	16.65	16.75	16.65	22.15	21.1	21.8	21.75	22.45	21.75	20.75	20.95	20.9	20.5	20.9	21.6
Cooling loss B.t.u. per b.h.p. hr	3,785	3,795	3,670	4,190	4,360	4,275	4,800	4,695	4,590	4,690	4,670	4,460	4,575	4,450	4,390
Cooling loss per cent	24.75	24.95	24.00	36.5	36.1	36.6	41.0	41.50	39.2	38.20	38.50	36.6	36.9	36.50	37.2
Exhaust and radiation per cent	58.60	58.30	59.35	41.35	42.8	41.6	37.25	36.05	39.05	41.05	40.55	42.5	42.6	38.05	41.2
Throttle	Full	open		Full	open		Full o	pen		Full o	pen		Full o	pen.	
Barometer—ins	29.85	29.83	29.85	29.40	29.40	29.40	29.68	29.68	29.68	29.40	29.40	29.40	29.65	29.59	29.65
Exhaust pressure ins. mercury	3.7	3.7	3.6	3.3	3.3	3.2	1.8	1.7	1.8	1.1	1.1	1.1	4.7	4.8	4.7
Humidity, per cent	53	58	48	70	73	69	61	61	58	78	80	78	60	65	55
Exhaust analysis CO_2	...	8.63	...	...	12.1	...	....	12.95	....	....	11.90	....	....	13.25	....
O	...	0.20	...	...	0.2	...	....	0.35	....	....	0.35	....	....	0.20	....
CO	...	7.63	...	...	2.4	...	....	0.20	....	....	1.60	....	....	0.65	....
N	...	83.54	...	...	85.3	...	....	86.50	....	....	86.15	....	....	85.90	....

TABLE No. 12

Test No.	F-1	F-2	F-3	F-4
Date	July 9	July 9	July 9	July 9
Air temp. F	81.5	82.5	85.5	84
Exhaust temp. F	1,155	1,165	1,165	1,161
Fuel per hour, lbs	20.0	19.5	19.4	19.6
Cooling water per hour, lbs	1,170	1,140	1,253	1,285
Cooling water inlet temp., °F.	59	59	58	58
Cooling water outlet temp., °F	183.5	184	174	171.5
Cooling water temp. rise, °F	124.5	125	116	113.5
Cooling water B.t.u. per hr	145,800	142,500	145,300	145,800
Brake load, net lbs	51.8	51.7	51.5	51.7
Brake M.E.P. lbs	79.1	79.0	78.7	79.1
Torque lbs.—ft	97.4	97.2	96.9	97.2
Speed, r.p.m	1,784	1,793	1,793	1,789
Brake horse power	33.0	33.1	33.0	33.1
	Premier	Mixtrol	Aviation	Mix-Ur-Oil
Gasoline—S.G	0.737	0.851	0.717	0.865
Cal. value	19,830	B.t.u. lb.	19,485	B.t.u. lb.
Fuel per b.h.p. hour—lbs	0.606	0.589	0.588	0.592
Thermal eff. per cent	21.2	....	22.2	....
Cooling loss, B.t.u. per b.h.p. hr	4,420	4,310	4,410	4,410
Cooling loss per cent	36.8	....	38.5	....
Exhaust and radiation, per cent	42.0	....	39.3	....
Throttle	Full	open	Full	open
Oil temp. in crank case, °F	203	215	200	220
Barometer, ins. mercury	29.72	29.72	29.72	29.72
Exhaust pressure, ins. mercury	3.3	3.3	3.3	3.3
Humidity, per cent	78	77	70	73
Exhaust analysis CO_2	12.95	13.55	13.45	13.50
O_2	0.75	0.20	0.35	0.25
CO	0.00	0.00	0.00	0.00
N_2	86.30	86.25	86.20	86.25

TABLE No. 13—TESTS ON ENGINE STRIPPED.

Test No.	A-19	A-21	A-20	A-22	A-23
Date	July 26	July 26	July 26	July 26	July 26
Air temp. °F	78.7	82	82	85	87
Exhaust temp. °F	1,200	1,285	1,330	1,305	1,225
Fuel per hour, lbs	20.25	23.35	26.05	27.48	32.3
Cooling water outlet temp. °F	146	154	161	161	155
Brake load, net lbs	55.8	50.2	44.0	44.3	44.2
Brake M.E.P. lbs. per sq. in	85.2	76.8	67.2	68.7	67.4
Torque lbs. ft	105	94.4	82.6	83.5	83.1
Speed r.p.m	1,758	2,265	2,710	2,714	2,735
Brake horse power	35.0	40.6	42.6	42.9	43.1
Gasoline—S.G. (Sunoco)	....	....	.738	....	....
Cal. value	....	....	19,000 B	.t.u. per	lb......
Fuel per b.h.p. hour—lbs.	0.58	0.575	0.612	0.641	0.75
Thermal eff. per cent	23.2	23.3	21.8	20.9	17.9
Throttle	....	....	Full ope	n.......	....
Barometer, ins	29.82	29.82	29.82	29.82	29.82
Exhaust pressure Hg	None	1.1	1.3	1.5	1.5
Humidity, per cent	74	78	78	80	75
Exhaust analysis CO_2%	14.2	14.4	14.0	13.2	10.0
O_2%	0.6	0.5	0.4	0.4	0.4
CO %	0	0	0	0.9	5.4
N_2%	85.2	85.1	85.6	85.5	84.2

The Saint-Paul Ward Main Sewer in the City of Montreal

Features Governing the General Plan and Design, and Details of Construction

Geo. R. MacLeod, M.E.I.C.
Chief Engineer, Technical Service, City of Montreal.

Paper read before the Montreal Branch of The Engineering Institute of Canada, October 11th, 1928

The Saint-Paul ward main sewer is so called because it drains the greater part of Saint-Paul ward, but the drainage area, 1,135 acres, includes also a part of the town of La Salle.

As may be seen from the accompanying map, figure No. 1, the easterly boundary of the area is not a natural "height of land" but an artificial barrier formed by the aqueduct canal of the city of Montreal. The same is true of a portion of the northerly boundary, where the Lachine canal prevents a certain amount of drainage towards the valley of the Little River Saint-Pierre.

The point of final concentration for the area under discussion, so far as the new sewer is concerned, is at the intersection of Pitt and Dunn streets, where the new sewer discharges into a circular brick sewer of 6 feet diameter built in 1914-15. The latter sewer follows Pitt street and St. Patrick street, passes under the Canadian National Railway and discharges into the Little River Saint-Pierre at a point near the old water works tailrace.

It should be stated here that the capacity of this 6-foot brick sewer is less than that of the new 10-foot St. Paul Ward sewer, but as the area to be drained by the latter will not be fully developed for some years, the 6-foot sewer will adequately take care of the flow for the present, and when the run-off shall have become too great for this arrangement, a new auxiliary sewer to take care of the extra flow will be built from the intersection of Pitt and Dunn streets to a junction with the very large Saint-Pierre river collector, which is proposed to be built next year. This junction with the Saint-Pierre river collector will be near Atwater avenue and the tailrace.

Commencing at Pitt and Dunn streets, the new Saint-Paul ward sewer runs parallel to and close to the aqueduct canal as far as Raudot street, a distance of 7,090 feet, composed of 1,029 feet of 10-foot diameter, 2,677 feet of 9½-foot diameter and 3,384 feet of 9-foot diameter, all of horseshoe section. Thence the sewer runs along Raudot street, (a southwesterly direction), and this part is composed of 1,325 feet of circular brick of 6-foot diameter, 1,075 feet of 5½-foot diameter, and 350 feet of circular 5-foot diameter, which brings it to the intersection of Jogues street, from whence it turns almost due west along the north line of the unsubdivided farm, (cadastre 4684), with gradually decreasing diameters of 4.5, 4, 3.5, and finally 3 feet, terminating for the present at the boundary between Montreal and La Salle; the total length of this branch being 4,075 feet.

Determination of Drainage Areas

The drainage area, for the purpose of determining the

Figure No. 1.—General Plan of St. Paul Ward Drainage District.

coefficient of run-off, which varies from place to place, is divided into ten areas of different sizes, according to the local conditions of the soil, the slope, the character of the surface, and the minimum time of concentration.

In designing sewers, more especially trunk sewers, the first step is to determine the outermost limit or boundary of the whole area. The next is to subdivide this into sections or areas over which the conditions named above are fairly uniform. Then, taking a given area with a given intensity of rainfall, the total quantity of water falling on the area under study, in a given time, is easily arrived at. Next by applying the run-off coefficient adopted for the local conditions, the proportion of the water finding its way into the sewers is calculated, and hence the total quantity that must be taken care of at the point of concentration on that particular portion of the trunk sewer.

The formulæ governing the intensities, and the considerations determining the run-off factor which were used in designing the Saint-Paul ward main sewer, being the result of years of study and research in the Technical Service of the city of Montreal, were very fully discussed and explained in the paper presented before the Montreal Branch of The Institute by J. G. Caron, A.M.E.I.C., on April 16th, 1925, and later printed in The Engineering Journal of June 1925, and for that reason need not be repeated here.

Run-off Factors

It is sufficient to give some idea of the variation in the run-off factor from one division of the drainage area to another. For example, referring to figure No. 1, the division of 430 acres at the extreme or south end of the district is given a run-off factor of only 39.3 per cent; this area is all composed of open fields without streets or urban development of any kind. The slope is fairly flat and it is known that a large part of the area has been reserved for a park. Incidentally, it should be mentioned that this area will be served later by an extension of the trunk sewer along the aqueduct from a junction at Raudot to whatever distance may be required. The diameter of this extension will be 7 feet 4 inches, and, of course, the discharge from this future sewer was taken into account in designing the main trunk from Raudot to Pitt street.

The next area, 312 acres, is given a run-off factor of 60 per cent chiefly because the streets are very close together, indicating a large proportion of paved surface per acre, and the subdivision consists of narrow lots, with not a very great depth, which indicates a very large proportion of roof area per acre.

An even higher factor, 64 per cent, is given to the 34 acres north of Rielle street, between Wedgewood and De-Villiers streets.

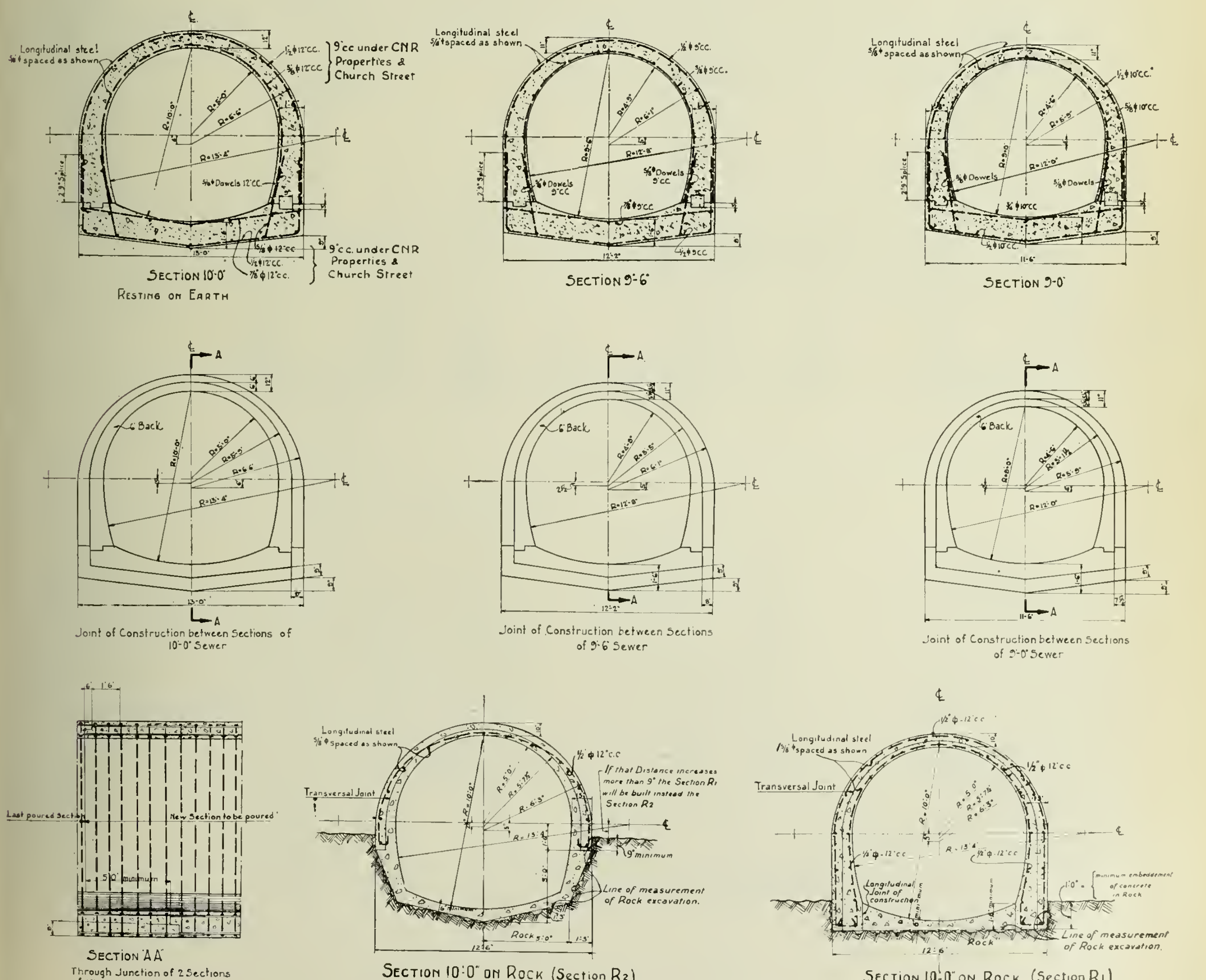


Figure No. 2.—Typical Cross-sections for 10′ 0″, 9′ 6″ and 9′ 0″ Sewers.

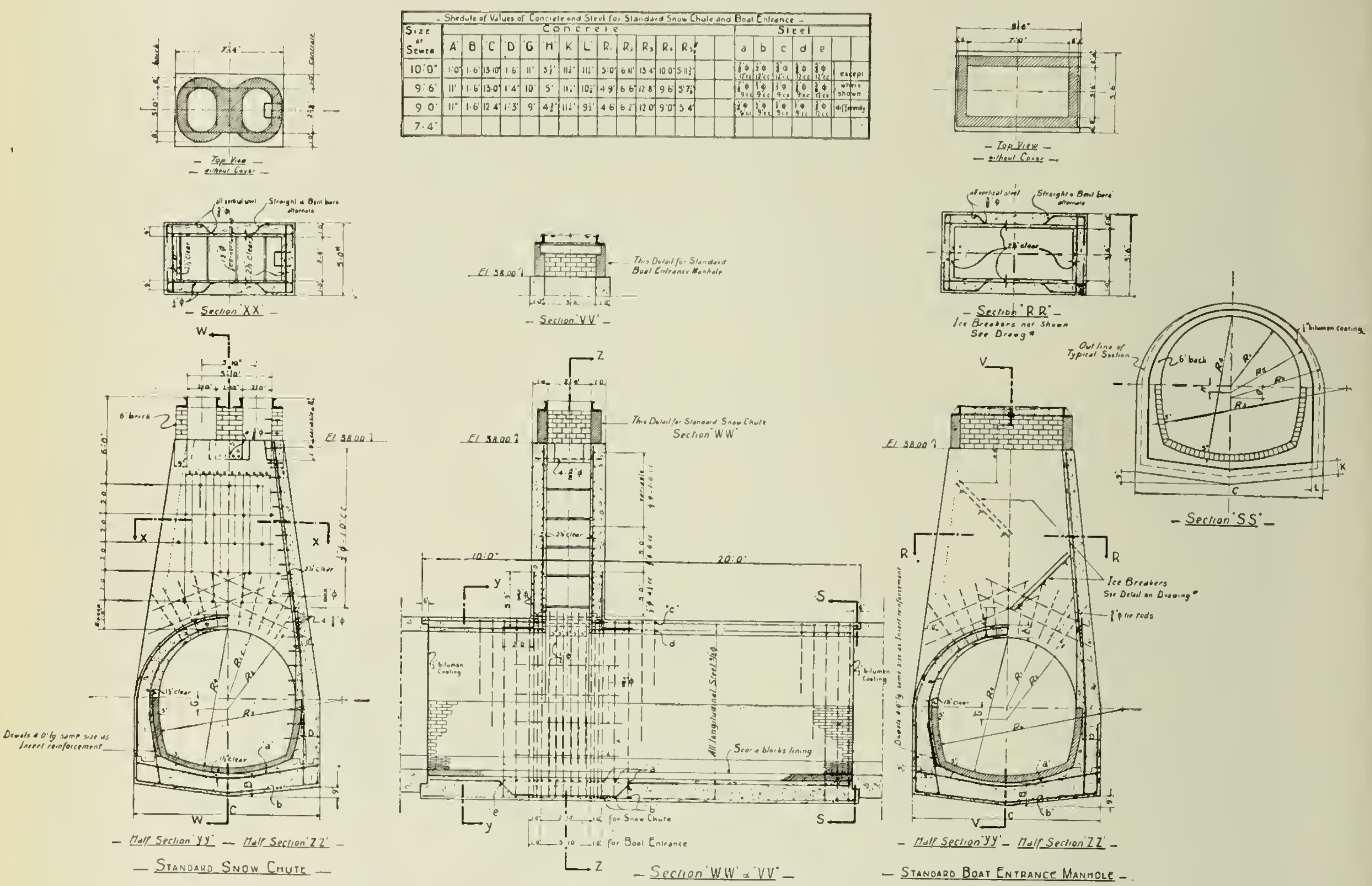
Other examples of the run-off factor on the diagram, figure No. 1, are:—144 acres, 50 per cent; 13.5 acres, 40 per cent; 42 acres, 52 per cent.

Another feature of this trunk sewer not yet mentioned is the branch of circular brick sewer, 4 feet in diameter, on DeMaricourt street, connecting with the 9.5-foot trunk at the aqueduct and extending along DeMaricourt and Rielle streets, a distance of 2,000 feet. This branch is now under construction and as soon as it is completed it will be possible to discontinue operating the sewerage pumps, which have been handling the sewerage from an area of about 130 acres in the vicinity of Rielle street, this area being too low to drain by gravity into the existing system of old sewers in the northern part of the district.

The total length of trunk sewer, including the branches of circular section, is 13,165 feet.

As there is nothing unusual connected with the size or the design of the circular brick sewers on Raudot street and on DeMaricourt street, the data given below refers only to the reinforced concrete section, 7,090 feet long, parallel to the aqueduct canal.

As the fall between the foot of Raudot street and the



- Shedule of Values of Concrete and Steel for Standard Snow Chute and Boat Entrance -

Size of Sewer	A	B	C	D	G	H	K	L	R1	R2	R3	R4	R5			a	b	c	d	e		
10'0"	1'0"	1-6"	13'0"	1'6"	11"	5½"	11½"	11½"	5'0"	6'11"	13'4"	10'0"	5'11½"			ϕ 12"cc	ϕ 12"cc	ϕ 12"cc	ϕ 12"cc	ϕ 12"cc	except	
9'6"	11"	1-6"	13'0"	1'4"	10"	5"	11½"	10½"	4'9"	6'6"	12'8"	9'6"	5'7½"			ϕ 9"cc	ϕ 9"cc	ϕ 9"cc	ϕ 9"cc	ϕ 12"cc	where shown	
9'0"	11"	1-6"	12'4"	1'3"	9"	4½"	11½"	9½"	4'6"	6'2"	12'0"	9'0"	5'4"			ϕ 9"cc	ϕ 9"cc	ϕ 9"cc	ϕ 9"cc	ϕ 12"cc	differently	
7'4"																						

Figure No. 3.—Detail Plan for Snow-chute and Boat Entrance.

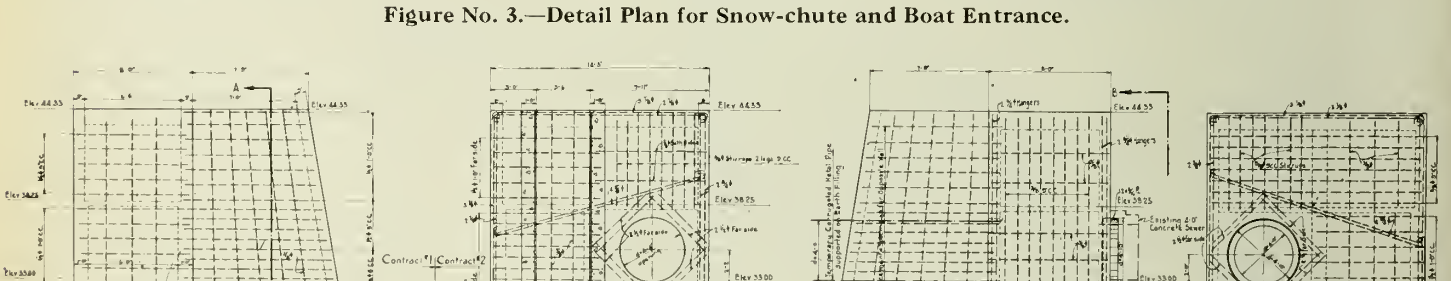


Figure No. 4.—Detail Plan of Chamber Connecting with Syphon under Aqueduct Canal.

intersection of Pitt and Dunn streets is nil at the surface, the rate of grade of the sewer is the minimum allowable, 0.10 feet per 100 feet. This very flat grade of course gives a very low velocity and hence necessitates a large sectional area of sewer.

Hydraulic Elements of Sewer

The hydraulic elements of the Saint-Paul ward main sewer have been computed from the invert to the crown and have been plotted on cross-section paper, taking as unity the height of the section, and from this diagram the ratio of each of the three hydraulic elements, area, mean velocity, and discharge, of the filled segment to that of the entire section, corresponding to any ratio of depth of flow to the vertical diameter may be obtained. This diagram gives also the ratio of the wetted area and mean hydraulic radius of the filled sections, in terms of the vertical diameter.

A slope of $S = 0.001$ and $n = 0.015$ has been used in the preparation of the diagram and the following constants have been derived:—

Diameter of equivalent circle	$= 1.0326\ D$
Wetted perimeter	$= 3.2895\ D$
Area	$= 0.8358\ D^2$
Hydraulic radius	$= 0.2542\ D$

According to this the maximum discharge occurs when the wetted area reaches 93 per cent of the whole section, and such discharge is then increased 0.07 per cent more than the sewer flowing full.

Details of Design

For details of design of the reinforced concrete sections, see figure No. 2. Before adopting this horseshoe section, complete calculations and designs of a section with semi-elliptical arch were made; a comparison of the elements of the latter with those of the horseshoe type resulted as follows:—

Comparison of a Horsesh e and Semi-elliptical Sections.

	Horseshoe	Semi-elliptical
Section	83.60	76.509
Perimeter	32.87	32.038
Hydraulic radius	2.543	2.388
Height	10 ft.	10 ft.
Width	10 ft.	10 ft.
Grade	0.001	0.001
Velocity	5.82	5.637
Discharge	486 c.f.s.	431 c.f.s.
Concrete	2.01 cu. yds.	1.6 cu. yd.
Steel	140.66 lbs.	112 lbs.

In construction, the invert was, of course, laid first, and allowed to stand untouched for at least 24 hours before beginning to place arch forms or doing any work which might crush or distort the newly poured invert. It is noted that there must be a space of at least 5 feet between the lap joint of invert, (section "A-A"), and the lap joint of side wall and arch sections. After construction commenced, the contractor was permitted to pour along with the invert

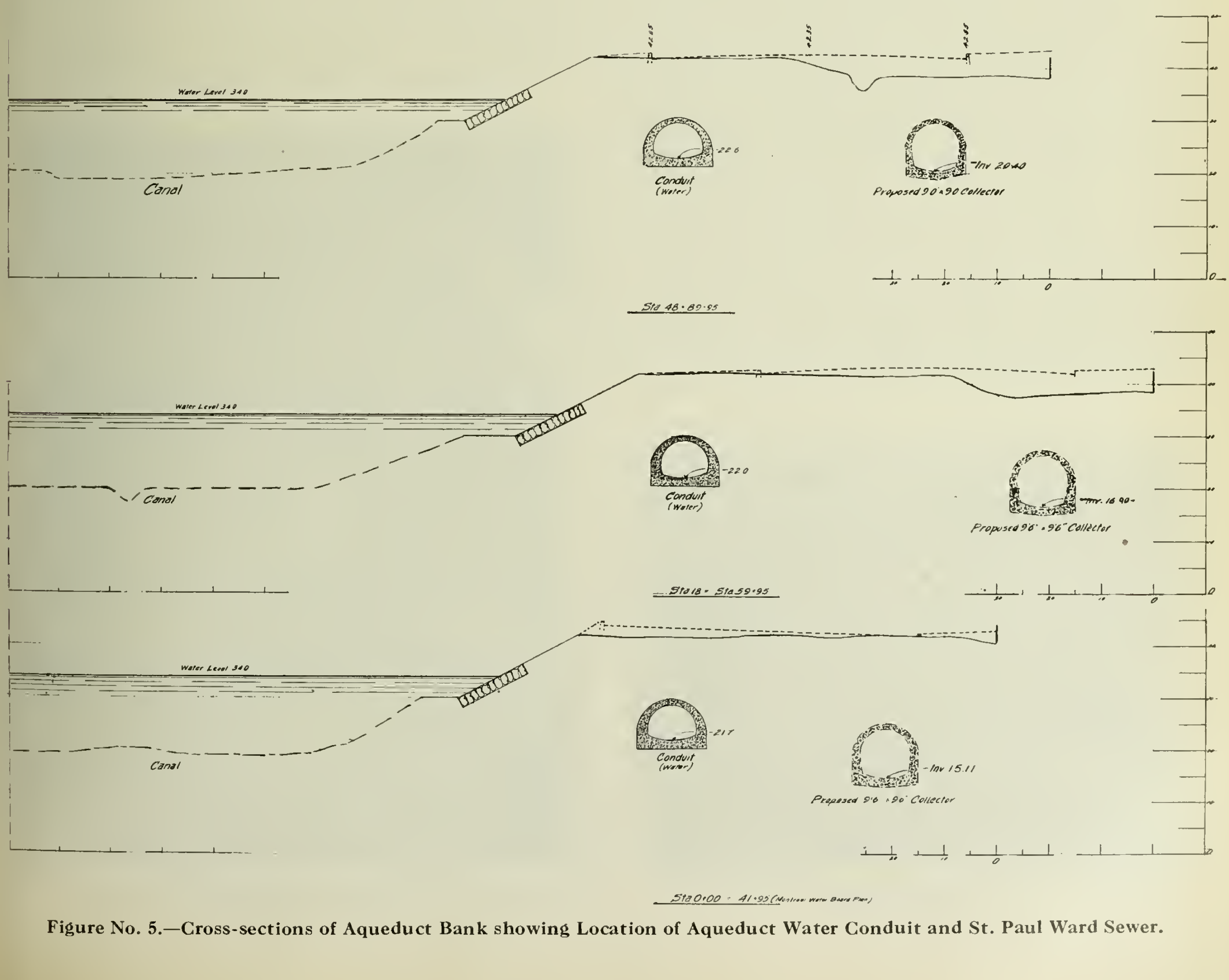


Figure No. 5.—Cross-sections of Aqueduct Bank showing Location of Aqueduct Water Conduit and St. Paul Ward Sewer.

Figure No. 6.—General View of 10′ 0″ Sewer, Looking Eastwards from Intersection of Canadian National Railway.

Figure No. 8.—Interior of Sewer, Looking Westwards, from Junction Chamber, Station 0 + 00.

a height of six inches of side walls, the object being to provide a face to hold the lower edges of the collapsible steel forms for the arch.

Figure No. 5 shows two cross-sections of the aqueduct canal, with a reinforced concrete water conduit in its " north " bank, and the space between this conduit and the sewer. The upper section shows practically the maximum distance between sewer and water conduit, and the lower section the minimum, which occurred for a distance of about 600 feet east of Church avenue. The average distance between sewer and conduit for the greater part of the work was about the mean between the maximum and minimum.

It turned out, however, that most of the rock excavation occurred on the stretch of sewer which was nearest the conduit. Before any rock blasting was permitted, the water conduit was emptied and remained empty during the whole period of blasting. Careful inspection of the conduit was made before and after blasting, and it was seen that no damage whatever was caused to the water conduit from that cause. It was feared that if any accident should occur with the conduit full of water, (under pressure), a very large area of that part of the city would be flooded, but happily such accident was entirely avoided.

The rock extended from station 0+00 to station 16+80, the maximum depth of rock excavated being 13.7 feet, the average depth 5½ feet, and the total quantity 3,954 cubic yards.

Before designing the cross-section, test pits and borings were made along the route of the sewer, so that the profile of rock above grade and the character of the soil were fairly well known in advance. In view of the proximity of the aqueduct and certain areas of a swampy nature, care was taken to provide a fairly substantial invert, and clauses were embodied in the specifications in case special foundations of crushed stone, plank flooring, class C concrete, or

Figure No. 7.—View of Bracing under Canadian National Railway Tracks.

Figure No. 9.—Interior of Sewer, Station 3 + 78, Looking Westwards, showing 120 ft. of Blaw Knox Steel Forms.

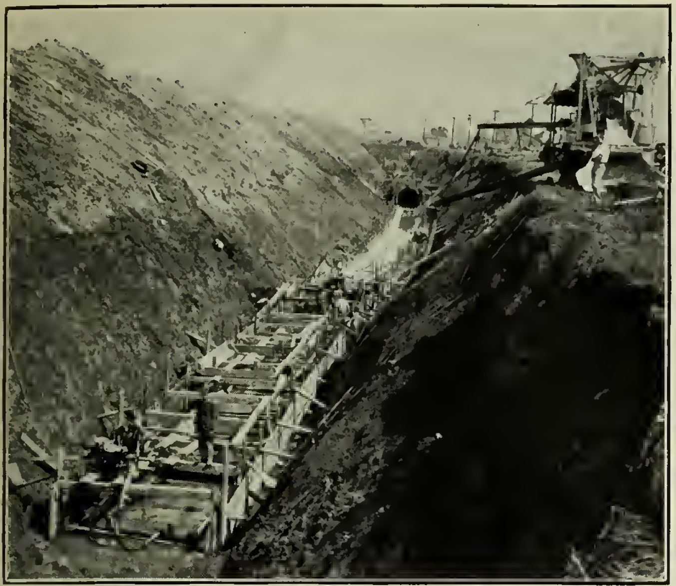


Figure No. 10.—General View of Works from Station 15 + 00, Looking Westwards.

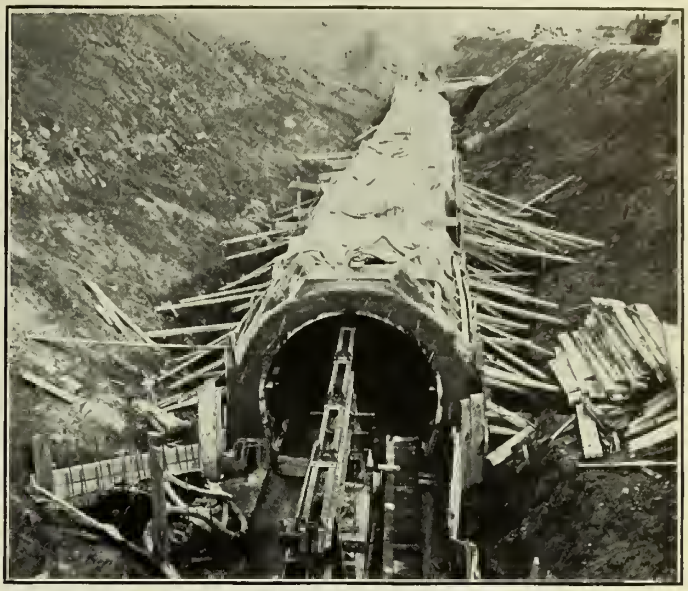


Figure No. 12.—View of End of 9′ × 9′ Sewer (Station 70 + 77.5) and Invert of Junction Chamber.

piles might be required. During actual construction no piles or class C concrete were required under the invert.

SPECIAL FOUNDATIONS

Special foundations were required from stations 33+50 to 33+77 and stations 39+08 to 39+50, representing a total length of 69 feet. These foundations consisted of eight rows of 2-inch planks about 2 feet apart, parallel to the axis of the sewer driven to a depth of from 5 to 6 feet below the sub-grade and covered with a layer of broken stone 9 to 12 inches thick. In other sections where the bottom of the trench was not firm and dry the sewer was built on a layer of broken stone and a 2-inch plank flooring with a layer of broken stone on top. For this purpose the quantity of wood used was 18,834 f.b.m. and the broken stone 522½ cubic yards.

The surveys, studies and plans for this trunk sewer were all worked out by engineers in the Technical Service of the city, under the general direction of the Montreal Sewers Commission, the personnel of which is as follows:—

Chairman:—The chairman of the Executive Committee of the city of Montreal.

Members:—H. A. Terreault, M.E.I.C., director of public works of the city; W. S. Lea, M.E.I.C., consulting engineer; T. J. Lafrenière, M.E.I.C., chief sanitary engineer, Provincial Bureau of Health.

Member and secretary:—Geo. R. MacLeod, M.E.I.C., engineer in charge of Technical Service.

It will be noted that the commission includes the chief executive officer of the city, the head of the Public Works Department, and the head of the engineering department, thus giving close intercourse between the commission and the engineering staffs in charge of design and construction, while the two consultant members are available at any time, and actually did come in for direct consultation on many special problems connected with the designs and during construction.

The inspection and testing of the materials, (cement, sand, stone, reinforcing steel, etc.), was performed by J. T. Donald and Company.

The construction contract was executed by the Atlas Construction Company, Limited. Work commenced on December 15th, 1926, and was completed in December 1927, while the official inspection and provisional acceptance took place on December 22nd, 1927.

Figure No. 11.—General View of Works from Station 41 + 30, Looking Eastwards.

Figure No. 13.—General View of Works from Station 70 + 50, Looking Eastwards, Bucyrus Drag-Line Backfilling at Station 67 + 00.

THE

ENGINEERING JOURNAL

THE JOURNAL OF
THE ENGINEERING INSTITUTE
OF CANADA

VOLUME XI NOVEMBER 1928 No. 11

Annual General and General Professional Meeting

Hamilton, Ont., February 13th, 14th and 15th, 1929.

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 October fifteenth, nineteen hundred and twenty-eight. 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:	C. H. Mitchell, M.E.I.C.,	Toronto.
VICE-PRESIDENTS:		
**Zone A.*	R. N. Blackburn, M.E.I.C.,	Regina.
	C. J. Mackenzie, M.E.I.C.,	Saskatoon.
	L. A. Thornton, M.E.I.C.,	Regina.
**Zone C.*	J. L. Busfield, M.E.I.C.,	Montreal.
	Geo. R. MacLeod, M.E.I.C.,	Montreal.
COUNCILLORS:		
†*Halifax Branch*	O. S. Cox, A.M.E.I.C.,	Halifax.
	J. F. Lumsden, M.E.I.C.,	Halifax.
†*Cape Breton Branch*	S. C. Mifflen, A.M.E.I.C.,	Sydney.
	J. P. Cotter, A.M.E.I.C.,	Sydney.
†*St. John Branch*	A. R. Crookshank, M.E.I.C.,	St. John.
	S. R. Weston, M.E.I.C.,	St. John.
†*Moncton Branch*	A. S. Gunn, A.M.E.I.C.,	Moncton.
	G. C. Torrens, A.M.E.I.C.,	Moncton.
†*Saguenay Branch*	N. D. Paine, A.M.E.I.C.,	Kenogami.
	H. B. Pelletier, A.M.E.I.C.,	Chicoutimi.
†*Quebec Branch*	A. B. Normandin, A.M.E.I.C.,	Quebec.
†*St. Maurice Valley Branch*	B. Grand Mont, A.M.E.I.C.,	Three Rivers.
	C. H. Jette, A.M.E.I.C.,	Three Rivers.
††*Montreal Branch*	F. A. Combe, M.E.I.C.,	Montreal.
	C. J. Desbaillets, M.E.I.C.,	Montreal.
	F. C. Laberge, M.E.I.C.,	Montreal.
	P. B. Motley, M.E.I.C.,	Montreal.
‡*Ottawa Branch*	C. Camsell, M.E.I.C.,	Ottawa.
	J. E. N. Cauchon, A.M.E.I.C.,	Ottawa.
†*Peterborough Branch*	R. L. Dobbin, M.E.I.C.,	Peterborough.
	E. R. Shirley, M.E.I.C.,	Peterborough.
†*Kingston Branch*	D. S. Ellis, A.M.E.I.C.,	Kingston.
	G. J. Smith, A.M.E.I.C.,	Kingston.
‡‡*Toronto Branch*	A. E. K. Bunnell, M.E.I.C.,	Toronto.
	R. B. Young, M.E.I.C.,	Toronto.
†*Hamilton Branch*	A. H. Munson, A.M.E.I.C.,	Hamilton.
	R. K. Palmer, M.E.I.C.,	Hamilton.
†*London Branch*	G. E. Martin, A.M.E.I.C.,	London.
	W. P. Near, M.E.I.C.,	London.
†*Niagara Peninsula Branch*	R. L. Hearn, M.E.I.C.,	Niagara Falls.
	C. H. Scheman, M.E.I.C.,	Bridgeburg.
†*Border City Branch*	L. M. Allan, A.M.E.I.C.,	Windsor.
	Harvey Thorne, M.E.I.C.,	Windsor.
†*Sault Ste. Marie Branch*	J. M. Silliman, A.M.E.I.C.,	Sudbury.
	C. H. Speer, M.E.I.C.,	Sault Ste. Marie.
†*Lakehead Branch*	G. P. Brophy, A.M.E.I.C.,	Port Arthur.
	G. H. Burbidge, M.E.I.C.,	Port Arthur.
†*Saskatchewan Branch*	D. A. R. McCannel, A.M.E.I.C.,	Regina.
	W. M. Stewart, A.M.E.I.C.,	Saskatoon.
†*Lethbridge Branch*	G. S. Brown, A.M.E.I.C.,	Lethbridge.
	H. R. Miles, M.E.I.C.,	Lethbridge.
†*Edmonton Branch*	C. A. Robb, M.E.I.C.,	Edmonton.
	R. S. L. Wilson, M.E.I.C.,	Edmonton.
†*Calgary Branch*	J. H. Ross, A.M.E.I.C.,	Calgary.
	W. B. Trotter, A.M.E.I.C.,	Calgary.
†*Vancouver Branch*	T. E. Price, A.M.E.I.C.,	Vancouver.
	W. Brand Young, A.M.E.I.C.,	Vancouver.
†*Victoria Branch*	R. F. Davy, A.M.E.I.C.,	Victoria.
	W. S. Drewry, A.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.

The Second Plenary Meeting of Council

The second Plenary Meeting of the Council of The Institute was held on Monday, Tuesday and Wednesday, October 15th, 16th and 17th, 1928, the following members being present:—

President Julian C. Smith, M.E.I.C., in the chair; Past-President A. R. Decary, M.E.I.C.; Vice-Presidents J. H. Hunter, M.E.I.C., W. G. Mitchell, M.E.I.C., and S. G. Porter, M.E.I.C.; Councillors W. C. Adams, M.E.I.C., M. B. Atkinson, M.E.I.C., A. J. M. Bowman, A.M.E.I.C., W. E. Clarke, M.E.I.C., E. Davis, M.E.I.C., H. W. L. Doane, M.E.I.C., R. L. Dobbin, M.E.I.C., R. J. Gibb, M.E.I.C., B. GrandMont, A.M.E.I.C., P. J. Jennings, M.E.I.C., Fraser S. Keith, M.E.I.C., O. O. Lefebvre, M.E.I.C., T. R. Loudon, M.E.I.C., H. R. MacKenzie, A.M.E.I.C., N. F. McCaghey, A.M.E.I.C., C. M. McKergow, M.E.I.C., W. F. McLaren, M.E.I.C., W. P. Near, M.E.I.C., W. H. Powell, M.E.I.C., P. L. Pratley, M.E.I.C., L. T. Rutledge, M.E.I.C., J. Stephens, M.E.I.C., J. G. R. Wainwright, A.M.E.I.C., F. L. West, M.E.I.C., and Treasurer F. P. Shearwood, M.E.I.C.

Letters of regret were read from Past-President George A. Walkem, M.E.I.C., Vice-President F. O. Condon, M.E.I.C., and Councillor J. L. Busfield, M.E.I.C.

Monday, October 15th

Morning Session

The president took the chair at the morning session of October 15th, and welcomed the visiting councillors, after which the report of the Nominating Committee for 1928, containing the list of nominees for officers for the year 1929, was presented and approved for communication to the membership. This list accordingly appears on page 566 of this issue of The Journal.

The design for the Sir John Kennedy Medal, which was approved at the last meeting of Council, was submitted for the information of councillors present, and the quality and weight of the medal were decided upon.

The attention of Council was drawn to the forthcoming World Engineering Congress to be held in Tokyo, Japan, in October 1929. The secretary reported that The Institute had been requested to send delegates, and also to contribute papers. The secretary was directed to obtain further information regarding this event and bring the matter up for consideration at a later meeting of Council.

The financial statement to September 30th, 1928, was submitted and approved, and the recommendations of the Finance Committee with regard to special cases, resignations, and Students in arrears were accepted.

The following elections and transfers were effected:—

Elections		Transfers	
Members	4	Associate Member to Member	2
Associate Members	4	Junior to Associate Member	2
Juniors	1	Student to Associate Member	4
		Student to Junior	7

F. P. Shearwood, M.E.I.C., the chairman of the Committee on Grades of Membership, presented a report of that committee's work, from which it appeared that the matter of the grades of membership would require further consideration, the opinion of the committee being strongly divided as to the policy which it is desirable for The Institute to adopt. Two main questions had been considered by the committee, the first being whether the scope of The Institute's membership should be widened so as to admit in some capacity men who cannot be considered fully and broadly educated engineers, but whose experience in engineering work or allied occupations has given them technical knowledge which could contribute materially to the principal object of The Institute, the dissemination of professional knowledge. Among these men would be included, for example, engineers holding responsible positions requiring exceptional engineering experience, but whose work is of a technical rather than a scientific nature.

The second point before the committee, dealt with the desirability of making any changes in the nomenclature and arrangement and qualifications of the present grades of membership.

From Mr. Shearwood's report it appeared that the committee had been unable to arrive at any definite recommendations, on account of fundamental differences in the points of view of the various members.

During the discussion which followed several members expressed the hope that in any changes that might be recommended there would be no tendency to lower the educational standard for admission to The Institute, and a suggestion was made that the Council's power of waiving the requirement for examination, as set forth in the concluding sentence of Section 8 of the By-laws, should perhaps be taken away or limited.

Further discussion on this report was held over until a later point in the meeting.

Afternoon Session

During the afternoon session the chair was taken by Vice-President S. G. Porter, M.E.I.C., and nearly the whole period was taken up with the consideration of a number of applications for admission and transfer, from which the members of Council present were able to judge of the difficulties which are experienced in classifying applicants whose training has not been exactly that contemplated in the By-laws. A number of special cases were also discussed. Eight Students were admitted.

Following this, the report of the Library and House Committee was presented, and in connection with this report it was decided to approve the expenditure necessary to change the swing of the various doors in the Headquarters building from inwards to outwards, so as to comply with the city building By-laws, and certain other necessary repairs were authorized.

Tuesday, October 16th

Morning Session

On the morning of Tuesday, October 16th, a set of rules governing the award of the Plummer Medal were submitted and approved, these rules being generally similar to those in force for the Leonard Medal. They are printed on page 571 of this issue of The Journal.

The newly elected officers of the Edmonton Branch were noted and approved.

Vice-President S. G. Porter, M.E.I.C., presented the report of his Committee on the Relations of The Institute with the various Provincial Professional Associations, and stated that this committee had considered the following questions:—

(1) Considering the welfare of the profession in its broadest sense, what relationship should exist between The Engineering Institute of Canada and the various provincial associations?

(2) What obstacles are there in the way of attaining the desired end?

(3) What procedure do you suggest for overcoming them?

While the committee was not yet in a position to make a definite recommendation, it appeared that a considerable number of its members believed that the ultimate integration of all provincial organizations or their amalgamation into one body was attainable, but the committee had not been able to define the action which in its opinion The Engineering Institute should take in this movement.

Mr. Porter suggested that the committee be continued, and asked to present at the next Plenary Meeting of Council as definite a recommendation as it is possible to make on the whole subject; this report to be made after informal discussion with the various provincial associations. He reminded the members of Council present that The Institute had taken a leading part in connection with the original organization of the various provincial associations, a model act having in fact been drawn up in 1919 by a committee of The Institute. He felt that a certain amount of responsibility remained with The Institute to assist and to aid in harmonizing the efforts of the provincial associations for the best interests of the profession as a whole. He pointed out that where there are two or more distinct organizations functioning entirely on their own accounts without any interchange of views, there is always a tendency to diverge gradually in their procedure, which is what appeared to be happening three or four years ago when The Institute offered its facilities and a conference of representatives of the various associations was held with the view of discussing these divergences and securing more uniform practice.

He stated that this matter had recently been discussed very fully in Alberta, both at meetings of the Alberta Association of Professional Engineers and at Branch meetings of The Institute. He further presented a resolution passed at the last annual meeting of that Association appointing a committee to study the problems involved in coördinating the activities of the various engineering organizations in Canada, and to work in conjunction with similar committees from other organizations, looking forward to the ultimate integration of all these bodies into one national organization.

He believed that sooner or later there would necessarily be some Dominion-wide organization of these provincial bodies, and thought that if The Institute did not suggest some means of providing for this amalgamation, the associations themselves would eventually have to do so.

During discussion, which was participated in by councillors from the Maritime provinces and British Columbia, it was noted that this topic was receiving careful consideration from the Councils of a number of the professional associations, and that in some places it had been suggested that the provincial associations might possibly function as provincial divisions of The Institute.

Past-President A. R. Decary, M.E.I.C., pointed out that the legal functions of the professional associations must be exercised by bodies deriving their authority from the several provincial governments, (this following from the provisions of the British North America Act), and in discussing any scheme of closer relationship between The Institute and any of the associations this feature must always be borne in mind.

At the unanimous request of Council, Mr. Porter accepted the chairmanship of this committee for the coming year, and the committee was accordingly continued with the same personnel as last year.

Professor T. R. Loudon, M.E.I.C., presented a report of the work of the Service Bureau Committee which had been appointed in March 1927 as a result of a discussion as to ways and means of stimulating interest among the members of The Institute. A progress report had been presented at the last Plenary Meeting of Council, at which time the recommendations of the Committee had been approved. These recommendations included the further development of the Employment Service, and the publication of a weekly bulletin to aid in this work. The E-I-C News had accordingly been started, its primary purpose being to serve the members in the matter of employment and bring The Institute membership in touch with employers. Prof. Loudon stated that although he could not yet present a definite report on the results obtained, the progressive increase in the enquiries from both those seeking positions and those seeking men have been most encouraging.

He pointed out that to carry on successfully the work of The Institute's Employment Service Bureau, the active and whole-hearted support of the members of The Institute was a necessity, and he felt that every member of Council present should use every opportunity to impress upon the members in his own particular Branch of The Institute the fact that The Institute is endeavouring to be of real service to its members, particularly in bringing the Employment Service to the notice of employers.

In connection with the E-I-C News similar assistance was essential to the success of the publication. This coöperation should take the form of supplying interesting news items or information regarding works in progress in various localities; of bringing the publication to the attention of the proper officials of industrial and other organizations who employ technically trained men, and of aiding to secure official notices of calls for tenders from the provincial and municipal governments for publication in the News.

To this end it was thought that each Branch might have a small Service Committee to advance the interests of this part of The Institute's work.

The report was received and the committee was continued with the same personnel.

The next subject dealt with was the report of the Legislation and By-laws Committee, the chairman, O. O. Lefebvre, M.E.I.C., presenting certain recommendations regarding amendments to the By-laws to be proposed by Council concerning the compounding of fees, Students' subscriptions to The Journal, and the schedule of fees.

It was decided to take no action at the present time regarding the compounding of fees, and discussion followed on the question whether the present obligation of Students to subscribe to The Journal should be continued. It was pointed out that in many cases this requirement militated strongly against the formation of Students' Sections, and in fact tended to deter Students from joining The Institute, and after considerable discussion it was decided to propose an amendment to Section 73 of the By-laws providing that the subscription to The Journal be optional to all Students.

Afternoon Session

At the afternoon session the recommendations of the Legislation and By-laws Committee regarding the suggested increase in members' annual fees were considered, and it was noted that the proposal decided upon at the plenary meeting of Council in 1927 for an increase applying to the fees of Members, but not to other grades, had been withdrawn, since it had become apparent that the limitation of the increase to one grade of membership did not meet with the approval of the membership at large.

After considerable discussion it was decided to propose an amendment to Section 34 of the By-laws for the consideration of the next annual meeting providing for an increase in fees of $3.00 for Members, $2.00 for Associate Members, and $1.00 for Juniors; this, if it becomes effective, would result in an increase in the revenue of The Institute which would enable its increased activities to be adequately financed.

In connection with the work of the Papers Committee a letter was read from the Chairman, J. L. Busfield, M.E.I.C., in which he suggested that the work of his committee in arranging for speakers for outlying Branches would be much facilitated if the smaller Branches would get together themselves, arrange a tentative series of dates, and then call upon Headquarters for assistance in making the final arrangements. The opinion was generally expressed that more work could be accomplished by this committee if the Branches would take the initiative, and it was decided to ask all councillors present to bring this matter strongly before the executive committees of their Branches.

The next item of business concerned the report of the Committee on Method of Admission of Members, this committee having been appointed by Council in July last to study the desirability of changing the present method of dealing with applications for admission and transfer. The report recommended certain modifications in Sections 27 and 28 of the By-laws, and outlined a method of procedure in which all members of Council would have the opportunity of submitting a written opinion on the eligibility of a candidate before his admission or transfer is definitely voted upon by Council.

The report also recommended the abandonment of the present method of councillors voting by letter ballot, and

Second Plenary Meeting of Council, Montreal, Oct. 15-17th, 1928.

1. B. Grand Mont, A.M.E.I.C., (St. Maurice Valley Br.).
2. R. J. Gibb, M.E.I.C., (Edmonton Br.).
3. M. B. Atkinson, M.E.I.C., (Niagara Penn. Br.).
4. W. G. Mitchell, M.E.I.C., Vice-Pres., (Quebec Br.).
5. W. P. Near, M.E.I.C., (London Br.).
6. Fraser S. Keith, M.E.I.C., (Montreal Br.).
7. S. G. Porter, M.E.I.C., Vice-Pres., (Calgary Br.).
8. P. L. Pratley, M.E.I.C., (Montreal Br.).
9. Julian C. Smith, M.E.I.C., President.
10. F. L. West, M.E.I.C., (Moncton Br.).
11. A. R. Decary, D.A.Sc., M.E.I.C., Past Pres., (Quebec Br.)
12. H. W. L. Doane, M.E.I.C., (Halifax Br.).
13. P. J. Jennings, M.E.I.C., (Calgary Br.).
14. E. Davis, M.E.I.C., (Victoria Br.).
15. A. J. M. Bowman, A.M.E.I.C., (Border Cities Br.).
16. H. R. MacKenzie, A.M.E.I.C., (Sask. Br.).
17. N. E. D. Sheppard, A.M.E.I.C., Asst. Sec.
18. O. O. Lefebvre, M.E.I.C., (Montreal Br.).
19. R. J. Durley, M.E.I.C., Secretary.
20. J. Stephens, M.E.I.C., (Saint John Br.).
21. N. F. McCaghey, A.M.E.I.C., (Saguenay Br.).
22. M. B. Atkinson, M.E.I.C., (Niagara Penn. Br.).
23. T. R. Loudon, M.E.I.C., (Toronto Br.).
24. W. F. McLaren, M.E.I.C., (Hamilton Br.).
25. W. C. Adams, M.E.I.C., (Montreal Br.).
26. W. H. Powell, M.E.I.C., (Vancouver Br.).
27. R. L. Dobbin, M.E.I.C., (Peterborough Br.).
28. J. G. R. Wainwright, A.M.E.I.C., (Toronto Br.).
29. W. E. Clarke, M.E.I.C., (Cape Breton Br.).
30. F. P. Shearwood, M.E.I.C., Treasurer.

proposed that five negative votes should be required to exclude from membership.

O. O. Lefebvre, M.E.I.C., pointed out that the objects of the committee were to find a more satisfactory method than the present one of dealing with applications for admission or transfer, and also, if possible, to devise a means of reducing the time spent by Council in dealing with applications. It was pointed out that the procedure suggested by the committee required every councillor to give consideration to each application before it came before the Council meeting, and general approval was expressed of this feature.

After considerable discussion it was resolved to accept the report of the committee, that Council was generally in accord with the proposed change in the method of election, and that the report be referred to the Legislation and By-laws Committee for further consideration of the details of the proposed procedure, and the effects of the proposed changes in connection with other suggested amendments.

In regard to the report of Mr. Shearwood's Committee on Grades of Membership, Mr. Lefebvre suggested the desirability of modifying the concluding sentence of Section 8 of the By-laws, with the view of simplifying procedure and saving the time of Council in dealing with applications. He proposed that the last sentence of the second paragraph of Section 8 of the By-laws should be amended to read, "Any or all of these examinations may be waived at the discretion of Council if the candidate is forty-five years of age or over, and has held a position of professional responsibility for ten or more years."

It was pointed out that this amendment, without taking away the power of Council to waive the examination requirement, would limit this power, and would considerably reduce the number of debatable cases to be considered by Council.

After considerable discussion as to the desirability or otherwise of requiring all candidates who have not had university training to pass an examination, Mr. Lefebvre's suggestion was approved, and it was decided to propose an amendment to Section 8 at the annual meeting in accordance with this recommendation.

The attention of Council was drawn to the fact that the first award of the Past-Presidents' Prize for a paper on the subject of Engineering Education would take place next year, for essays to be submitted during the prize year from June 1928 to June 1929. In view of the importance of this subject, members of Council present were asked to bring this matter to the attention of members of their Branches in order that a number of papers worthy of the importance of the subject might be secured for the competition.

The secretary reported that the Board of Examiners and Education had a revised examination syllabus in course of preparation, which would shortly be printed and issued, and which called for more uniform requirements in the different branches of engineering, resulting in a simpler and more logical examination system. This document, in draft form, had been communicated to the Examining Boards of the various provincial associations with a request for their criticism and comment.

With regard to Section 3 of the By-laws defining the classes of membership in The Institute, it was pointed out that on several occasions different Branches of The Institute had suggested changes in the present grades of membership, and that this question had been discussed by Mr. Shearwood's committee. In view of the fact, however, that this committee had presented no definite recommendation, it was decided that no action should be taken at the present time, but that the matter should be fully discussed during the coming year and taken up again at the next plenary meeting of Council.

Letters were read from the Moncton and Lethbridge Branches indicating that there is some dissatisfaction on the part of the smaller Branches at the present scale of rebates, and the feeling of the meeting was that some increase should be made in the rebates to the smaller Branches, but it was decided that no action should be taken until after the annual meeting and until some decision had been reached as to the increase of fees.

Consideration was given to the desirability of Council paying the expenses of delegates from the various Branches to each annual or regional meeting, as is done by certain of the American Engineering Societies, but in view of the financial position of The Institute at the present time it was decided that no action should be taken. It was suggested that the matter might be referred to the various Branches with a request for an expression of opinion.

A tentative programme of the Annual Meeting Committee of the Hamilton Branch was submitted and approved, and it was noted that the dates had been changed to February 13th, 14th and 15th, 1929.

The question of holding other professional meetings during 1929 was discussed, but as no requests had yet been received from any of the Branches, it was decided that each councillor should take the matter up with his Branch Executive Committee, and forward any suggestions to Council for consideration at an early meeting.

Wednesday, October 17th

At the morning session of Wednesday, October 17th, the president in the chair, M. B. Atkinson, M.E.I.C., presented a memorandum to Council expressing the opinion that The Journal in its present form did not meet the requirements of the members, in that it was too large to be conveniently filed away; he considered that it should either be reduced to 6 by 9, or continued in its present form and transactions issued in addition without charge to members, containing the most important papers presented to The Institute.

The secretary stated that if the size of The Journal were reduced as suggested, very serious difficulty would be experienced in connection with advertising, upon which The Journal depends for its main revenue. At the present time industrial advertising is so standardized as to make it almost impossible to sell advertising for any magazine of a size differing materially from 9 by 12.

With regard to transactions, the Secretary drew attention to the fact that when the last volume of transactions was issued, as a result of some demand, only approximately three hundred copies, at a cost of $3.00 each, were disposed of out of one thousand printed.

After further discussion, it was resolved that the officers of The Institute should give this matter study, and present it for further discussion at a later meeting.

The secretary presented a communication from A. D. Swan, M.E.I.C., requesting an opinion as to the liability of engineers in the province of Quebec during the period of five years after the completion of a piece of work, as the revised statutes of the province do not specifically mention engineers, although they do mention architects and contractors.

It was pointed out that the courts in the province of Quebec have in the past held engineers responsible in the same way as contractors and architects, but that this matter, having to do with legal responsibility, was one which should really be dealt with by the Corporation of Professional Engineers of Quebec, and it was accordingly referred to that body, with a request for an opinion on the subject.

At the request of the Canadian Construction Association a joint conference between representatives of the Royal Architectural Institute of Canada, The Engineering Institute of Canada, and the Canadian Construction Association, was approved, for the purpose of discussing the Canadian

Construction Association's proposed Standard Forms for Contracts.

A request having been received from the Ecole Centrale des Arts and Manufactures for a representative of The Institute at their Centenary Celebrations in Paris in 1929, the Secretary was directed to arrange, if possible, for The Institute to be represented on this occasion.

The secretary presented a table showing the numerical changes which had taken place in the membership list during the past six years, through admissions, removals, transfers, etc., which showed that at the present time the membership is increasing somewhat slowly. The opinion was expressed that this condition was to be expected in view of the fact that many engineers found that they could not belong to two societies, and as it was compulsory for them to belong to a Provincial Association, refrained from joining The Institute. The president felt that this only emphasized the desirability of working out some friendly arrangement with the Provincial Associations.

The president stated that he felt that the work of The Institute as a whole, and the work and activities of the Branches and their members, should receive all the publicity possible, and asked for a discussion as to possible ways and means of accomplishing this.

M. B. Atkinson, M.E.I.C., pointed out that the engineer is naturally a reticent person, and thought that some endeavour should be made by The Institute to promote publicity in connection with the large number of important engineering works being carried on throughout the Dominion, and about which very little is now being said in the non-technical press, arranging that full credit should be given to the engineer, who is so largely responsible for the prosperous condition of Canada today.

Vice-President S. G. Porter, M.E.I.C., stressed the fact that not only could publicity be secured through the press, but by engineers taking an active part in public affairs, serving on public committees, city councils, and on legislative committees, and in that way giving advice and pointing out to the various bodies that govern communities and provinces the necessity for securing proper engineering advice.

The president agreed that good work was being accomplished by the Branches, but felt that a small committee at Headquarters, of possibly three members, could aid in coordinating the efforts of the Branches, although in no way taking away from them their initiative in connection with local publicity.

After some further discussion it was resolved that a Publicity Committee of three be appointed by the president, more particularly for the purpose of aiding and coordinating the work of the various Branches as regards publicity. The committee was accordingly appointed, consisting of Fraser S. Keith, M.E.I.C., chairman, W. G. Mitchell, M.E.I.C., and W. C. Adams, M.E.I.C.

There being no further business, a hearty vote of thanks was unanimously accorded to the president, in acknowledgment of his services as presiding officer, which had done so much to ensure the success of the second Plenary Meeting of Council.

Rules Governing the Award of the Plummer Medal

The following rules governing the award of the Plummer Medal were adopted by Council at the Plenary Meeting on October 16th, 1928:—

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.

OBITUARIES

Robert Fowler, M.E.I.C.

Members of The Institute will learn with regret of the death of Robert Fowler, M.E.I.C., which occurred at Victoria, B.C., on September 19th, 1928. Mr. Fowler was born in Cobourg, Ont., on September 30th, 1857, and began his professional career on the Temiscouata Railway construction. Later he was transferred to the Canadian Pacific Railway line construction along lake Superior and between Fort William and Winnipeg under both the government and the Canadian Pacific Railway Company. Upon completion of that work he returned to Ontario and was engaged upon construction of Canadian Pacific Railway lines in that province and subsequently in Manitoba and Saskatchewan.

In 1905 Mr. Fowler moved to Victoria, B.C., and in 1907 he became engineer for Oak Bay, and under his direction the public works of the municipality were largely constructed. He retired from active practice in 1927 on account of ill health but was retained by the municipality as consulting engineer.

Mr. Fowler joined The Institute as an Associate Member at the time of its inception in 1887, and transferred to the class of Member in 1912. He was always keenly interested in the affairs of The Institute and was a staunch supporter of the Victoria Branch. He was also a member of the Association of Professional Engineers of British Columbia, having joined at the time of its establishment.

Alexander Pringle, M.E.I.C.

In the death of Alexander Pringle, M.E.I.C., which occurred at the Medical Arts Hospital, Montreal, on October 5th, 1928, there has passed a member of The Institute who for years was prominent in engineering circles in eastern Canada, and one whose membership in The Institute dates from the day of the Canadian Society of Civil Engineers, to which he was elected Member in 1899.

Born in Montreal on July 9th, 1864, Mr. Pringle received his education at Bishop's College, Lennoxville, Que., and in 1892 joined his father, the late Thomas Pringle, forming a partnership known as T. Pringle and Son. About this time they collaborated with the late Mr. W. McLea Walbank in connection with the development of power known as the Lachine Rapids Hydraulic and Land Company's plant, near Montreal, which passed into the control of the Montreal Light, Heat and Power Company in 1903.

In 1898, Mr. Thomas Pringle retired from the business, and from that time the firm was continued as T. Pringle and Son, and managed by Alexander Pringle alone. Among other works, Mr. Pringle carried out the surveys and original development of the Shawinigan Water and Power Company's plant at Shawinigan Falls, Que.; the plant for the Canadian Electric Light Company at Chaudiere Falls, Que., and a water power development near Mille Roches on the Cornwall canal; mills for the Montmorency Cotton Mills at Montmorency Falls, Que., and various buildings for the Dominion Cotton Company. In 1907, the company was incorporated and known as T. Pringle and Son, Limited, Mr. Pringle being elected president, which office he held until the time of his death. Some years ago he was vice-president of the Wayagamack Pulp and Paper Company, Ltd., and a director of the Wabasso Cottons Company, Ltd.

Mr. Pringle resided at Chateauguay Basin, Que. He was a member of the Engineers' Club, the Kanawaki Golf Club, the Montreal Amateur Athletic Association, and was a governor of the Montreal General Hospital.

Kenneth Grahame Polyblank, M.E.I.C.

It is with regret that we record the death of Kenneth Grahame Polyblank, M.E.I.C., which took place at Rouyn, Que., on October 17th, 1927. Mr. Polyblank, who at the time of his decease was assistant chief engineer of the National Transcontinental Railway Branch Lines Company at Taschereau, Que., was born at Bristol, England, on August 17th, 1884. Mr. Polyblank was connected with the Canadian Northern Railway and later with the Canadian National Railways from 1911 to 1924, at which time he became assistant chief engineer of the Rouyn Mines Railway. He was overseas from 1915 to 1919, seeing service with the infantry and with the Canadian Engineers. Mr. Polyblank joined The Institute as an Associate Member in 1923, and transferred to the class of Member in 1926.

PERSONALS

L. McGillis, S.E.I.C., formerly of the staff of the Tramway Light and Power Company, Rio de Janeiro, Brazil, is now connected with the North Shore Power Company at Three Rivers, Que.

V. R. Currie, Jr.E.I.C., is at present assistant engineer on the Trent canal at Peterborough, Ont. Mr. Currie, who is a graduate of Queen's University of the year 1923, was formerly on the staff of the Abitibi Fibre Company, Ltd., at Smooth Rock Falls, Ont.

R. F. Howard, M.E.I.C., manager of power sales, Gatineau Power Company, attended the opening ceremony of the new Toronto-Leaside 220 kv. terminal on October 1st, as the official representative of the Gatineau Power Company.

I. S. Patterson, S.E.I.C., has joined the students' course at the plant of the Canadian General Electric Company at Peterborough, Ont. Mr. Patterson graduated from the Nova Scotia Technical College this year with the degree of B.Sc.

Darrel D. Steeves, Jr.E.I.C., who was formerly chief estimator with Messrs. Martin and Krausman, general contractors, Detroit, Mich., is now connected with Messrs. Gannett, Seelye and Fleming, Inc., public utility engineers, Harrisburg, Pa.

Edward M. Van Koughnet, S.E.I.C., is now connected with the Sao Paulo Tramway Light and Power Company, Limited, at Sao Paulo, Brazil. Mr. Van Koughnet, who was formerly employed by the Canadian and General Finance Company, Ltd., Toronto, as estimator on transmission lines design and cost, is a graduate of the Royal Military College of the year 1922.

G. F. O'Connor, A.M.E.I.C., who has been in private practice at Niagara Falls, Ont., is attending the graduate school at the University of Michigan, Ann Arbor, Mich., has been awarded a Roy D. Chapin Fellowship in highway engineering, and is taking a course of studies leading to a Master's Degree. Mr. O'Connor graduated from Queen's University with the degree of B.Sc. in 1921.

Dr. H. G. Acres, M.E.I.C., consulting engineer, Niagara Falls, Ont., Walter Blue, A.M.E.I.C., manager of development, Gatineau Power Company, and R. L. Hearn, M.E.I.C., chief engineer, H. G. Acres Company, were present on September 30th, at the inaugural and technical tests when power was first turned on at the Grand Falls, N.B., generating station of the International Power Company.

A. T. C. McMaster, M.E.I.C., is now with the McMaster-Jacob Engineering Company, Limited, consulting, designing and supervising and sales engineers, Toronto. Mr. McMaster, who is a graduate of the University of Toronto of the year 1903, was formerly senior power house engineer in connection with the Welland ship canal at St. Catharines, Ont.

D. C. Macpherson, S.E.I.C., of the staff of the Dominion Bridge Company, Ltd., has been transferred from Toronto, where he was employed on the Royal York hotel, to Halifax, where work is proceeding on the combined new terminal and Nova Scotia hotel for the Canadian National Railways. Mr. Macpherson graduated from Queen's University in 1924 with the degree of B.Sc.

J. Saint John, Jr.E.I.C., has undertaken the management of La Mouche Mine, Newfoundland. He was at one time efficiency engineer with the Nova Scotia Steel and Coal Company at West Wabana, Newfoundland, and has also been connected with the Newfoundland Power and Paper Company at Deer Lake, and the Buchans Mining Company, Buchans, Newfoundland.

C. H. McL. Burns, A.M.E.I.C., is now with the engineering department of the International Nickel Company at Copper Cliff, Ont. Mr. Burns was at one time chief engineer with the Maritime Coal, Railway and Power Company, following which he resided in Philadelphia, Pa., specializing on the mechanical equipment of mines and the preparation of coal. Prior to his present move, Mr. Burns was located at North Glenside, Pa.

G. Ernest Booker, A.M.E.I.C., has joined the engineering staff of the Power Corporation of Canada with headquarters in Montreal. Until recently Mr. Booker was on the staff of the Metabetchouan Sulphite and Power Company, Ltd., at Desbiens, Que. He was for a time with James Ruddick, M.E.I.C., consulting engineer, Quebec city. Mr. Booker was at one time in private practice in Halifax, and subsequently accepted a position as mechanical engineer with the British-American Nickel Corporation at Deschenes, Que.

H. E. Mott, A.M.E.I.C., has accepted the position of chief engineer with the Standard Radio Manufacturing Corporation, Limited, Toronto. Mr. Mott graduated from McGill University with the degree of B.Sc. in electrical engineering in 1922, and following graduation joined the staff of the Canadian Marconi Company as test engineer, subsequently occupying the positions of engineer of test room, superintendent of works, and works engineer until 1927, when he resigned in order to become connected with the DeForest Radio Corporation, Toronto, as chief engineer.

V. Pearson, A.M.E.I.C., formerly superintendent of power plants for the government of Alberta, Edmonton, Alta., has resigned to take charge of the Edmonton branch of Electrical Engineers Limited. From 1914 to 1917, Mr. Pearson was in charge of the electrification of the Canmore Coal Company property at Canmore, Alta., later becoming chief engineer of that company. In 1919 he became superintendent of public utilities for the town of Macleod, and remained in this position until 1923, when he entered the employ of the provincial government of Alberta.

Walter Griesbach, A.M.E.I.C., has recently been appointed chief engineer of the Foundation Company of Canada, Limited, Montreal. Following his graduation from Queen's University with the degree of B.Sc., in 1912, Mr. Griesbach became attached to the Department of Public Works of Canada, and while with the department he was assistant engineer and resident engineer on breakwater construction and in charge of surveys of various harbours and rivers. In 1918 he joined the staff of the Foundation Company of Canada, Limited, as office engineer, which position he has held to the present time.

Harry B. Dickens, A.M.E.I.C., is at present connected with Messrs. Lang and Ross, on transmission line survey in connection with the Flin Flon mine. Mr. Dickens, who was surveyor and assistant manager at the Amiri tin mine, Nigeria, West Africa, during 1913-1915, was on active service in the Cameroons and Nigeria, West Africa, from May 1915 to September 1919, for the greater part of 1917-1919, being in charge of the Mama and Mada patrols in Nigeria. After the war, Mr. Dickens was engaged on timber limit surveys in northern Ontario, later joining the engineering staff of the Underwriters' Survey Bureau, Toronto. In 1923 he was employed by Frank Barber and Associates, and in 1924 he was employed with the township of East York. Prior to accepting his present position, Mr. Dickens was on the staff of the Welland ship canal at Port Colborne, Ont.

Charles H. Jackson, Jr.E.I.C., formerly assistant superintendent on paper mill construction with Price Brothers and Company, Ltd., at Riverbend, Que., is at present connected with Messrs. Ross and McDonald, architects, on the construction of the new Dominion Square Building, Montreal. Mr. Jackson is a graduate of the University of Toronto of the year 1923 and has had varied experience, having been engaged in surveying mining claims in Rouyn, Que., clerk in charge of stores, materials, payroll, etc., on conduit construction with J. A. Mercier Company, Detroit, instrumentman and field engineer on paper mill construction with W. I. Bishop Company, Ltd., and Price Brothers and Company, Ltd., at Riverbend, Que., and assistant to resident engineer paper mill construction at Pine Falls, Man., with the Carter-Halls-Aldinger Company, of Winnipeg.

G. A. Browne, A.M.E.I.C., is now assistant general superintendent of the engineering division of the Department of Pensions and National Health, Ottawa. Prior to his present appointment Mr. Browne was assistant general superintendent of the engineering division of the Department of Soldiers' Civil Re-establishment at Ottawa. From November 1915 to March 1917 he was with the Canadian Engineers, Second Tunnelling Company, C.E.F., and served in France with the rank of lieutenant. On being discharged, Mr. Browne became resident superintendent, engineering branch of the Military Hospital Commission, following which he was made western district superintendent of the engineering branch of the Military Hospitals Commission-Invalided Soldiers' Commission, which was later changed to the Department of Soldiers' Civil Re-establishment.

F. M. Dawson, A.M.E.I.C., is at present professor of hydraulics at the University of Wisconsin, Madison, Wis. Professor Dawson, who graduated from the Nova Scotia Technical College in 1910, with the degree of B.Sc., and from Cornell University in 1913 with the degree of M.C.E., was formerly Dean of Men of the College of Engineering at the University of Kansas, Lawrence, Kansas, and prior to that was professor of hydraulics at the College of Civil Engineering, Cornell University. Professor Dawson was overseas with the C.E.F. from 1915 to 1919, being attached to the 40th Battalion in 1915 with the rank of lieutenant. He was transferred to the Canadian Engineers in 1916, mentioned in dispatches in 1918, and was awarded the Military Cross in 1919. He was promoted to captain in 1918, and was adjutant of the 8th Battalion for ten months, being discharged in April 1919. Following his return to this country he was a partner with the firm of Monks, Manhard and Dawson, engineers, agents and contractors, Montreal.

W. A. Spence, A.M.E.I.C., is now located at Fort Churchill, Man., with Dominion Explosives, Limited. After graduating from Queen's University in 1917, with the degree of B.Sc., Mr. Spence became a pilot in the Royal Air Force and served until 1919, following which he was an assistant on the survey of a portion of the interprovincial boundary between Manitoba and Saskatchewan for the Dominion government. In 1920 he was engaged on development work on mining properties in northern Manitoba, and in 1921 and 1922 he was in charge of reconnaissance, location and construction of roads and highways for the Colonial Government in British Honduras. On his return to Canada, Mr. Spence was in charge of plant maintenance and construction for the Whalen Pulp and Paper Company, Limited, at Port Alice, B.C., and was later in charge of surveys on investigation of the Bridge River power project and location of transmission line for the British Columbia Electric Railway Company. During 1926 he was engineer on construction of sidewalks, sewers, retaining walls, etc., for the municipality of South Vancouver, B.C., and later was engineer for the Thomsen and Clark Timber Company, Limited, in charge of logging, railway location and construction. Prior to accepting his present position, Mr. Spence was located at Jordan River, B.C.

Recent Additions to the Library

Proceedings, Transactions, etc.

Presented by the Societies:

The Mining Institute of Scotland: List of Members, 1928.
The Society of Naval Architects and Marine Engineers: Year Book, 1928.
The American Society for Testing Materials: Year Book, 1928. 1928 Supplement to Book of A.S.T.M. Standards.

Reports, etc.

Department of Mines, Canada:

Mines Branch: Investigations in Ceramics and Road Materials, 1926; Investigations in Ore Dressing and Metallurgy, 1926; Investigations of Fuels and Fuel Testing, 1926; Investigations of Mineral Resources and the Mining Industry, 1926.
Geological Survey: Memoir 152, Le Région de Saint-Urbain, District de Charlevoix (Quebec); Economic Geology Series, no. 5, Oil and Gas in Western Canada.

Department of the Interior, Canada:

Forest Service: Timber Pathology in Relation to Wood Utilization in Canada; Wood Preservation in Canada; Timber Physics Research in Canada; Pulp and Paper Research in Canada; Timber Testing in Canada.

National Research Council, Canada:

Report no. 22: An Experimental Study of Sieving.

The Quebec Streams Commission:

Annual Report, 1927.

Department of Commerce, United States:

Commerce Year Book, vol. 1: United States, 1928.

Technical Books, etc.

Presented by the Kansas City Testing Laboratory:

Handbook of Petroleum, Asphalt and Natural Gas.

Presented by Chapman & Hall, Limited:

Port Studies, by Brysson Cunningham.

Presented by E. & F. N. Spon, Limited:

Practical Designing in Reinforced Concrete, by M. T. Cantell.

ELECTIONS AND TRANSFERS

At the meeting of Council held on September 11th, 1928, it was reported that, in accordance with Council's instructions, a ballot had been opened on July 18th, 1928, and the following elections and transfers were accordingly effected:—

Member

SMALL, Herbert W., Jr., chief engr., Alcoa Power Company, Arvida, Que.

Associate Members

ARNOLD, Guy Walker, B.Sc., (Univ. of N.B.), i/c all elect'l design of d.c. motors, etc., Canadian Westinghouse Company, Hamilton, Ont.

LANGLOIS, Raoul, C.E., (Ecole Polytech.), asst. chief engr., Montreal Tramways Commission, Montreal, Que.

Juniors

HAYES, Roland Earle, B.Sc., (McGill Univ.), sales engr. & mgr., water works dept., General Supply Company of Canada, Ottawa, Ont.

MUMFORD, Patrick Foster, M.E., (Stanford Univ.), Canadian Westinghouse Company, Hamilton, Ont.

Affiliate

MURPHY, Maurice Edward, mech'l supt., Dominion Coal Company, Glace Bay, N.S.

Transferred from the class of Student to that of Associate Member

BUTTERWORTH, John Victor, B.Sc., (N.S. Tech. Coll.), topographical engr., Geological Survey of Canada, Ottawa, Ont.

Transferred from the class of Student to that of Junior

CARTEN, Francis Tracy, B.Sc., (Univ. of N.B.), with H. G. Acres Co., Grand Falls, N.B.

ELKINGTON, Gerald Erlam, B.Sc., (McGill Univ.), erecting engr., Canadian General Electric Co., Ltd., Toronto, Ont.

GAUVIN, Herve Alfred, B.Sc., (Univ. of Sask.), sec.-treas., and i/c design & estimates, Gauvin, Ltd., Ottawa, Ont.

Students Admitted

BRAKE, Erie Charles, B.Sc., (Queen's Univ.), Canadian General Electric Co., Ltd., Peterborough, Ont.

CLARK, James E., B.Sc., (Queen's Univ.), Canadian General Electric Co., Ltd., Peterborough, Ont.

CRUMP, Norris R., 971 Dominion street, Winnipeg, Man.

DODDRIDGE, Paul William, B.Sc., (Univ. of N.B.), Canadian General Electric Co., Ltd., Peterborough, Ont.

DUNCAN, John Daniel, B.A.Sc., (Univ. of B.C.), Canadian General Electric Co., Ltd., Peterborough, Ont.

FELLOWS, Geoffrey Meysey, Imperial Bank of Canada, St. James & McGill streets, Montreal, Que.

HAGGERT, Gordon J., B.A.Sc., (Univ. of Toronto), Canadian General Electric Co., Ltd., Peterborough, Ont.

HALL, Thomas Leonard, B.Sc., (Univ. of N.B.), Canadian General Electric Co., Ltd., Peterborough, Ont.

MORRISON, J. Alexander, B.A.Sc., (Univ. of Toronto), Canadian General Electric Co., Ltd., Peterborough, Ont.

MORRISON, Gilbert Rutter, P.O. Box 561, North Sydney, N.S.

MURRAY, Victor Stuart, B.Sc., (Queen's Univ.), 1139 Parent avenue, Windsor, Ont.

TAYLOR, John Joseph, B.Sc., (Univ. of Alta.), Canadian General Electric Co., Ltd., Peterborough, Ont.

At the meeting of Council held on October 15th, 1928, the following elections and transfers were effected:—

Members

FIEGEHEN, Edward George, mech'l dept., Dominion Bridge Company, Lachine, Que.

FLEMING, Alexander Greig, B.A., (Queen's Univ.), chief chemist, Canada Cement Company, Montreal, Que.

HAVILAND, Frank Leslie, Grand.S.P.S., (Univ. of Toronto), chief engr. & sales mgr., Standard Steel Construction Company, Welland, Ont.

RICKER, Herbert A., B.A.Sc., (Univ. of Toronto), mech'l engr. on a.c. generator design, Canadian Westinghouse Company, Hamilton, Ont.

Associate Members

COMETTE, Romeo, C.E., (Ecole Polytech.), engrg. office work, estimator, etc., Lake St. John Power & Paper Co., Montreal, Que.

FREGEAU, John Henry, B.Sc., (McGill Univ.), supt., North Shore Power Company, Three Rivers, Que.

LEGATE, Robert Moorhead de Comlay, B.Sc. (E.E.), M.Sc. (E.E.), (Univ. of N.B.), engrg. dept., Montreal Light, Heat & Power Cons., Montreal, Que.

MANSON, George James, S.P.S. 1904, M.E. 1913, (Univ. of Toronto), managing director, Manson's, Ltd., Hawkesbury, Ont., and president, Manson Chemical Co., Montclair, N.J.

Junior

McMAHON, John Leonard, B.Sc., (Univ. of Man.), dftsman., C.N.R., Winnipeg, Man.

Transferred from the class of Associate Member to that of Member

BLACK, William Duncan, B.A.Sc., (Univ. of Toronto), vice-president & managing director, Otis-Fensom Elevator Co., Ltd., Hamilton, Ont.

DAY, Joseph Charles, B.Sc., (McGill Univ.), designing engr., Lake St. John Power & Paper, Montreal, Que.

Transferred from the class of Junior to that of Associate Member

COOPER, Paul Emerson, B.Sc. (C.E.), (McGill Univ.), res. engr. on constrn., at Kent Falls, N.Y., for International Paper Co.

NENNIGER, Emil, struct'l engr., (Technical School of Burgdorf), designing engr., office of Dr. Arthur Surveyer, M.E.I.C., Montreal, Que.

Transferred from the class of Student to that of Associate Member

ANTLIFF, James Cooper, B.Sc., (McGill Univ.), asst. to gen. supt., elect'l dept., Montreal Light, Heat & Power Cons., Montreal, Que.

BREHAUT, Harry Baker, B.Sc., (Univ. of Sask.), res. engr. on C.N.R. constrn., Edmonton, Alta.

RUTHERFORD, Andrew Scott, B.Sc., (McGill Univ.), supt. on new Dominion square block, Montreal, for George A. Fuller Co. of Canada, Ltd.

STEWART, William Lewis Reford, Grad., (R.M.C.), managing director, Stewart Construction Co., Ltd., Sherbrooke, Que.

Transferred from the class of Student to that of Junior

BENJAMIN, Abraham, B.Sc., (McGill Univ.), engr., Electrical Commission of Montreal, Montreal, Que.

HENDERSON, Ian Gordon, B.Sc., (McGill Univ.), field engr. & struct'l dftsman, Dominion Bridge Co., Montreal, Que.

HICKS, Ben Church, B.Sc. (E.E.), (McGill Univ.), relay mtce. & inspection, Shawinigan Water & Power Co., Montreal, Que.

McBRIDE, Ernest Willard, B.A.Sc., (Univ. of Toronto), i/c control dept., Abitibi Power & Paper Company, Iroquois Falls, Ont.

McCLURE, Lindley Wilberforce, B.Sc., (McGill Univ.), cable engrg. research, Northern Electric Co., Ltd., Montreal, Que.

THWAITES, Joseph Taylor, B.Sc., (Queen's Univ.), i/c service dept., Wentworth Radio & Auto Supply Co., Hamilton, Ont.

VERNOT, George E., B.Sc., (McGill Univ.), engrg. dept., Fraser Brace Company, Montreal, Que.

Students Admitted

BERGER, Bernard A., Undergrad., (McGill Univ.), 796 Champagneur avenue, Outremont, Que.

BERRY, Melville Douglas, Undergrad., (Univ. of Manitoba), 521 Newman street, Winnipeg, Man.

BROWN, Edward Daw, Undergrad., (N.S. Technical College), 72 South street, Halifax, N.S.

COOPER, Lawrence O'Toole, Undergrad., (McGill Univ.), 3483 Peel street, Montreal, Que.

TAGGART, E. McKay, Undergrad., (McGill Univ.), 825 University street, Montreal, Que.

MOFFATT, Harold Seymour, B.Sc., (Queen's Univ.), with Frank Barber & Associates, Ltd., Toronto, Ont.

SMITH, Gordon Carington, Grad., (R.M.C.), Undergrad., (McGill Univ.), 79 Grande Allee, Quebec, Que.

YEOMANS, Richard Henry, Undergrad., (McGill Univ.), 55 Wolseley Ave., Montreal West, Que.

BOOK REVIEWS

Mechanics for Engineers

By J. C. Smallwood and F. W. Kouwenhoven. D. Van Nostrand Company, New York, 1928, buckram, 6 x 10 in., 185 pp., tables, diagrs., $2.50.

This book, as the preface states, is the outcome of an attempt by the authors to write a brief text suitable for engineering students taking a course in mechanics limited to about 60 or 80 classroom hours. The principal reasons advanced for adding to the list of textbooks on mechanics are that applied mechanics is not an easy science to teach that the average ,student finds it difficult to learn and apply, and that the more comprehensive treatises are not easy to assimilate by those taking a course of limited duration. The authors claim nothing new except in the arrangement and selection of material, the choice of problems and in the emphasis laid on principles of special importance to engineering students. The book treats the conventional problems of statics and dynamics, and numerous well-chosen examples are worked out and set as problems in each chapter. It would be unfair to be too critical of a book which is evidently intended to be used concurrently with a short lecture course, as the explanation of an instructor would help out the text where basic principles are not set forth as fully as many teachers would consider to be desirable. The purpose of such a book places limitations on the treatment of the various topics, and restricts its usefulness in the case of students who may have to study the subject apart from a concurrent lecture course. In a brief chapter of four pages on units of measurement of force and mass, it is stated that "the absolute system is not used in English units, being confined to the metric system." In the preceding paragraph, the authors have defined a certain unit of force, viz., 1 ÷ 32.174 of a pound, which, they state, "has been given a definite name and subjected to use in scholastic circles. Since it has never been used in any commercial physical laboratory or in engineering literature or practice, its only function being to confuse the student of mechanics, it will not be named here. It is mentioned only in order to encourage other writers and teachers to join the present tendency to discard it." The poor "poundal",—for such is the name of this disreputable unit,—is evidently in the worst possible odour. The reviewer is sufficiently old-fashioned to believe that some of the difficulties in connection with the teaching of mechanics are in a measure due to this attitude towards the absolute system of units, which, he believes, may be made to serve other purposes than "to confuse the student." The book is clearly illustrated, and within well recognized limits can be made to serve its purpose in a short lecture course in mechanics.

E. Brown, M.E.I.C.,
Prof. Applied Mechanics & Hydraulics,
McGill University.

Fixation of Atmospheric Nitrogen

By Frank A. Ernst. D. Van Nostrand Company, New York, 1928, buckram, 6 x 9 in., 154 pp., figs., tables, $2.50.

For the past thirty years, chemical engineers have been actively developing methods of utilizing the stores of nitrogen in the atmosphere and converting the gas into compounds which can be used for the manufacture of explosives, fertilizers, photographic films, artificial leather and silk, and a multitude of other purposes. This book tells the story of their success.

It is no longer necessary to depend for our nitrogen supply on the sodium nitrate deposits of Chile, for of nearly one and a half million tons of nitrogen consumed in 1927, some 807,000 tons were obtained from the air by the three processes which are now commercially successful, while 341,000 tons were derived from coke-oven by-products and 298,000 tons from Chilian nitrate.

The demand for explosives during the war, particularly in Germany, gave a great impetus to the nitrogen industry, but the most important developments have taken place since 1918, indicating that the main source of fixed nitrogen will be the direct synthetic ammonia process, in which a compressed mixture of hydrogen and nitrogen is passed at high temperature over a catalytic agent. This process now supplies over 70 per cent of the total nitrogen fixed.

Direct combination of the nitrogen and oxygen of the air can be effected by the arc process, by passing air through a zone of high temperature in an electric furnace, thus forming nitric oxide, which is then absorbed in water and utilized as nitric acid. This was actually the first method to be employed commercially, but its high power consumption has militated against its wide development.

The third method, in which calcium carbide and pure nitrogen are made to react at a red heat, yields calcium cyanamide, and was first carried out commercially on this continent at Niagara Falls, Ontario, in 1909. It is still responsible for about 30 per cent of the world's production.

These processes, with their many developments, are well described in Mr. Ernst's book, which possesses the virtue, somewhat rare in a work dealing with so technical a subject, of being easy to follow even for a reader who knows but little chemistry. It can be recommended, not only as giving a readable and adequate treatment of the main chemical and engineering features of the industry, but also describing the conversion products and discussing the economic and historical aspects of the subject. Statistical appendices and an excellent bibliography add to its usefulness.

Chemical Encyclopædia

By C. T. Kingzett, F.I.C., F.C.S., Fourth Edition, D. Van Nostrand Company, New York, 1928, buckram, 6 x 9 in., 807 pp., tables, $10.00.

The object of this encyclopædia is to serve as a work of reference for use not only by professional chemists, chemical engineers, manufacturers, students, merchants and brokers, but also by other professional and business men in general. The subject matter comprises pure, physical and applied chemistry, a description of the elements and their chief compounds, brief accounts of ore and other natural products, and also the more important chemical terms and theories.

To compile a book of this type is an extremely difficult task and Mr. Kingzett is to be congratulated on the masterly manner in which he has gathered together such a vast number of facts appertaining to chemistry and its applications.

A careful examination of this book has served to show that there are few materials or subjects relating to chemistry, theoretically or industrially, for which some reference will not be found. It is particularly valuable in abounding in references for the convenience of those requiring further information than is contained in this encyclopædia. This book will be found particularly valuable by those coming in contact with chemistry, industrially or professionally, and possesses the great advantage of being written in simple, non-technical language, easily understood by those who are not chemically trained.

J. R. Donald, M.E.I.C.,
Managing Director, J. T. Donald and Co., Limited, Montreal.

Principles of Highway Engineering

By Carroll Carson Wiley, C.E., McGraw-Hill Book Company, New York, 1928, buckram, 6 x 9¼ in., 510 pp. tables, figs., illus., $4.00.

There is perhaps no branch of engineering in which the public is so directly interested as that dealing with the construction and maintenance of highways. The highway engineer finds himself in direct contact with the people of his locality, and occasionally has to display a degree of tact and diplomacy greater than that called for in almost any other line of engineering work.

The rural roads of the United States in 1926 had a total length of over 3,000,000 miles, of which about 500,000 miles had been surfaced. When we add to these the 500,000 miles of city streets, and imagine these traversed by 23,000.000 automobiles, some idea of the extent and importance of the field of the highway engineer may be gained.

The book under review, while designed primarily as a textbook on the subject, includes within its five hundred pages discussion on practically all the important topics connected with highway engineering, and will be found useful as a reference book by any engineer whose work touches on this subject matter. Materials, drainage, methods of construction, road surfaces, repairs and maintenance, surveys and location, finance, traffic and operation, are all treated, and while the practice described is, of course, that usual in the United States, Mr. Wiley's conclusions will be found largely applicable to Canadian work.

As might be expected in view of the special climatic and local conditions occurring in different parts of Canada, some of the followed methods in this country differ from those described in Mr. Wiley's book. For example, in concrete roads Canadian practice in many localities tends towards a wider pavement, a somewhat stronger section and a richer mix of concrete than those suggested by the author, while in asphaltic material a somewhat softer quality than that proposed by him is usual, thus permitting of a plasticity very desirable in a cold climate.

The book can be recommended, and its usefulness is increased by excellent illustrations and a good index.

BRANCH NEWS

London Branch

Frank C. Ball, A.M.E.I.C., Secretary-Treasurer.

The London Branch has been following the policy of substituting motor trips to accessible points of interest in the place of regular meetings during the summer months. The trips have become a valuable part of the Branch activities, having stimulated the interest of friends of the members as well as proving instructive to the members of The Institute.

Summer Excursions

There have been three trips during the past summer, one to the gravel plants of the John E. Russell Company at Paris and Waterford, a second to the Welland ship canal and a third to the plant of the St. Mary's Cement Company.

On June 9th, a party from London and neighbouring towns gathered at Paris in the morning and inspected the gravel plant of the John E. Russell Company. Members were the guests of the company for lunch at Brantford and then drove to the plant at Waterford. Members of the company were generous with their time and information in conducting the group over the plants. About thirty-five men were present, including many who were not members of The Institute.

The main trip of the season was to the Welland ship canal. Cars left London on the morning of Saturday, July 21st, and arrived at Port Colborne in time for an inspection of the work there. After lunch the party was conducted along the canal by members of the canal staff, to whom the London Branch is very grateful for their kindness. Supper was provided at Port Dalhousie. To those who were able to attend, the trip provided new items of interest. The members of the London Branch have found that there is sufficient new construction work on the canal each year to warrant annual trips of inspection, and members of the staff have always been very kind in making the visit really worth while.

A shorter motor trip, coupled with a supper-meeting, was held on Saturday, September 29th, to the plant of the St. Mary's Cement Company. The afternoon was spent in an inspection of the plant, under the guidance of the plant superintendent and the chemist, Mr. G. Larsson. The two groups were conducted over the property, from the quarry to the bagging of the finished product, following the progress of the material through its various processes. Each process was carefully described at the plant and in an address by Mr. Larsson in the evening. To learn of the manufacture of cement under the generous hospitality of the St. Mary's Cement Company proved a treat to the members of the party.

London Branch plans for the near future include a trip through the Bell Telephone exchange, with an address by one of the local Bell Telephone officials, on October 24th, and an address by Deputy Minister of Highways R. M. Smith, A.M.E.I.C., on November 21st, 1928.

Montreal Branch

C. K. McLeod, A.M.E.I.C., Secretary-Treasurer.
W. McG. Gardner, A.M.E.I.C., Branch News Editor.

St. Paul Ward Main Sewer

The complexity of modern life in large cities and the important role which the engineer is playing in the improvement of public services was strikingly portrayed in an illustrated paper on "St. Paul Ward Main Sewer," presented before the Montreal Branch on October 11th by Geo. R. MacLeod, M.E.I.C.

The speaker, in opening his address, emphasized the absolute necessity in present municipal sewer design of clearly visualizing future developments within the respective drainage areas. In the present instance, the 1,135 acres drained by the trunk sewer under consideration would probably not be fully developed for some years, yet it was economical to provide a section of 9 to 10 feet diameter. This large sectional area followed as a consequence of the street elevations at the terminals being practically at a dead level. With the flow of the St. Lawrence controlling the height at the discharge and the ground topography setting the depth of the intake, the minimum allowable rate of grade, namely, 0.10 feet per 100 feet, was all the fall obtainable.

While a careful comparison of the semi-elliptical with the horseshoe design indicated the superiority of the former as regards strength per unit of weight, this advantage was offset by the required increase in the width of the cut for an equivalent capacity, a preponderant factor where a considerable depth of excavation is involved. Furthermore, the horseshoe section has a greater capacity for the same diameter in width.

An interesting feature of the construction was an indicated economy in the drag line, slope sides method of handling this large excavation.

As the size of the sewer in this case rendered periodic inspection in the usual manner hazardous, a special manhole of sufficient size was provided to permit the introduction of a small boat.

In the interesting discussion which followed, led by Major W. H. Wardwell, M.E.I.C., the speaker favoured a large and attentive audience with careful and explicit replies.

The complete paper is published in another part of this issue.

In introducing the speaker of the evening, the branch chairman, F. C. Laberge, M.E.I.C., welcomed the members to the opening of the fall session. On the conclusion of the address and following the expression of a hearty vote of thanks, moved with enthusiasm by Alderman Stewart F. Rutherford, A.M.E.I.C., the meeting adjourned for a friendly chat around the refreshment table.

Lapped Pipe Joints

The tremendous increase in the pressures and temperature employed in steam plants and oil refineries during the past ten years has been of necessity accompanied by the development of a safe and durable type of pipe joint. The interesting engineering evolution and the improved manufacturing process which have effected this reliability under severe operating conditions provided the subject for an admirable paper on "Lapped Pipe Joints" by Mr. A. M. Houser, engineer of products, Crane Company, Chicago.

In his inability to be present before the branch on October 18th, Mr. Houser entrusted the delivery of his well-illustrated paper to the capable offices of his confrère, Mr. J. O. Lange.

In the excellent discussion which followed, F. A. Combe, M.E.I.C., referred to the very few existing high pressure plants now operating in Canada, while E. A. Ryan, M.E.I.C., brought out the fact that little difference existed in the nature of test fractures produced in either lap welded pipe or seamless tubing.

In reply to questions, the speaker mentioned the strength requirements of the American Standards Association and the division of the bolting materials into three classifications. In closing, Mr. Lange, responding to L. Cowan, S.E.I.C., described a method of case hardening nuts by the cyanide process.

E. A. Ryan, M.E.I.C., closed the meeting by proposing a hearty vote of thanks. H. G. Thompson, A.M.E.I.C., sub-chairman of the Papers Committee, presided.

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 first fall outing of the season took place on the afternoon of September 27th, 1928.

For the last two years, the members of this branch have been promised the pleasure of visiting the modern filtration plant which supplies St. Catharines with water and which was constructed under the supervision of a past-chairman of the Branch, Alex. Milne, A.M.E.I.C.

Mr. Milne is very proud of his plant, and justly so, for it embodies the very latest improvements in mechanical equipment and the architectural treatment is rather better than usual for this type of structure.

This year, the Entertainment Committee, in response to various requests, decided to combine other features with the visit to the filtration works and thus make a full afternoon; in consequence, arrangements were made whereby the Scots could have a round of golf at the Lookout course and the technically-minded engineers could visit the Ontario Paper Mills, both of which are within a radius of three miles.

Some seventy-five members availed themselves of the privileges thus granted and enjoyed themselves thoroughly, twenty-four meeting at the Golf Club and the balance at the paper mill.

The output of this large mill, some 315 tons per day, goes exclusively to the making of only one newspaper, the Chicago Tribune.

The pulpwood is obtained mainly from the north shore of the St. Lawrence river, below Quebec city, and carried by steamer up the present Welland canal to the storage grounds. A sight that always impresses itself upon visitors to this district are the great mounds of stored pulpwood, some two hundred feet high and visible for several miles.

Both sulphite and ground pulp are made in this mill and mixed in the proportion of 15 per cent sulphite to 85 per cent ground pulp for the production of newsprint. One of the features which impressed itself upon the party was the adeptness with which the men broke the paper strip by means of a compressed air hose and started a new roll without stopping the machinery. The plant covers some seventy acres of ground and employs about six hundred and thirty men. The newsprint rolls each weigh about one thousand pounds and are shipped by train to Chicago.

An approximate analysis of one ton of this paper gives the following interesting figures:—

1.22 chords of wood
15 horse power
1,500 pounds coal
4 man-days.

About 4.30 p.m. the two groups, golfers and paper men, joined forces at the filtration plant. Alex. Milne, A.M.E.I.C., superintendent of water works, and G. F. Peterson, chairman of the Water Works Commission, met and accompanied the party.

The total capacity is ten million gallons per day, with five million storage reservoir and provision for a future duplication. It stands near the brink of the Niagara escarpment and draws water from lake Erie, via the Welland canal. After coagulation and filtration, the flow is by gravity down the escarpment and across the flat some three and one-half miles to the city of St. Catharines, with a head of about 180 feet, giving a city main pressure of about 70 pounds.

Three electrically-driven Crocker-Wheeler motors, directly connected to DeLaval pumps, give four, six and ten million gallons respectively for the low lift from the forebay to the coagulating basin. There is also an emergency generator set consisting of a 250-h.p., 8-cylinder Sterling gas engine connected to a 125-k.v.a. Lancashire generator. All valves are hydraulically operated under a constant pressure of 75 pounds maintained by a separate electrically-driven pump.

Each of the six double unit rapid sand filters is 14 by 28 feet and has a capacity of two million gallons.

Mr. Milne flushed out one of these units for the benefit of the visitors, and then invited the party to partake of the refreshments which the commission had very thoughtfully provided. As it was then nearly six o'clock, these were welcomed with enthusiasm and partaken of freely.

Chairman E. G. Cameron, A.M.E.I.C., then proposed a vote of thanks and mentioned incidentally that Mr. Milne and Mr. Peterson were too modest, particularly about the method of financing the whole project. He understood on good authority that the plant had been constructed with practically no added cost to the ratepayers or water users beyond the regular water rates. Due to great far-sightedness, a reserve fund for this work had been started quite a number of years ago. The total expenditures had been about $434,000, but, due to this reserve fund, only $275,000 worth of debentures had to be issued, and these were being retired in thirty equal annual instalments and were quite easily taken care of by means of the present rate, which is comparatively low, some $10.50 per annum for an eight-room house. S. R. Frost, M.E.I.C., and Roy Beatty, of Welland, also expressed their appreciation of the quality of the work.

On leaving the building, the visitors were shown an added feature, a visual proof that the plant was functioning properly. In the entrance hall, a well had been built over one corner of the clear water storage basin. The basin was floored with white tile at this point and lights placed so that on looking down through the plate glass cover and some 20 feet of water they could clearly distinguish the four five-cent pieces which had been dropped there.

Peterborough Branch

S. O. Shields, Jr.E.I.C., Secretary-Treasurer.

At a meeting of the Executive Committee of the Branch on September 6th, 1928, M. W. Cruthers, A.M.E.I.C., chairman, expressed regret that G. H. Burchill, JR.E.I.C., was leaving to accept a position as assistant professor of electrical engineering at Nova Scotia Technical College. It was moved and seconded that H. O. Fisk, M.E.I.C., be appointed to the executive, replacing Mr. Burchill. B. L. Barns, A.M.E.I.C., subsequently agreed to carry on Mr. Burchill's duty on the Meetings and Papers Committee.

Roller Bearings

The first meeting of the Peterborough Branch for the season was held on September 28th, 1928, the speaker being Mr. S. C. Partridge, district sales manager of the Timken Roller Bearing Company. Taking as his subject "The Alloy Steel Mill of the Timken Company," Mr. Partridge briefly sketched the equipment installed and the processes involved in the production of the steel used in roller bearings.

Electric furnace steel is used for the purpose, a 60-ton furnace requiring 10,000 k.w., and the largest in the world, being employed. Open-hearth furnaces of various capacities are also installed for other purposes to give the mill rolling capacity.

Two reels of moving pictures illustrated the address and well depicted the progress of the material from the stock pile, through the furnace, the soaking pits, the various rolling mills and saws until it emerged as bars or tubes of the necessary shape and size for the manufacture of the bearings. The production of seamless steel tubing for the raceways by the Mannesman process was especially interesting.

An active discussion followed the address, during which a large number of questions drew from the speaker much additional information on the actual manufacture and application of roller bearings. It was stated that the Chicago, Milwaukee and St. Paul Railway had 2,000 bearings in service and the Pennsylvania has 400

St. Catharines Water Works Filtration Plant.

cars so equipped. Several speakers gave instances of the reduction in losses by the use of anti-friction bearings on large machinery, such as the dryer sections of paper machines. On railway equipment, a saving of 7 or 8 to 1 on draw bar pull was obtained and 15 per cent when running.

While oil lubrication was recommended, the speaker stated that grease was permissible up to 2,000 r.p.m.

V. S. Foster. A.M.E.I.C., acted as chairman for this meeting. A cordial vote of thanks was moved by R. C. Flitton, A.M.E.I.C., and tendered to Mr. Partridge for his address.

ENGINEERING EDUCATION

In the absence of Chairman W. M. Cruthers, A.M.E.I.C., B. L. Barns, A.M.E.I.C., presided at the meeting held October 11th, 1928, and introduced Mr. R. E. Doherty, consulting engineer of the General Electric Company, Schenectady, N.Y., whose subject was entitled "The Effect of Present Engineering Education As It Is Reflected In the Young Men Who Come to the General Electric Company."

Through his experience in the A.C. Engineering Department, as a consulting engineer and co-worker with the late Dr. C. P. Steinmetz, and later by his connection with the General Electric Student Course, Mr. Doherty is well qualified to speak on this subject.

The opinions he expressed were based on careful observation and records of the 250 to 300 graduates from 120 colleges who annually join the company. While pointing out that the university courses in engineering had been gradually evolved to meet the needs of many industries, and could not suddenly be changed, he criticized mainly the large number of semester hours compared with other professional courses, the ratio being on the average about 150 to 125.

The result was that the student had no time for other interests and tended to become a bookworm. He was good at inductive reasoning and had a great knowledge of formulæ, but could not reason deductively and was lost when on the frontier of new things where no formulæ exist.

The speaker's remedies for this condition were a reduction in semester hours by cutting out some of the shop and laboratory work and greater emphasis on the fundamentals of physics, chemistry, etc., throughout the course. In view of the fact that only 30 per cent of students graduates, he thought there should be a "getting-off place" at two years for students unsuitable to the four years course and graduation. It was claimed that the present courses, with long hours, were driving young men away from engineering to other professions, such as commerce.

Considerable discussion followed the address, and the speaker's opinion was asked on many other aspects of the subject; for example, the "Sandwich system" of college and factory training, post-graduate work, the value of technical high schools, etc.

A hearty vote of thanks to Mr. Doherty for his address was proposed by E. R. Shirley, M.E.I.C., and cordially approved by those present. Besides a large turnout of branch members, there were present at this meeting the city clerk and representatives of the local Board of Education.

St. Maurice Valley Branch

Romeo Morrissette, A.M.E.I.C., Secretary-Treasurer.

THE PUBLIC SERVICE COMMISSION'S DEBT TO THE ENGINEERING PROFESSION

The first meeting of the season of the St. Maurice Valley Branch was held at the Laurentide Club, Grand'Mere, Quebec, on Saturday, October 20th. The members gathered at the Laurentide hotel, where dinner was served at six o'clock.

The speaker of the evening was Alex. Lariviere, A.M.E.I.C., chief engineer of the Quebec Public Service Commission, who chose for his subject "The Public Service Commission's Debt to the Engineering Profession."

In his opening remarks, Mr. Lariviere stated, "Engineers originated, designed, constructed and operate public utilities, and it is not strange that the engineers' place in the field of their regulation is an important one." The speaker referred briefly to the work of the commission engineers, but dealt principally with the part played by other engineers who have to appear before the commission on behalf of public service to advise upon technical matters in dispute. He also outlined the organization, jurisdiction and procedure of the Public Service Commission and the principles followed by the commission.

At the conclusion of Mr. Lariviere's address, a hearty vote of thanks was tendered by Bruno Grand Mont, A.M.E.I.C., Councillor.

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

RAILWAY CONSTRUCTION ENGINEERS

There are openings for experienced railway construction engineers in connection with the construction of a large railway being carried on by a Canadian company in Colombia. Applicants must have a fairly good knowledge of the Spanish language. Apply to Box No. 64-V.

ESTIMATOR AND DESIGNER

Large Canadian firm manufacturing material handling machinery such as cranes and hoists, also a variety of heavy mechanical work, including sluice gates, has an opening for a man with experience in design and estimating along these lines. Apply Box No. 80-V.

SALES ENGINEER

A large manufacturing company in Montreal has an opening for a graduate engineer on its sales staff. The company manufactures compressed air machinery. A man familiar with pneumatic tools, portable compressors is one whose application will be given most serious consideration. Apply to Box No. 84-V.

SALES ENGINEER

A large manufacturing company in Montreal has an opening for a graduate engineer on its engineering sales staff. The company manufactures compressed air mining machinery and oil engines. Preference will be given to those having some experience in these lines. Apply with full particulars to Box No. 85-V.

SALES ENGINEERS

Two graduates of two or three years for sales and demonstration of construction of (road) machinery. Would be given experience and instruction on operation. Apply Box No. 86-V.

PROMOTION ENGINEER

A large Canadian industrial company, distributing a construction material from coast to coast, has an opening for a graduate engineer between the age of 25 and 30 to carry on promotional work in the western provinces from the head of the Great Lakes to British Columbia. Apply to Box No. 93-V.

JUNIOR ELECTRICAL ENGINEER

A recent graduate in electrical engineering is required by a pulp and paper company. Previous experience unnecessary. The position offers excellent opportunities for advancement. Apply to Box No. 103-V.

DRAUGHTSMAN

Draughtsman with some architectural experience required for municipal work. Applicant must state age, experience, salary expected and submit sample of drawing. Apply Box No. 105-V.

STEAM PLANT DESIGNER

A thoroughly experienced man familiar with modern practice in the layout of boilers, turbines, piping and the usual accessory equipment. Apply giving full details of experience to Box No. 106-V.

MECHANICAL DESIGNER

A man with several years experience in the layout of mechanical equipment, shafting, piping and generally familiar with industrial plant practice. Apply giving full details of experience to Box No. 107-V.

STRUCTURAL DESIGNER

A man fully competent to design and detail simple structures in steel, timber and reinforced concrete. Apply to Box No. 108-V.

FACTORY MANAGER

Required by progressive and growing Canadian company engaged in the manufacture of a wide range of material handling machinery, factory manager capable of assuming entire responsibility for maximum production at lowest cost. Position offers unlimited scope to ambitious and energetic man. Apply giving details of training, experience, and salary required to Box No. 109-V.

ELECTRICAL ENGINEER

An electrical draughtsman for maintenance and construction design in a large steel plant. University graduate preferred. State age, education, experience, and salary to Box No. 110-V.

ELECTRICAL DESIGNER

Electrical designer with at least five years experience in designing electrical sub-stations for power companies. Applicant must be thoroughly familiar with latest types of switch-

Situations Vacant

board equipment. Give full detailed information in first letter, including age, salary expected, names of references, recent photograph, and samples of drawings made. Permanent work with good future for the right man with large power company in eastern Canada. Apply Box No. 111-V.

Industrial Designer and Draughtsman

Young engineer with electrical training, for an industrial firm in Montreal, preferably one with experience after graduation, on electrical heating and ventilating layouts. Must be a good draughtsman. Remuneration depends on capacity of applicant. Apply, giving full particulars, to Box No. 112-V.

Junior Draughtsman

Junior draughtsman, for a firm in western Ontario, with experience on structural steel. Apply to Box No. 113-V.

Electrical Engineer

Electrical engineer wanted for design and construction work on hydro-electric power house. At least three years experience desirable. Position probably permanent on completion of work. Apply to Box No. 114-V.

Mechanical Draughtsman

Mechanical engineer and draughtsman, between twenty-five and thirty-five years of age, preferably experienced in paper mill engineering. Apply, stating past experience, education, married or single, salary expected and when services available, to Box No. 115-V.

Construction Engineer

Young engineer, preferably one with two or three years experience in general construction, for design and detailing work. Location, Montreal. Apply to Box No. 116-V.

Draughtsman

Must be capable of working up reinforced concrete structures and power house substructure design for a power development in the middle west. Apply to Box No. 119-V.

Hydro-Electrical Engineer

There is an opening for an expert hydro-electrical engineer in the Irrigation Branch of the Public Works Department, United Provinces, India. The applicant must be a university graduate, with practical experience in the design, construction and control of reaction-turbine-stations, high voltage transformation and transmission systems. The applicant must be not less than 36 years or more than 42 years of age. The appointment will be made for five years in the first instance. Full particulars may be secured upon application to Box No. 122-V.

Assistant to Superintendent

Technical superintendent to act as assistant to superintendent of steam plant for large newsprint mill. Graduate engineer essential. In reply, state age, experience and salary expected. Position permanent. Apply to Box No. 123-V.

Designer and Detailer

A structural steel company requires a designer and detailer. Good living conditions and good prospects. Interesting variety of work. Apply, giving full particulars and references, to Box No. 124-V.

Civil or Mechanical Engineer

Civil or mechanical engineer for office and field work on hydro-electric power plant. At least three years experience desirable. Apply to Box No. 125-V.

Structural Designer

Experienced structural designer for the design of factory buildings required for a large industrial company in Montreal. The position is permanent, and preference will be given to applicant who has had experience on architectural work or building design. Apply to Box No. 127-V.

Mechanical Draughtsman

Mechanical draughtsman required for the layout of mechanical equipment, including heating and ventilating, and electrical equipment. Position permanent. Apply to Box No. 129-V.

Draughtsmen

Large power company requires several draughtsmen with experience in topographical survey work or on general design. Apply to Box No. 130-V.

Designer and Draughtsman

Experienced man for general structural and mechanical work in connection with mine, mill and smelter construction and maintenance. Offer $225.00 per month and transportation from Montreal or Toronto to location in Northern Quebec. Apply Box No. 131-V.

Mechanical Draughtsman

Young mechanical draughtsman for a pulp and paper company in Northern Quebec. This position will develop into operating engineer. Apply to Box No. 132-V.

Mechanical Draughtsman

Wanted by a large public utility company in Montreal, a young engineer with experience on civil engineers' plans. Must be neat daughtsman. Apply to Box No. 134-V.

Mechanical Superintendent

First class mechanical superintendent with experience and capable of taking complete charge of machine shop employing approximately 300 men, manufacturing brass and iron valves, plumbing goods, locomotive specialties, also large steel and bronze fittings and specialties for pulp mills. Apply giving full particulars as to qualifications, past experience and salary expected to Box No. 137-V.

Electrical Salesman

A company in the province of Quebec, has an opening for an electrical engineer to take charge of their merchandise sales department. The applicant must speak French and English, and must have had previous experience in salesmanship, and be able to conduct sales campaigns and supervise sales staff. He must also be able to direct the advertising and must have a personality necessary for such a position. Apply giving full particulars regarding qualifications to Box No. 138-V.

Traffic Superintendent

Traffic superintendent wanted on South American tramway property. Require man with experience in actual operation of street cars and buses on modern city property. Preference given to young man and to technical graduate if with necessary practical experience. Applicants please state full details of education, experience, present salary and give references. To right man this opening presents great opportunities. Apply to Box No. 139-V.

Mechanical Designer and Estimator

A company in Montreal has an opening for a mechanical engineer with experience in the design of digester and acid plants for sulphite pulp mills. The work will be designing and estimating special equipment, and the position offers excellent opportunities for advancement. Apply giving full details to Box No. 140-V.

Mechanical Draughtsman

A manufacturing company in central Ontario has an opening for a mechanical draughtsman with several years experience. The work is in connection with the extension and alteration of the company's manufacturing plant. Apply giving full details of experience to Box No. 141-V.

Mechanical Draughtsmen

Several good mechanical draughtsmen with paper machine experience preferred. Apply giving age, past experience, salary expected and when services are available, to Box No. 142-V.

Combustion Engineer

A manufacturing company specializing in the domestic heating field, has an opening on its sales staff for a young engineer with knowledge of heating and combustion systems. Salary and commission basis. Apply to Box 143-V.

Situations Wanted

Construction Engineer

Electrical engineer, B.Sc., M.Sc., wishes to locate in Montreal on electrical construction or installation work involving power and distribution equipment. Experience covers design, testing, operation, maintenance and installation of power equipment. Can handle men successfully and show results. Now employed in Quebec. Apply Box No. 40-W.

Recent Graduate

Graduate of Univ. of B.C. '28 with the following experience is open for a position: Instrumentman and designer on the construction of roads; resident engineer on construction of buildings; structural designer and inspector on construction of a concrete warehouse. Apply Box No. 49-W.

Mechanical Engineer

A.M.E.I.C. experienced in drawing office, production and plant maintenance; four years as engineer-in-charge of works plant installation and maintenance, mechanical and electrical; three years as sales engineer; conversant with wide variety of machinery; recently mainly on pneumatic plant; having just returned from residence abroad is open for engagement in suitable capacity. Apply Box No. 84-W.

Civil Engineer

B.A.Sc. '23, D.L.S., with experience in railroad switch work, pipe lines, sewers, setting mill machinery, motors, pumps, layout of foundations and concrete form work for reinforced concrete, erection of steel reinforced concrete, brick and wooden structures, surveys and topographic surveys, at present in United States, would like to secure work in Canada. Apply Box 86-W.

Construction Engineer

A.M.E.I.C., with twenty-six years' experience, including ten years railway construction and sixteen years on reinforced concrete bridge, as resident engineer in Canada and United States, desires position. Apply Box No. 93-W.

Airport Engineers

Civil engineer with two years surveying and five years general construction wishes to join an engineering firm specializing in or wishing to commence a department for location, design and construction of airports. Location Montreal or in Ontario. Apply Box No. 99-W.

Spare Time Work

Graduate of this year, at present employed in Montreal, wishes to secure some spare time employment in the city; either draughting or clerical work associated with engineering. Available three or four evenings each week. Apply Box No. 100-W.

(Continued on next page)

Situations Wanted

Electrical Engineer

Graduate of N.S. Tech. Coll. '25, age 27, single, two years Westinghouse test course, one year assistant electrical superintendent of a large mining concern, desires position in public utility work. Available at reasonable notice. Apply Box No. 101-W.

Civil Engineer

A graduate of McGill Univ. '24, with some knowledge of French, wishes to return to Canada from the U.S.A. His experience includes instrumentman on railway construction, resident engineer on railway construction, instrumentman on general maintenance, and transitman on preliminary surveys. Apply to Box No. 103-W.

Civil Engineer

McGill graduate with eleven years experience on the construction of hydro-electric developments and industrial buildings desires a position as resident engineer. Open for engagement at very short notice. Apply to Box No. 117-W.

Civil Engineer

Toronto Univ. graduate '25 desires permanent position, preferably but not necessarily on hydro-electric development. Most recent experience, design of bridges, culverts, etc., two years; river control studies and open channel hydraulics for hydro developments, two years; draughtsman and detailer on hydro development, three years; mechanical draughtsman on steam power plant work, two years; at present in Southern California, but available on short notice. Apply to Box No. 119-W.

Sales Engineer

A graduate mechanical engineer resident in Toronto, experienced in the design and construction of industrial plants and smaller work, would like to represent manufacturing concerns in this territory. Remuneration could be adjusted after a reasonable trial. Apply to Box No. 123-W.

Civil Engineer

A graduate civil engineer with over 15 years varied experience, mostly in the construction field, desires a position on construction as superintendent or resident engineer, or on editorial or publicity work, with which he has had experience. Apply Box No. 124-W.

Structural Designer and Draughtsman

Structural designer and draughtsman, graduate engineer with 16 years experience in Canada and in the city of New York, on all types of structures, including tall buildings, apartments, hotels, warehouses, factories and industrial buildings. At present in Montreal, desires spare time employment, evening, Saturday afternoons, etc., at home or office, designing, laying out, figuring, checking or estimating. Apply to Box No. 127-W.

Electrical Engineer

Graduate of McGill Univ. '27 in electrical engineering, age 24, single, desires a position which will give him experience in construction or design along this line. Employed since graduation by a large public utility on pole line work. Has also had considerable experience in surveying. Apply to Box No. 129-W.

Canadian Electrical Code Requires Second Edition

Under the auspices of the Canadian Engineering Standards Association, Committees have just completed a five-day session in Montreal, at which consideration has been given to proposed revisions for the second edition of the Canadian Electrical Code. Two days were spent by a special Committee of provincial representatives in a preliminary discussion of comments and suggestions for revisions made by various provinces with the object of attaining provisional agreement. This meeting was attended by the following provincial representatives: F. W. W. Doane, Doane Engineering Company, Halifax, Nova Scotia; F. P. Vaughan, Electrical Contractor, Saint John, New Brunswick; J. N. Mochon, Board of Electrical Examiners, Quebec; A. G. Hall, Hydro-Electric Power Commission, Toronto, Ontario; J. H. Schumacher, Electrical Contractor, Winnipeg, Manitoba; S. R. Parker, Department of Railways, Labour and Industries, Regina, Saskatchewan; D. Donaldson, Electric Light and Power Department, Edmonton, Alberta; and H. L. Taylor, Provincial Inspector of Electrical Energy, Vancouver, British Columbia; and also Mr. Dobson, chairman of the C.E.S.A. Code Committee; A. S. L. Barnes and H. F. Strickland, code editors, and B. Stuart McKenzie, C.E.S.A. secretary.

It was reported that the code had been adopted by legislation in five provinces and special provincial editions had been issued. In Nova Scotia the code is administered by the Nova Scotia Fire Prevention Board, in Quebec by the Board of Electrical Examiners, in Ontario by the Hydro-Electric Power Commission, in Saskatchewan by the Department of Railways, Labour and Industries, and in British Columbia by the provincial Department of Electrical Energy. In New Brunswick the code has been officially adopted in the cities of Saint John and Campbellton, and the provincial commitee is endeavouring to have the code adopted by other cities before obtaining provincial legislation. In Alberta a bill has been drafted with the object of securing provincial legislation and it is expected that this will be favourably received at the next session of the legislature. In Manitoba the question of legislation is being carefully considered by the C.E.S.A. provincial committee on the code.

The meeting of the provincial representatives was followed by the meeting of the C.E.S.A. Committee on Canadian Electrical Code, which was held in the Ministers' room at the Court House under the chairmanship of W. P. Dobson, chairman of the C.E.S.A. Committee on Canadian Electrical Code, and the attendance at this meeting was particularly representative and was well maintained throughout the sessions.

Suggestions for revisions to Canadian Electrical Code were thoroughly discussed using as a basis the recommendations from Committee of Provincial Representatives. As a result of the discussion many recommended revisions were approved, particularly with regard to grounding, motor rules, demand factors, wattage of outlets and other matters; and full advantage was taken of the experience gained since the publication of the first edition of the Canadian Electrical Code in October 1927. Revisions appearing in the National Electrical Code for 1928 were considered, much of the material therein contained being approved for adoption and a certain amount of the material from provincial rules will be incorporated in the new edition of the Canadian code. One particular feature of the discussion was the active part taken therein by manufacturers and utility companies.

Part 2 of the Canadian code covering specifications was considered and it was decided to proceed with the drafting of specification for electrical apparatus in preparation for the establishment of an approvals laboratory for electrical apparatus in connection with the National Research laboratories at Ottawa. It was felt that these specifications should cover minimum standards and that they be modelled mainly on specifications now being used by the Hydro-Electric Power Commission laboratories at Toronto and Underwriters' laboratories at Chicago, also any available British specifications.

With reference to Part 3 of the Canadian code covering outside wiring rules it was felt that the drafting of rules be proceeded with at once. A definite recommendation to this effect was made to the committee by the Grounding Panel and requests have also been received from the C.E.S.A. provincial committees, communication companies, power companies, Quebec Power Commission and other interests. It was finally decided that a committee be formed to draft a set of rules covering minimum requirements, taking as a basis rules now in force in many of the provinces, also rules being prepared by the various electrical associations.

The revisions approved at the meeting of the code committee will be issued in draft form and sent out to the various provincial committees for final endorsement. Thereafter preparation will be made for the publication of the second edition of the Code and it is hoped to issue this in the spring of 1929. It was the consensus of opinion that this second edition should not need revision for at least two years and it was proposed that the next meeting of the C.E.S.A. Committee on Canadian Electrical Code be convened in 1930.

Reports from all provinces indicate the successful progress of the Canadian Electrical Code since its publication by the Canadian Engineering Standards Association and it is felt that much has been accomplished in the attainment of uniform wiring rules throughout Canada.

The Kerr Engine Company, Ltd., Walkerville, Ontario, have issued a new booklet entitled "Valves and Hydrants," containing illustrations and price list of brass and iron valves, fire hydrants, indicator posts, etc. The Kerr Company will be pleased to send copies of this publication to any persons interested, upon request for Catalogue No. 6.

Horton Steel Works Limited have just issued a booklet entitled "Johnson Differential Surge Tanks," which was prepared under the direction of Mr. Raymond D. Johnson, and which points out the particular advantages gained by using the differential surge tank for hydraulic power plant regulation. The pages are profusely illustrated with installations made by the company, including pipe lines, penstocks, tees, manifolds, wyes, etc. Chile and Japan, as well as the United States and Canada, are represented. Copies may be secured from the company by request.

Preliminary Notice

of Applications for Admission and for Transfer

October 22nd, 1928.

The By-laws now 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 election 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 1928.

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 or 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

GILES—BEVANS HENRY DRUMMOND, of Montreal, Que., Born at Montreal, April 20th, 1903; Educ., B.Sc. (Met. Eng.), McGill Univ., 1927; 1923-24, lab. asst., Canadian Laco Lamps; 1927 to date, engr. with the Canadian SKF Co., Ltd., covering eastern Canada, on installn., service, inspection, etc., ball and roller bearing in pulp and paper mills, textile mills, woodworking plants, steel mills, etc.

References:—G. Janes, E. Klein, C. V. Christie, A. J. Grant, C. M. McKergow, R. DeL. French.

GRAY—ROBERT BALFOUR, of 19 Salisbury Road, Pointe Claire, Que., Born at Glasgow, Scotland, Jan. 3rd, 1892; Educ., 1914 and 1919-20, design of structures, Glasgow Technical College; 1909-14, struct'l training in templet shop, fabrication shops and field work, Sir W. Arrol & Co., Glasgow; 1915-18, supervision work on constrn. of Sinai Desert Railways, roads, waterworks, with the Royal Engineers; 1919-20, dfting., office work, on boilers, stationary and marine, Babcock & Wilcock, Ltd., Scotland; 1919-24, dfting., office work on structures and tank work, and 1925-27, squad leader i/c of struct'l detailing and plate work, Dominion Bridge Company, Lachine; at present district sales engr. for Montreal, with the Robb Boiler Works, Amherst, N.S.

References:—F. P. Shearwood, C. S. Kane, D. C. Tennant, A. S. Wall, A. Peden, H. H. Hawkes.

HARZA—LEROY FRANCIS, of 205 W. Wacker Drive, Chicago, Ill., Born in Brookings County, South Dakota, U.S.A., Feb. 6th, 1882; Educ., B.S. in M.E., South Dakota State College, 1901, B.S. in C.E., Univ. of Wisconsin, 1906, Civil Engineer, Univ. of Wisconsin, 1908; 1901-12, field engrg., surveying, constrn., dfting. and misc. subordinate jobs; 1912 to date, engineering practice as consltg. engineer, with interruption of about one year for war work. Projects handled as chief engr. or consltg. engr., in responsible charge of investigation, design and constrn., include the following: two bridges in Oregon; hydro-electric projects for Great Lakes Power Co., St. Mary's River, Sault Ste. Marie, Ont., the Central Power Company, Kearney, Neb., and many other power companies in the U.S.A.; automatic hydro-electric station for the Michigan Gas & Elec. Co.; six automatic hydro-electric stations for the Interstate Public Service Co., Indiana; municipal storage dam and pipe line, City of Akmulgee, Okla.; two large bridges across the Dix River in Kentucky; two hydro-electric projects in Texas now in progress for the Central Power & Light Co., and one for the Lake Superior District Power Company.

References:—J. L. Lang, A. E. Pickering, J. W. LeB. Ross, N. R. Gibson, W. L. McFaul, E. Vinet.

REID—WILLIAM JOSEPH WALTER, of Hamilton, Ont., Born at Oak River, Man., March 31st, 1898; Educ., B.A.Sc., Univ. of Toronto, 1924; with the Otis-Fensom Elevator Co., Ltd., as follows: 1921 and 1922 (summers), factory employment; 1923 (summer), constrn. employment; 1924 (May-Dec.), student course; 1925-26, i/c of elect'l manufacturing in factory; Oct. 1926 to Dec. 1927, asst. constrn. mgr., and Dec. 1927 to date, constrn. manager.

References:—W. D. Black, A. M. Reid, O. W. Titus, C. H. Mitchell.

STUART—FRANCIS LEE, of 949 Broadway, New York, N.Y., Born at Camden, S.C., U.S.A., Dec. 3rd, 1866; Educ., grad. Emerson Institute, Washington, D.C.; private tutor in maths. and bridge work; 1884, entered railroad service with Baltimore & Ohio R.R., and during next thirteen years had active experience with various railroads in eastern and southern part of United States, also in coal mining and public works; 1897, dist. engr., eastern side of Nicaragua Canal; 1899-1900, divn. engr., Istmian Canal Commission; 1900, asst. engr. and engr. of surveys, Baltimore & Ohio R.R.; 1905-10, chief engr., Erie R.R.; 1910-15, chief engr., Baltimore & Ohio R.R. (during period 1905-15 served on many technical and terminal committees in New York, Cleveland, Pittsburg, Cincinnati, St. Louis, Chicago and other cities); 1915 to date, consltg. engr. in private practice in New York City, largely of a personal service to clients of an economic or investment nature, but also engaged on much work of a public nature, including 1917-18, chairman, Terminal Port Facilities Commn., War Industries Board, U.S. Govt.; 1918-20, chairman, Budget Commn., U.S. Railroad Administration; 1920-21, consltg. engr., Cunard project and H.E.P.C., Niagara Falls, Ont.; 1920 to date, consltg. engr., Hudson River bridge project, New York; 1923-27, retained by trunk lines entering New York on terminal matters.

References:—H. G. Acres, J. M. R. Fairbairn, R. L. Hearn, T. H. Hogg, T. K. Thomson.

WHITE—ROSS, of Kenogami, Que., Born at Lake Weir, Florida, U.S.A., July 5th, 1885; Educ., B.S. in C.E., Iowa State College of Agriculture and Mechanic Arts, 1910; member, A.S.C.E.; 1910-13, asst. engr., City of Manila, P.I., checking designs and in charge of constrn. of bridges, bldgs. and seawall; 1913-18, asst. engr., Turlock Irrigation Dist., Turlock, California, surveys, mtce. and operation of 180,000 acres irrigation project; 1918-22, surveys, diamond drill borings, detail studies and plans for Don Pedro dam and power house work for Turlock Irrigation Dist.; 1922-24, res. engr. on Don Pedro project—work consisted of a dam (concrete), 284 ft. high and a 15,000 kva. hydro-electric plant; 1924-26, asst. chief engr. on Exchequer project of Merced Irrigation Dist., Merced, Calif., responsible charge of all field engrg. on project; 1926-28, res. engr. in charge of all field engrg. on the Buck's Creek project of the Feather River Power Co., Storrie, Calif.—project consists of a 325,000 c. yds. rock fill dam, two concrete arch dams, three miles of tunnel, one mile of highhead penstock, and a 70,000 hp. power plant, also involves ten miles of narrow gauge rly. and ten miles of wagon road (cost of project $9,000,000.00); March 1928 to date, asst. supt. on the Shipshaw hydro-electric development of the Alcoa Power Company, Ltd., Kenogami, Que.

References.—A. Surveyer, J. W. Rickey, H. W. Small, H. R. Wake, R. E. Parks.

WINTER—L. A. GUY, of 1611 Hertel Ave., Buffalo, N.Y., Born at Toronto, Ont., April 14th, 1901; Educ., B.A.Sc. 1922, M.A.Sc. 1923, Univ. of Toronto; 1919-22 (summers), chem. lab., Dunlop Tire & Rubber Co., Toronto; 1923-25, asst. to chief chemist, and 1926 to date, chief chemist, Dunlop Tire & Rubber Co., Buffalo, N.Y.

References:—E. A. Allcut, E. P. Muntz, W. A. Campbell.

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

BREMNER—DOUGLAS, of 205 The Boulevard, Westmount, Que., Born at Montreal, May 21st, 1893; Educ., B.Sc. (Civil), McGill Univ., 1915; 1911-12 (summers), shop practice, Northern Electric Co., Ltd., Montreal; 3 years building roads, sewers, houses, etc., sharing responsibility with J. H. Norris; 1915-18, with A. F. Byers & Co., Ltd., Montreal, securing promotion to head of outside construction, gen. mgr., etc., also director of the company and its subsidiary; Jan. 1918, organized Bremner, Norris & Co., Ltd., being president and man. director, duties consisted of engrg. design, etc., and constrn. of bldgs., as well as executive duties, constructed large number of factories, churches, schools, etc.; at present president and man. director of above company, also directing engrg. staff.

References:—J. H. Hunter, C. K. McLeod, E. Brown, F. B. Brown, C. M. McKergow, F. S. Keith, L. deB. McCrady, A. B. McEwen.

FOR TRANSFER FROM THE CLASS OF JUNIOR TO A HIGHER GRADE

LYON—JOHN EDWARD, of 100 Bagot St., Kingston, Ont., Born at Ottawa, Ont., Aug. 28th, 1895; Spec. War Cet., R.M.C., 1917, D.L.S., O.L.S,, Sch. Mil, Engrg., Eng.; 1914-15, asst., Dom. land surveys; 1917-19, overseas, Capt., R.C.E.; 1919-22, employed under A.D. Military Surveys; Nov. 1925 to date, dist. engr. officer, Mil. Dist. No. 5, Quebec, Que.

References:—A. G. L. McNaughton, A. C. Caldwell, S. H. Osler, P. S. Benoit, G. C. Cowper.

MONTGOMERY—SAMUEL CLIFFORD, of Ocean Falls, B.C., Born at Winnipeg, Man., July 24th, 1894; Educ., B.Sc. (Mech.), McGill Univ., 1915; 1915-19, overseas, Lieut., M.C.; 1919-20, mech. dftsman., Whalen Pulp & Paper Co., Woodfibre, B.C.; 1920 (Mar.-Aug.), designing dftsman., Western Canada Pulp & Paper Co., Port Mellon, B.C.; March 1923 to date, with Pacific Mills, Limited, Ocean Falls, B.C., as follows: 1923-24, mech'l dftsman., 1924-26, asst. to res. engr.; Feb. 1926 to date, asst. mech'l supt.

References:—W. Jamieson, R. H. Vaughan, E. A. Wheatley, D. W. Hodsdon.

SIMMERS—JOSEPH ADOLPH, of 170 Roehampton Ave., Toronto 12, Ont., Born at Toronto, Aug. 1st, 1895; Educ., B.A.Sc., Univ. of Toronto, 1921; 1914 (summer), rodman, dept. of works, City of Toronto; 1921 (Apr.-Dec.), assembly, calibration and research work on steam power plant meters, Bailey Meter Co., Cleveland, Ohio; 1923-24, junior traffic engr. on machine switching exchange in Manhattan, New York Telephone Company; 1924-26, mech'l and struct'l design, etc., as asst. to res. engr. of Spanish River Pulp & Paper Co., Ltd., Sturgeon Falls, Ont.; 1926 (Mar.-Nov.), supt. of production and design, Canadian Aluminum Co., Ltd., Toronto; Dec. 1926 to Feb. 1927, asst. i/c of export packing dept., Massey-Harris Co., Ltd., Toronto; 1927 (Mar.-June), order and purchase dept., also on research work, Turnbull Elevator Co., Ltd., Toronto; July 1927 to date, struct'l engr., checking design of concrete and steel bldgs., etc., City Architect's Dept., Toronto.

References:—F. N. D. Carmichael, P. M. Thompson, G. L. Wallace, W. L. Sagar, H. N. Mason.

FOR TRANSFER FROM THE CLASS OF STUDENT TO A HIGHER GRADE

BISHOP—JOHN GORDON, of 1260 Mackay St., Montreal, Que., Born at Cupids, Nfld., Dec. 5th, 1900; Educ., B.Sc. (Elect'l.), McGill Univ., 1923; May 1923 to date, with Northern Electric Company as follows: 1923-24, telephone engrg. dept.; 1924-28, radio engrg. dept., and April 1928 to date, transmission engrg. dept.

References:—W. C. Adams, H. J. Vennes, W. B. Cartmel, N. L. Morgan, W. L. Dawson, J. R. Fenwick.

GOODALL—ERNEST LORNE, of 1806 Ducharme Ave., Montreal, Que., Born at Ottawa, Ont., April 10th, 1901; Educ., B.Sc. (Mech.), McGill Univ., 1924; asst. engr. to Alan K. Hay, A.M.E.I.C., for Ottawa Suburban Roads Commn.; Jan. 1925 to date, with Abitibi Power & Paper Co.—1925-27, asst. plant engr., 1927-28, field engr. i/c of constrn. work other than design at the Smooth Rock Falls plant; at present on leave of absence to take post-graduate course at McGill University.

References:—J. A. Dickinson, H. J. Buncke, A. K. Hay, C. M. McKergow, S. H. Wilson.

LEWIS—DAVID JOSEPH, of 900 St. Catherine St. West, Montreal, Que., Born at Ottawa, Ont., Dec. 28th, 1899; Educ., B.Sc. (Civil), Queen's Univ., 1924; 1920 (summer), articled student, Dom. land surveys; July 1924 to May 1925, field engr. and inspr., laying underground conduits, Elect'l Commn., city of Montreal; 1925 to date, with Dominion Bridge Company as follows: 1925 (May-Sept.), field erection; Sept. 1925 to Feb. 1926, steel dftsman.; Feb. 1926 to date, designer, plate and tank dept.

References:—A. S. Wall, A. Peden, D. C. Tennant, W. P. Wilgar, G. E. Templeman.

— THE —

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Volume XI | Montreal, December 1928 | Number 12

The Development of Anticosti Island

Part I.—Location, Historical Reference, Transportation, Natural Resources and Logging Methods

J. H. Valiquette, A.M.E.I.C.
Manager, Anticosti Corporation, Anticosti, Que.

Part II.—Harbour Development, Handling of Pulpwood, Future Development of Harbours and Water Power

T. B. Fraser, S.E.I.C.
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Paper read before the Montreal Branch of The Engineering Institute of Canada, October 25th, 1928

Development of Anticosti Island—Part I.

Geographical Location and Size

The island of Anticosti is situated in latitude 49 north, and longitude 63 west, in the gulf of the St. Lawrence, 360 miles below the city of Quebec. The closest point to the mainland on the south shore is the Gaspé coast 40 miles distant and on the north shore Mingan, which is 21 miles distant.

The island has a length of 135 miles and a width of 35 miles, the area being 3,100 square miles or approximately one and one-half times the size of the province of Prince Edward Island.

Discovery and History

On August 15th, 1534, Jacques Cartier, the noted French explorer, entered what we now know as the gulf of St. Lawrence and discovered the island to which he gave the name " Ile de l'Assomption " as the discovery was made on Assumption day. At a later date the island was visited by another explorer, the Marquis de Roberval, and as his visit took place on Ascension day the name was changed to " Ile de l'Ascension." Later, however, the name Anticosti was adopted, which it is thought has its origin in the Montagnais Indian word natikoteck, meaning " the land of bears."

It was only in 1680 that the real history of Anticosti began, when King Louis XIV of France ceded the island to Louis Jolliet, his hydrographer, in recompense for his services in exploring the Mississippi river and Hudson bay. Jolliet took possession of his seigneurie, established his family there and centred his activities on seal hunting and fishing. Jolliet's peaceful tenantry was disturbed when Admiral Phipps on his way to besiege Quebec in 1690 took Jolliet, together with his wife and family, prisoners. This misfortune, however, did not discourage Jolliet, whom we see again in 1697 carrying on a fur trading business on the Mingan coast. In the following year, availing himself of his knowledge of hydrography, he published a map of the island of Anticosti. The exact date of Jolliet's death is not known, but it is thought to have been between 1699 and 1701. The place of his burial, too, is uncertain, but is considered to be somewhere on the island.

Following Jolliet's death the ownership of the island passed into the hands of his three children. Succeeding them, we learn that until the year 1874 the ownership was more or less complicated, when an attempt was made by the Forsyth Company of Newfoundland to colonize it. This attempt proved unsuccessful and disaster to the settlers was only averted by the government's timely intervention. In the following ten years we see further changes, and in 1884 Anticosti was sold by sheriff's auction to T. W. Stockwell, who disposed of it in 1888 to a company known as " The Governor and Company of the Island of Anticosti." Finally in 1895 this company's trustees sold Anticosti to Mr. H. E. A. Menier, of Paris, France, for the sum of $125,000.

With Mr. Menier's acquisition of the island came the

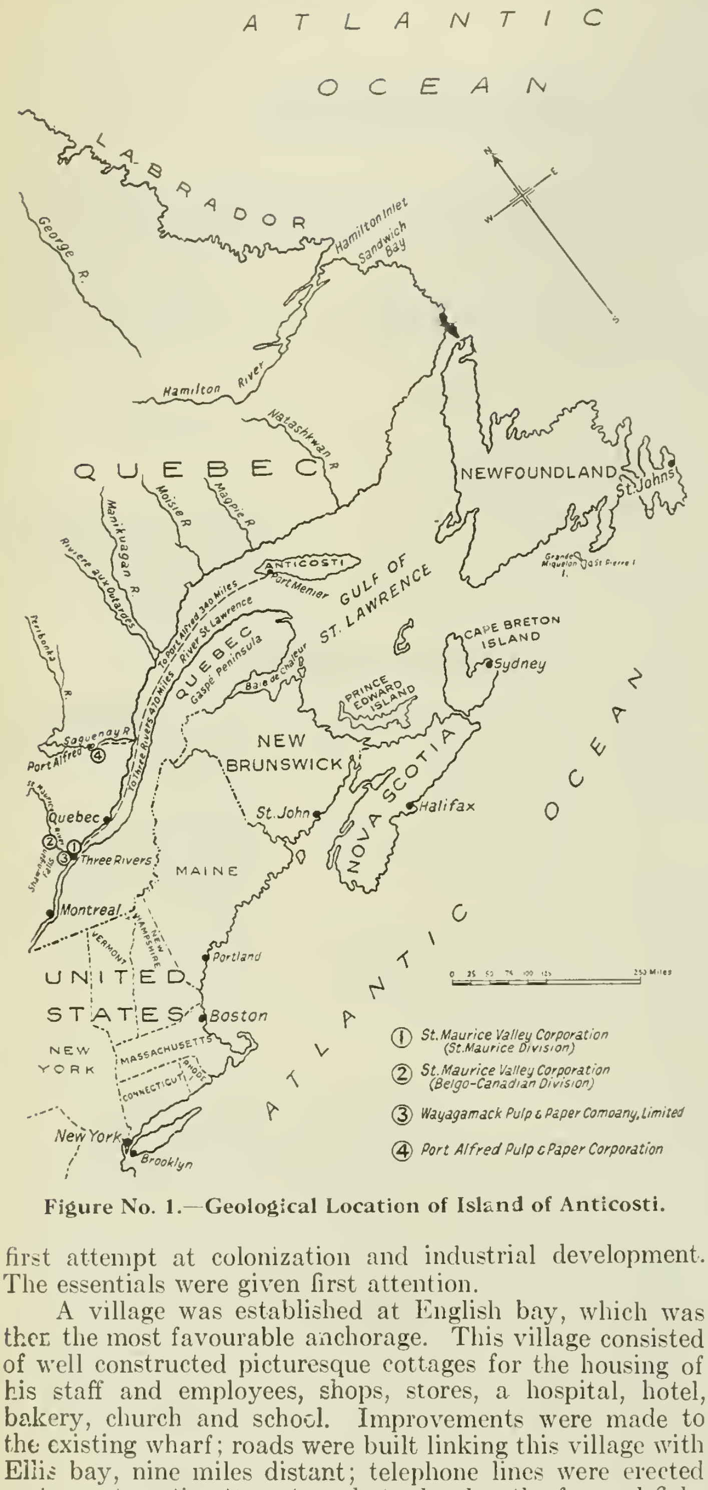


Figure No. 1.—Geological Location of Island of Anticosti.

first attempt at colonization and industrial development. The essentials were given first attention.

A village was established at English bay, which was then the most favourable anchorage. This village consisted of well constructed picturesque cottages for the housing of his staff and employees, shops, stores, a hospital, hotel, bakery, church and school. Improvements were made to the existing wharf; roads were built linking this village with Ellis bay, nine miles distant; telephone lines were erected and a systematic attempt made to develop the fur and fishing industries.

In addition to this, a farm was developed adjacent to the village to meet the needs of the inhabitants and to experiment with the agricultural possibilities of his new territory.

In 1899 Mr. Menier, realizing that valuable timber resources were at his command, saw that his efforts towards developing them were greatly restricted by continuing operations at English bay owing to its limited depth of water for harbourage. With a view of obtaining a deep sea port he commenced the construction of a wharf at Ellis bay, which provides the finest protection for ships in the island. The reef here, as at other points, is long and shallow, necessitating the construction of a wharf 3,500 feet in length, in order to reach a depth of 12 feet of water at low tide.

The harbour established, his next step was to construct an entirely new village at Ellis bay, which point was now to be the new centre of his activities. The new village was given the name of Port Menier. Profiting by his experience at English bay, he proceeded with the construction of more substantial and commodious buildings, aiming at larger industrial developments. Having established his new capital he erected for himself a villa modelled along the lines of a French chateau, upon which he spared no expense either in the construction or its sumptuous furnishings.

In 1910 he entered upon an extensive programme of pulpwood logging. He constructed a rossing plant, consisting of 20 knife barkers, together with a steam generating power plant to furnish the necessary power. A slasher, conveyor and loading equipment formed a part of the scheme. A standard gauge railroad was built to transport the wood from the logging area to this plant. This was finally extended about thirty miles down the island.

In 1913 an important event occurs in the history of the island, when its owner, Mr. H. Menier, died and was succeeded by his brother, Mr. Gaston Menier, who continued the operations then under way.

Pulpwood logging activities were carried on until 1918, to which date 500,000 cords of barked wood had been shipped. Encountering financial difficulties through the fall of the French currency, the owner decided to discontinue logging operations and a period of quiet ensues between that date and the sale of the island to the present owners.

The Anticosti Corporation

In the spring of 1926 negotiations were opened between the Wayagamack Pulp and Paper Company, the St. Maurice Valley Corporation and the Port Alfred Pulp and Paper Corporation and Mr. Gaston Menier for the purchase of the island. In May of this year the late Mr. H. R. Wickenden, then chief forester for the Wayagamack Pulp and Paper Company, proceeded to the island together with a party of timber cruisers to conduct an exploration. Following this the island was visited by several of the directors of the above companies and in July the island passed into the hands of the present owners. A limited company was formed known as The Anticosti Corporation, controlled jointly by the three paper companies. An agreement was made by which these companies would purchase the entire annual timber output of the island at a figure sufficient to provide for the expenditures, including operating expenses, bond interest, sinking fund, etc.

Transportation

Freight, passenger, mail and transportation of men, materials and supplies is handled by a joint company known as The Anticosti Shipping Company.

Two vessels, the "Fleurus" and the "Sable I," operate between Montreal, Quebec and Anticosti on a schedule of sailings drawn up to cover the season's operations. The "Fleurus," which was built at Le Trait, on the Seine, in 1926, is an oil burning steam vessel of 1,100 gross tons, having accommodation for forty first-class passengers and seventy-five second-class passengers, and has a speed of 12 knots. The "Sable I," built in England in 1914, also is a steam vessel of 734 gross tons, with accommodation for one hundred passengers and commodious freight capacity. She has a strongly constructed hull, with an ice breaking bow, and is capable of a speed of 11 knots.

For the distribution of materials and supplies along the coast, two auxiliary schooners are used as well as a fleet of small motor launches. The larger of the schooners, the "Jolliet," is equipped with a 150-h.p., semi-Diesel Fairbanks-Morse engine and has a speed of 10 knots.

A regular boat service has been maintained without difficulty between the months of April and December. During the winter, the government ice breakers, the "Montcalm" and "Mikula," make a monthly trip to the island. Supplies are discharged on the ice about two miles off shore and transported to the depot by tractors and teams.

During the past winter, arrangements were made with the Transcontinental Airways, Ltd., to transport mail from Murray Bay to points along the north shore of the St. Lawrence and to Anticosti. A light Fairchild monoplane, using skii for a landing gear, was used for this service, and its landing performance, even in severe weather, was remarkable. By this means an unbroken mail service has been established throughout the year. This, combined with wireless and cable service, keeps the inhabitants in constant touch with the mainland.

Natural Resources

The principal natural resources of the island may be said to be timber, farming, fur, fish and game. Of these only timber and fur are exploited by its present owners for commercial gain. The remaining resources are developed on a small scale, sufficient to meet local needs. The development of the timber resources is primarily the object of The Anticosti Corporation.

Timber

An idea of the vastness of the timber area may be had from the carefully prepared estimates of the Corporation's forestry engineers which show that there is a quantity of 14,400,000 cords of standing timber, of which about 40 per cent is spruce and 60 per cent balsam. This would represent sufficient raw material to manufacture about 11,000,000 tons of newsprint.

Forest Resources

The forest producing capacity can be determined in a general way by considering two dominant factors, namely, the climatological conditions and the geological origin and structure of the soil. The climate of the island is characteristic of that of the northern regions of the temperate zone, although greatly influenced by the surrounding sea. The period of vegetation is brief but intense, while the winter is of long duration. The summer heat and the winter cold are, however, less extreme than in the interior of the Laurentians of a more southerly latitude. The rainfall is moderate, and in comparison less than in the Quebec-Montreal region during the vegetation season. The predominating winds are southeasterly and northwesterly and have an apparent influence on the tree growth of the island which shows itself by the shore belt being of stunted and scrubby trees, while the protected localities show an excellent growth.

The geological properties of the soil are next in importance. The island of Anticosti is a remainder of the silurian deposit that in an early epoch formed a large part of northern Canada.

The disintegration of this rock forms a very rich top-

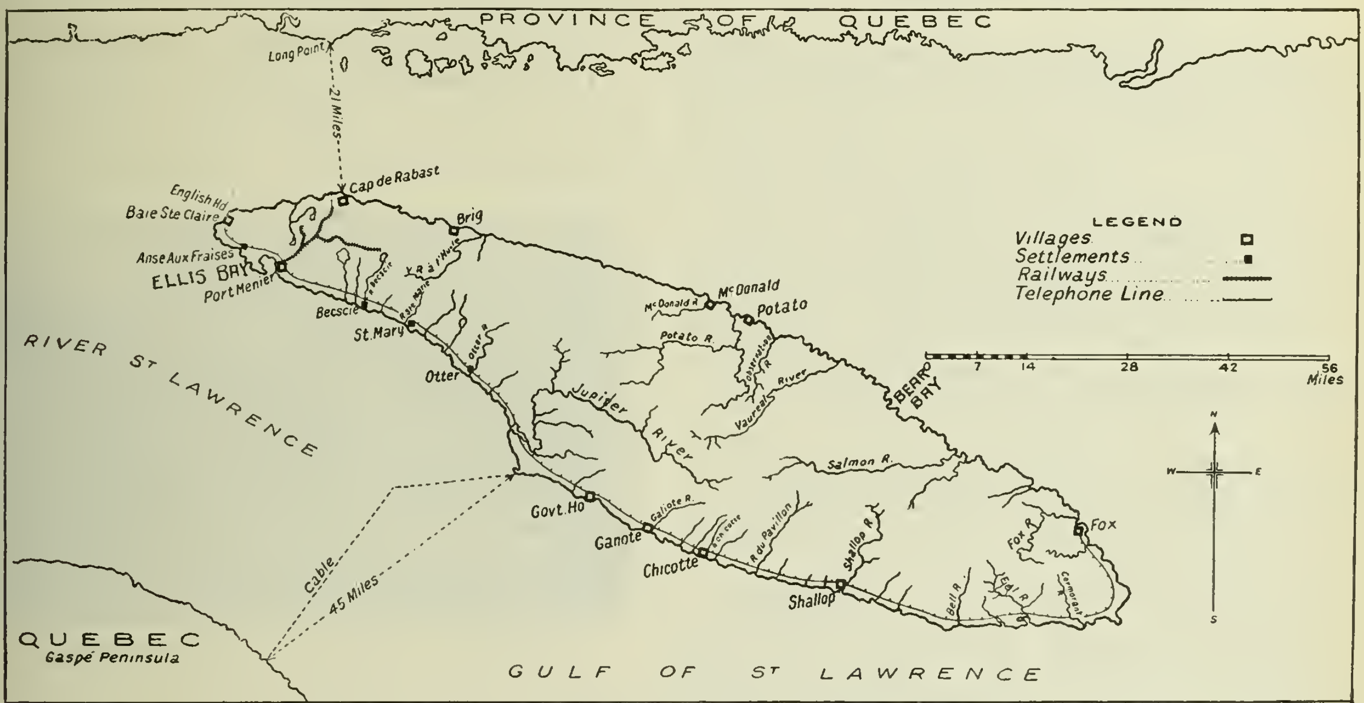


Figure No. 2.—Map of Island of Anticosti.

The most important part of the transportation arrangements is that provided for the shipping of pulpwood to the mainland.

During the season of open navigation, i.e., from May 1st to October 10th, a continuous service for the transportation of pulpwood has been maintained by the Water Transports Limited and the Canada Steamship Lines. The former company built and equipped six boats specially for this service, while the latter has placed at the disposal of the company sufficient additional boats to meet the balance of their requirements. These boats are of the lake type, 252 feet in length, with 42-foot beam and a bale capacity of 123,000 cubic feet under deck and when fully loaded to a mean draft of 16 feet carry 800 cords of wood in the hold and 600 cords on deck. Their speed is 9 knots.

To suit the loading and unloading plants the hatches have been made especially large, having a clear opening of 14 by 30 feet. This type of boat is well adapted to the pulpwood trade and has the added advantage of being a suitable grain and coal carrier, ensuring its continuous demand at all seasons.

Figure No. 2a.—View from Loading Plant Looking Across Ellis Bay.

Typical loose wood raft (centre); storage boom (right); and steamer "Fleurus" (foreground).

crust of gravel and clay and covers almost the entire island. Wherever these quarternary formations occur and the natural drainage of the soil is satisfactory, the timber thrives perfectly. Mentioned here is the drainage of the soil, which indeed is the factor that greatly promotes or limits the forest growth of the island. The limestone soil, whereof the clay is a component, is rather impermeable. This quality added to the effect of water in localities of flat topography, results in more or less extensive areas of swampy ground, often real peat bogs, called muskegs. This is, however, a characteristic of the northern part of the province and is also a result of the reaction on the soil of a comparatively cold climate. The rapid development of the timber on sloping land where drainage conditions are favourable is a striking contrast to the poor growth of timber on the above mentioned saturated areas. It is evident that if the future value of pulpwood would allow the expense of trenching swampy land many a square mile of now non-merchantable growth could be converted into a good timber in a reasonable time.

The timber of Anticosti is found in a virgin state, the balsam predominating. The balsam reproduces itself readily in protection and shadow. It has been observed that in a partly wind fallen stand the young regrowth of balsam starts to sprout rapidly. In the virgin forest, by the time the overmature balsam fails, there is generally a new generation well under way.

Forest fires are aiding the regeneration of spruce rather than that of balsam. A fire provides space and light necessary for the young spruce plant to thrive successfully. On the west end of the island the evidence of this may be seen where a forest fire has burnt over most of the old cutover areas and a young generation of spruce predominates. Along the Jupiter river, this is again evident, where a young forest of spruce has grown up after a fire of sixty years ago.

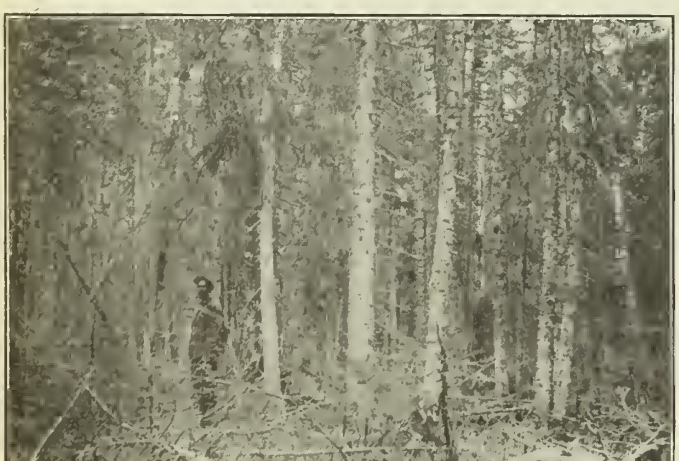


Figure No. 3.—Typical Spruce-Balsam Stand, near Potato River.

Where the spruce-balsam type grows to best advantage it yields as high as 50 cords per acre. Over large areas of the coastal regions of the island an average of about 10 cords per acre is found.

In swampy localities or dry and poor soil one finds the black spruce type in evidence. Where conditions are favourable this type yields up to 15 cords per acre. On the other hand, wherever the soil conditions are very poor, or on swampy ground, this type turns to so-called scrub spruce of a stunted appearance that seldom reaches a merchantable size.

Of leaf trees there is not a great variety. Birch always occurs on the better soil and poplar is frequent in certain localities on the north shore.

Reforestation, Annual Regrowth and Annual Decay

It may be stated that conditions for natural reforestation of the island are very favourable. The rate of the annual increment may be judged by the fact that it takes 60 to 70 years for the spruce-balsam type on average soil conditions to grow to a merchantable size and at that time it will yield about 11 cords to the acre.

Figure No. 4.—Potato River Looking Towards Sea.

It is believed at the present time the natural regrowth more than offsets what is cut and lost by decay and windfall.

The Anticosti Corporation are organizing to direct their exploitation in the more matured wood which will have the effect of deriving more benefit from the yearly regrowth of the young trees.

Fire Hazard

On account of its isolation as an island, Anticosti is not exposed to outside hazard, as are other limits on the mainland. However, on account of the highly inflammable nature of the soil in extended dry periods a constant enforcement of fire protection measures is necessary.

Fur

The principal fur bearing animals existing at present on the island are the fox and the beaver. The fox is native to the place, but through the efforts and research of Mr. Menier's botanist the strain was much improved and this fine little animal became very abundant. The trapping of the fox has been carried on for a great many years. The 1925-1926 catch of fox reached 1,600, 15 per cent of which were silver, the balance being cross and red.

Beaver were imported around the year 1900 and have multiplied very rapidly ever since. Fisher and mink were also imported, but are rarely seen today. Otter and marten, which are native, are found occasionally. Seals are taken on the reefs and shoals around the island.

Game

In 1897 and 1898, Mr. Menier imported about 300 couples of Virginia white tail deer. This interesting inhabitant of the forest has become so numerous that one must visit the place in order to see for oneself how plentiful they really are. It has been estimated that the island contains probably 100,000 deer. The deer is a meat resource of no small value. In the western portion of the island, in the vicinity of the settlements and in logging districts, close to 1,000 deer are killed annually for immediate consumption.

A herd of reindeer and a pair of elk were imported a few years ago. Both these animals appear to be thriving.

Wild fowl are in abundance during the migration season, the Canada goose being one of the most popular visitors. Partridge have confined themselves to the west end of the island but here they are steadily increasing in numbers.

Fish

In the larger rivers of Anticosti one finds excellent salmon and trout fishing. The disciple of Isaac Walton can find great opportunities for practising the noble art on the island. Mr. Menier had constructed at eight of the river mouths camps suitably equipped for the reception of sports and anglers.

Figure No. 5.—Commencement of Drive on Canard River.

The coast waters abound with cod, halibut and lobster. These are taken in sufficient quantity to supply the local needs.

Logging Methods

Logging

The cutting operations may be described as being carried on in two distinct manners, by company operated camps and by contract. The 12-foot log has proved to be the most suitable for driving and towing. The corporation at present operates two logging camps manned by their own forces and under the direct control of the superintendent of one of their logging districts. The larger of these camps this year has started on a cut of 15,000 cords and the smaller 7,000. The men in these camps are working on a piece work basis, being paid so much per log. The above operation represents only a small proportion of the total cut, which, during the past winter, amounted to 175,000 cords.

Cutting by contract is the usual practice in the logging of the island. Contracts vary from 6,000 to 30,000 cords. The contractor binds himself to deliver the wood at a certain price per 1,000 FBB on driving streams, at tractor roads or railway. The work of the contractor is under the constant check and supervision of the superintendent of the logging district in which he operates.

Figure No. 6.—Reindeer on Island of Anticosti.

In suitable locations, the cut is commenced early in summer, and usually finishes before the snow falls. Generally, however, the bulk of the cutting is done in winter, commencing early in the fall, and is brought to an end in the late winter when snow gets deep.

Logging conditions during the winter are very similar here to points on the mainland. The snowfall is not greater than elsewhere throughout the province of Quebec.

Driving

Wherever possible the wood is delivered on streams and driven into holding booms at the sea or direct to the main storage area at the shipping point.

The driving operation is carried on either by contract or by day labour. Preparation for the storage of water necessary for driving must be made the previous fall. Timber rock-fill dams are used for a head exceeding 8 feet. For dams with a lesser head, a round timber structure with an inclined sheeted face on the up-stream side is used. This is commonly known among lumbermen as a " charge d'eau " dam. A slope of 2 to 1 on the upstream face is found satis-

Figure No. 7.—Silver Fox Caught in Trap.

Figure No. 8.—Tug "George M. McKee," with Raft in Tow.

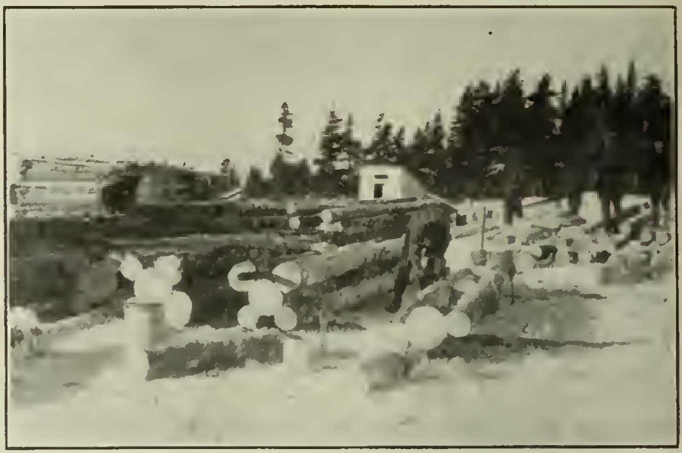


Figure No. 9.—Construction of Four-Piece Towing Boom.

factory, when the timber work is well set into the ground or anchor bolted to rock.

The natural run-off in Anticosti is rapid and without artificial water storage; driving can be carried on for a period of two to three weeks.

The driving capacities of the rivers depend, more or less, on the extent of improvements made. The average stream is capable of floating about 35,000 cords of wood during the months of May and June, when proper water storage is provided.

Towing

Wood driven on rivers other than those discharging into Ellis bay must be delivered into holding areas at the river mouths and held by booms, to be later made up into rafts and towed to the loading plant at Ellis bay. So far, the estuaries of three drivable streams discharging to the south shore have been developed into storage basins protected by cribs and booms, offering facilities for the storage of 70,000 cords.

For the rafting of wood heavy towing booms have been constructed. These consist of four pieces of round timber, bolted securely to 12 by 12 British Columbia fir blocks, one round timber being bolted to each face of the block. The average length of the boom sticks is 22 feet. These are joined with one-inch double chain locked with shackles. When floating they draw about 20 inches of water, leaving 10 inches exposed. The average raft towed during the past summer contained 800 cords of wood. This requires approximately 100 pieces of boom stick. The method employed in the making of rafts at the river mouths is as follows: The holding boom is opened on the falling tide, allowing the wood to enter the towing boom already placed at the opening. Cribs are located at each side of these openings to which the ends of the towing boom are securely fastened. When the boom is filled, it is towed to the awaiting tug by a shallow draft gasoline boat called an alligator. The raft is then taken in tow by the tug and delivered to the loading plant where it is floated into the holding area on a rising tide.

The tugs used for this work were the "Geo. M. McKee" and the "Hullman." The "Hullman" is a steam vessel of 171 gross tons, with a speed of 11 knots. She is powered with 650-h.p. triple expansion engines. The "Geo. M. McKee" is a Diesel oil tug of 720-h.p., capable of a speed of 11.3 knots. These two tugs towed a total of 73,000 cords of wood between the months of May and October. The average towing distance was eleven miles and the average raft towed was 800 cords.

To carry on a towing operation successfully in the gulf of the St. Lawrence the weather and tides must be studied closely. The tidal stream sweeping the southern coast of Anticosti has a speed of 1½ to 3 knots. This combined with a head wind is sufficient to force a tug to lose ground, even with a comparatively small raft. From the experience gained so far, it may be said that if accurate local weather forecasts can be procured, coastal towing is a success.

Tractor Hauling and Railroading

Tractor hauling, as a means of pulpwood transportation, is proving its worth in the logging operations of the island. Three Lynn tractors and two Holts have been used for the past two winters. On an average haul of six miles, 18,500 cords were transported during the past season. The main haul road was iced and on this road each of the larger

Figure No. 10.—Lynn Tractors Hauling Pulpwood.

Figure No. 11.—Caterpiller Tractor Hauling Pulpwood.

tractors were able to handle an average load of 35 cords. The coming winter's operations will include the hauling of 21,000 cords of wood a distance of six miles. Where this cut is being taken out, it was found impossible to skid during the summer with horses. To overcome this difficulty several spurs of Decauville track of 19-inch gauge have been used to bring the wood to the main haul road. Depending on the grade of the track, a train of 10 to 20 cars, each carrying ½ to ¾ of a cord, is handled by a team of two horses. The whole equipment is light and portable and is readily moved along as the cut progresses.

Logging operations are again being commenced on a small scale along the railway laid down by the Menier organization. A cut of 20,000 cords will be landed on a lake adjacent to the track. From the water, the wood will be jack laddered into flat cars and hauled to the loading plant.

Development of Anticosti Island—Part II.

Ellis Bay Harbour

Ellis bay is situated on the south coast of Anticosti, 7 miles from its western extremity. Extending inland for a distance of 3 miles, with a width of 1¾ miles, the bay forms the best natural harbour on the island. On either side of the mouth of the bay shallow limestone reefs extend into the sea, affording good protection. A reef 3,000 feet long borders the entire shore, being totally exposed at low-tide, but covered by from 3 to 5 feet of water at high-tide.

Figure No. 12.—Log Jammer Loading a Lynn Tractor.

The channel follows the centre line of the bay, running north 7° east. At the inner end and about 1,000 feet distant from the reef, a natural depth of 12 feet at low-water is obtained. This increases seaward to 22 feet at the mouth of the bay, being constant for approximately 1,000 feet on either side of the centre line. The tide rise at Ellis bay is 7½ feet springs and 5½ feet neaps.

In Part I of this paper it has been stated that Mr. Menier constructed a wharf 3,500 feet long, commencing at the east side of the bay and extending westward to the channel. This jetty has a width of 13 feet, extending from the village to the reef, which at this point is 2,800 feet from the shore. Here it widened out into a timber rock-filled wharf 35 feet wide and 900 feet long. A standard gauge railway runs the full length of the wharf and jetty.

When the corporation acquired the island, it was seen that this wharf was not sufficiently large, and that there was not a depth of water necessary for the type of vessel to be used in their pulpwood service. With a view to providing the proper facilities for the loading of their wood, the corporation embarked on the extension of this wharf. They also found it necessary to construct a general cargo wharf for the loading and discharging of men, supplies and equipment. For this work the services of the Foundation Company of Canada were secured, and construction operations commenced in November 1926. About this time the Department of Marine and Fisheries for the province of

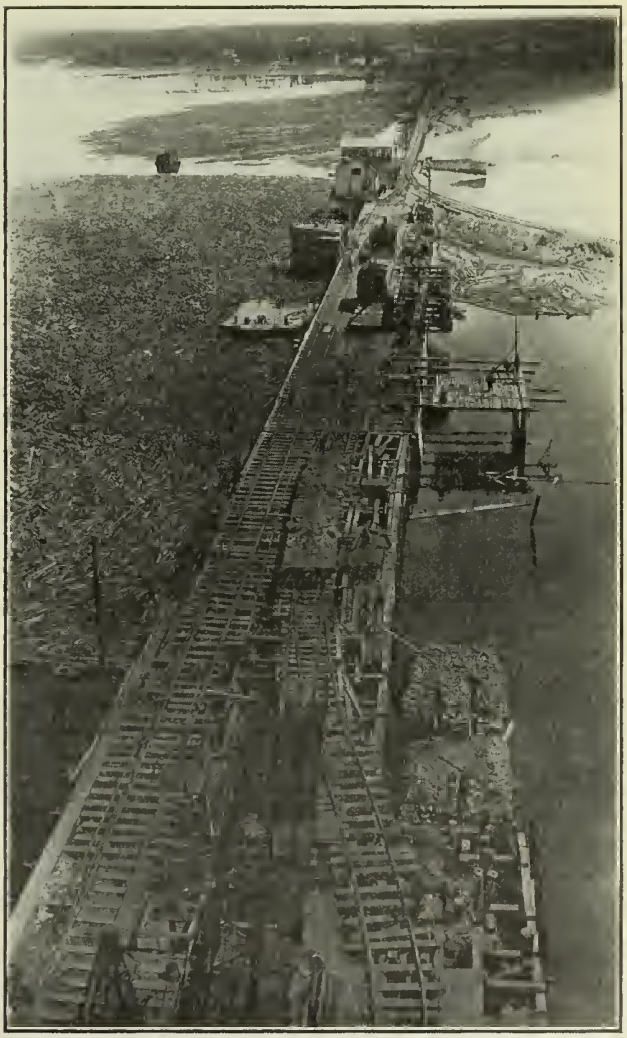


Figure No. 13.—Construction of Main Wharf at Ellis Bay.
View looking shoreward along wharf during construction.
Submarine drive and widening cribs at right side.

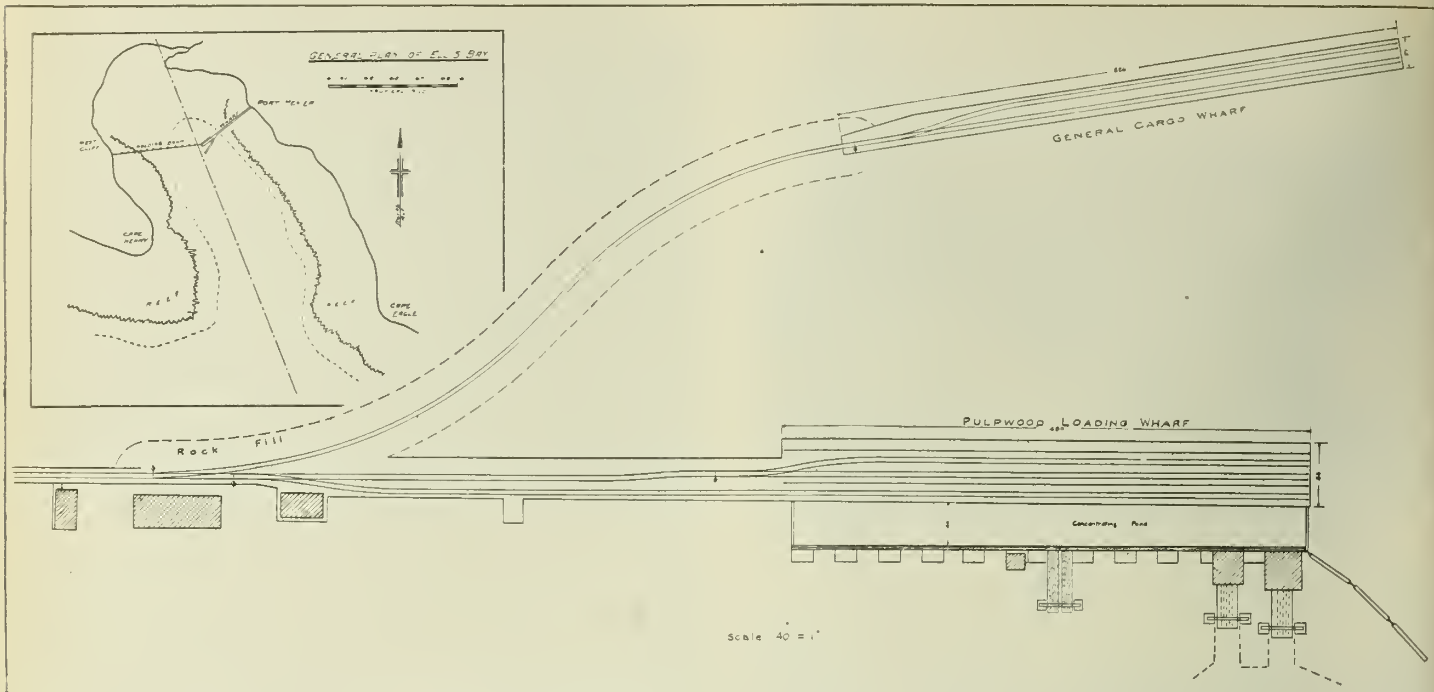


Figure No. 14.—General Plan of Ellis Bay; General Cargo Wharf and Pulpwood Loading Wharf.

Quebec became interested in the developments under way at this port, and a dredging programme was decided upon to provide sufficient depth of water in the harbour for sea-going vessels. Soundings showed that to obtain a depth of 20 feet at low-water, it would be necessary to excavate 34,000 yards of rock and 467,000 yards of gravel and clay. This work was commenced in June 1927 by the Canadian Dredging Company. A dipper-stick dredge, with an eight-yard bucket was employed on this work.

The outer 500 feet of the old wharf, which rested on clay, was widened from 35 feet to 55 feet by means of timber rock-fill widening cribs and their foundation excavated to solid rock at a depth of 20 feet at low-water. The opposite side of the wharf was piled to natural rock surface, to prevent the clay underlying the old structure from sliding. An additional length of 100 feet was built to the old wharf, being excavated to rock. At the time of the extension to the loading wharf, the construction of a new cargo wharf was also commenced. This structure has a rock-fill approach 660 feet long, which diverges from the jetty at a point 1,000 feet from its end. The end of this approach is 250 feet distant from, and at right angles to the main wharf, at which point the timber structure of the cargo wharf commences. This is 520 feet long and 27 feet wide and is made up of timber rock-filled cribs taken to rock. The clear distance between the outer ends of these wharves is 350 feet, so that the ship basin has an average width of 300 feet and is 500 feet in length. There is berthing space at each wharf for two boats and a dredged depth over the entire basin of 20 feet at low-water.

A line of booms and round timber cribs extending 5,000 feet from the end of the pulpwood wharf to the west side of the bay were also built. These, together with the wharf and jetty, block off the inner 1¾ square mile of the bay from the sea. This forms the principal storage area from which the wood for the season's operations is taken. A concentrating basin was also built at this time, but is described in connection with the loading plant.

Construction work was completed in July 1927. The chief difficulty encountered while carrying on this work was severe weather conditions during the winter, the bay being exposed to the northwest winds. A total of 35,000 cubic yards of rock-fill, 100,000 lineal feet of round timber and 3,000,000 F.B.M. of British Columbia fir were used. Owing to the shortage of men during the winter, the work was retarded somewhat. To overcome this, it was decided that the cribs for the cargo wharf would be built in Gaspé and towed to Ellis bay in the spring. The five cribs, each 90 by 27 feet, were landed at Ellis bay without any difficulty.

New Method of Handling Pulpwood

Loading Plant

The most popular methods employed at present in the loading of 4-foot pulpwood into boats is by conveyor or flume. Both of these methods involve the dropping of wood into the ship's hold from a height of 40 feet. This invariably results in considerable damage to the ship's tank tops and is also a menace to the safety of the stowers.

To overcome these difficulties, the Canadian Mead-Morrison Company devised a type of bucket, known as a "Pulpwood Trapper," to be used as an attachment to their standard type of straight line coaling crane for the purpose of transferring wood from the water to the ship's hold. The trapper is an oblong box-like structure of steel and wood, open planked and perforated, which by reason of its weight penetrates the floating wood. The floor of the box is formed by two gates, which are opened before descending into the wood and closed before the trapper is hoisted with its load. It has a capacity of 400 cubic feet, being 10 feet long by 8 feet wide by 5 feet high. With the wood maintained at a depth of 4 or 5 feet, the trapper is capable of taking ¾ cord or 80 sticks of 4-foot wood. When lowered into the boat, the gates are opened and the load is discharged at any desired point on the ship.

To assist this operation, the wood had to be concentrated in an enclosed pond to a depth of 4 feet. This pond, which is known as the concentrating basin, has a minimum depth of 12 feet of water at low-tide, is 40 feet in width and extends along the full length of the loading wharf.

The Mead-Morrison loading towers, of which there are two, are typical straight-line cranes, with a rail travel of

Figure No. 15.—Construction of Timber Crib for Wharf.
Crib, 100 by 27 feet, constructed on three small piers prior to overturning and floating into place.

490 feet, or the lengths of the two loading berths, so that one tower may be used on each ship or the two towers utilized on the same ship. The towers are steel structures, by Dominion Bridge Company, powered with Mead-Morrison engines, the main hoisting engine being 7 by 14½. The trolley has a travel of 140 feet, or sufficient to reach from the extreme farther side of the concentrating basin to the farther side of the boat. The portals of the cranes are designed to allow trains to pass under on the double track, so that the cranes may be utilized for unloading coal.

To maintain a proper, evenly distributed depth of wood in the concentrating basin is one of the most important factors governing the successful operation of the towers. The following is a description of how this is accomplished. From the main storage area the wood is jack-laddered in 12-foot lengths up inclined hauls, passing through the two slasher mills, from whence it is delivered in 4-foot lengths to a six-chain conveyor, located on cribs forming the back wall of the concentrating basin. This conveyor is built in two sections with independent drives, one section being reversible to suit the delivery of wood from two 6-chain jack-ladders, fed from a 4-foot wood storage, and located at the junction of these two sections. By this means wood from the jack-ladders can be distributed to one loading berth or to both as required.

Figure No. 16.—Launching Timber Crib.
Showing crib in act of overturning.

During the past season it has been the practice to load two boats simultaneously, using one tower on each boat. The towers are capable of averaging one trip per minute, the trapper taking ¾ cord per trip. This gives each tower a capacity of 50 cords per hour, under favourable conditions.

Loading commenced this year on May 15th, and ended October 10th, 120,000 cords of wood being shipped. The second slasher mill was not completed until August 1st, so that the plant was running at about 60 per cent capacity until that time. The average cargo carried was 1,375 cords of green wood. The return trip to Three Rivers, including unloading, occupied 5½ days; to Port Alfred, 4 days.

The electrical energy of the plant is developed in a steam-electric power plant on shore. This consists of a 500-h.p. horizontal steam engine belted to a 500-kv.a. generator. Power is transmitted to the wharf sub-station at 2,200 volts, where it is stepped down to 550 and 220 volts for distribution to motors, etc. The total power consumption of the town and loading plant is 450 h.p.

Unloading Plant

A variation from the common practice of unloading has been made at Port Alfred, Cap de la Madeleine and Wayagamack, these being the points to which Anticosti wood is shipped. At these places electrically-driven unloading towers, similar to the loading towers at Anticosti, have been installed. At Port Alfred and Cap de Madeleine the wood is loaded by men into steel opened-ended skips of 1½ cord capacity.

At the discharge end of the boom the forward wheels of the trolley descend in the trackway and the rear wheels ascend, this accomplishing the tipping of the skip to rapidly and automatically discharge the wood. The towers each have a capacity of 40 cords per hour.

The Wayagamack Company have equipped their towers with a new type of steel clam, which removes the wood directly from the boat without being handled by men. The clam is 4 feet wide, weighing 10 tons, and when dropped and closed on the piled tiers, forces its way through the wood, taking about ½ cord. Each tower handles 30 cords per hour by this method.

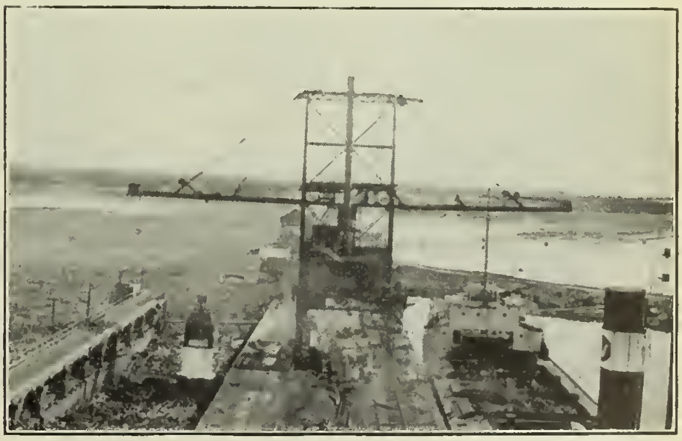


Figure No. 17.—Loading Plant at Ellis Bay.
Pulpwood trapper being hoisted from concentrating basin (left) to be discharged in the ship lying at wharf (right.)

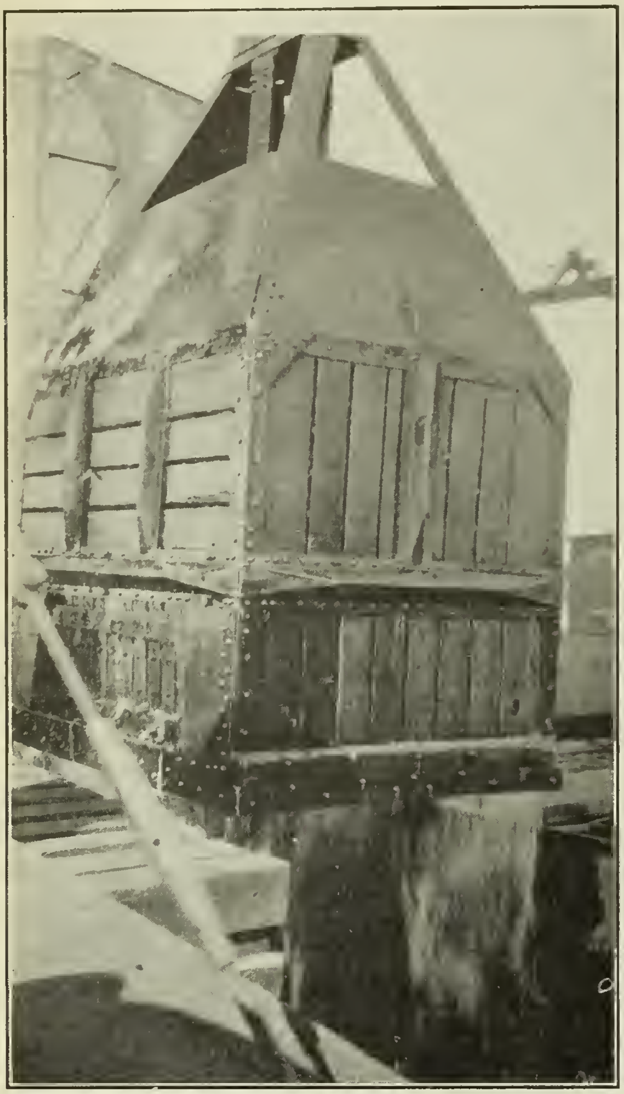


Figure No. 18.—Pulpwood Trapper.

Future Developments

Harbours

Anticosti presents a complex problem for the logging engineer. It would seem that with the abundance of timber and many swift running streams, this island would lend itself readily to development as a pulpwood limit.

The coast line, however, offsets the fine driving facilities to quite some extent. The island is fringed practically the whole way around with a limestone reef, extending from 500 feet to 2,000 feet in length, this being exposed at ebb tide. Beyond this, a depth of 20 feet at low water is not usually obtained within another 1,500 feet, so that a close approach to the shore by a large vessel is out of the question in many cases. There are indentations in the reef at several of the river mouths, but these are too small and too shallow for anything larger than a small schooner. The three natural harbours of the island are Fox bay, Ellis bay and Bear bay. Each of these bays is protected on three sides and form a natural basin in which to anchor ships, unless the wind is from the unprotected quarter.

Of these three bays, however, Bear bay is the only one with a natural depth of water sufficient to accommodate a 3,000-ton vessel in the protected portion of the bay. Fox bay has a depth of 12 feet at low water in the harbour, Ellis bay has a natural depth of 12 feet at the wharf, but this was increased to 20 feet at low water by dredging.

Figure No. 19.—Pulpwood Trapper being Raised from Concentrating Basin with Load of Pulpwood.

Referring to the map, figure No. 2, it will be seen that, unfortunately, none of the above-mentioned harbours occur at the mouth of one of the large rivers; in fact, Ellis bay is on the western extremity of the island and Fox bay is on the eastern extremity, so that the drainage to these points must naturally be very small. Besides this, the timber is much more dense in the wider central portion of the island. Of the 14,000,000 cords standing there are but 1,500,000 cords of wood within a radius of 25 miles of Ellis bay, and less than 1,000,000 within a radius of 25 miles of Fox bay. To utilize either of these places means extensive towing around the coast or transportation by railroad. It was decided that before going further, both of these methods would be given a fair trial on a working scale.

From experience so far, it would appear that towing wood loosely in raft is practical up to a distance of 25 miles. This may be increased by the use of solid wood rafts, such as are used on the coast of British Columbia. The railroading of pulpwood is being carried on economically up to this distance by several concerns in Canada. The topography and nature of the ground surface on the western portion of the island is very favourable for the construction of logging railroads, and at present a survey is being carried on to determine possible location and estimate the economical advantage of extending the present railway further down the island.

The central portion of Anticosti, with 12,000,000 cords of standing timber, is the section in which we are particularly interested. The logging of this portion will require the construction of two loading plants, one on the north

Figure No. 20.—Pulpwood Trapper Discharging Load of Pulpwood into the Ship.

shore and one on the south shore. Bear bay offers the most favourable harbour site on the north and undoubtedly will be developed in connection with a future programme. The south coast has no natural harbours, apart from Ellis bay. However, the Jupiter river entering the sea 50 miles from the west end of the island affords a favourable site for the development of an artificial harbour. By constructing a breakwater 1,200 feet long and dredging a ship basin ample protection can be secured. Three-quarters of a mile from the sea the wide valley of this river narrows down to 700 feet. Here a dam with a 30-foot head will provide a log storage of 100,000 cords. From this point the wood may be conveyed by flume directly to the ship.

Water Powers

In connection with the preliminary survey of harbours it has been thought advisable to examine any available water power which might be used for the operation of a mechanical loading plant.

Fifteen miles from Bear bay, on the Vaureal river, is found an interesting site for a small hydro-electric plant. Ascending the river 7 miles, one finds it running in a limestone canyon, about 500 feet wide, with perpendicular walls 200 feet high on either side. A mile up this canyon is situated Vaureal falls, having a perpendicular drop of 170 feet. The rapids above have a combined drop of 30 feet, so that the total available head is 200 feet. Visiting the falls in December, the river was found to be discharging 200 second-feet. The minimum low water flow is not known.

The Quebec Streams Commission have measured the flow of many of the rivers along the north shore of the St. Lawrence, and their experience has led them to use the figure 0.33 cubic feet per second per square mile when estimating the probable extreme low water flow for those rivers, on which records have not yet been established and which lie in approximately the same longitude as Anticosti.

Extreme low water conditions occur in the season between December 1st and April 1st, and are due to extreme cold and the fact that precipitation in the form of snow does not act to augment the flow of the river until the thawing season begins. For the purpose for which this power would be required during the loading season, the basis of estimating the power available should be the probable minimum rate of flow for the rivers between April 1st and November 1st. No data is available for establishing this except as before stated, by comparison with other rivers on the mainland whose records have been kept. From such a comparison a minimum flow during this period of 0.8 cubic feet per second per square mile has been assumed.

Without artificial storage, this flow with a head of 200 feet would give a continuous output of 600 h.p., or with a load factor of 40 per cent would warrant the installation of 1,500 h.p. of hydraulic machinery. It may be said that the river above the falls is not suitable for the construction of storage dams. The headwaters rise in a flat muskeg which is favourable to the retention of water and which will prevent the disappearance of the river during a long spell in the summer.

The Jupiter river is approximately 50 miles long, rising in shallow lakes at the centre of the island. It is estimated that its extreme low water flow between April 1st and November 1st is 200 second feet. By the construction of a dam on lake Wickenden, a storage of 368,000,000 cubic feet could be obtained, which would serve to augment low water flow, adding to it 66 second feet over a period of two months. A dam site for a power development on the Jupiter river is located 5 miles up from the sea. A head of 20 feet can be obtained, with a dam 400 feet long. The river bed is exposed limestone ledge. With this head and a regulated flow of 266 cubic feet per second, 475 h.p. could be developed, at 80 per cent efficiency, allowing an installation of 1,180 h.p. on 40 per cent load factor.

Lapped Pipe Joints

An Outline of the Evolution of the Pipe Joint and Its Development to Meet the Increase in Pressure in Modern Pipe Lines

Arthur M. Houser,
Engineer of Product, Crane Company, Chicago, Ill.

Paper read by J. O. Lange before the Montreal Branch of The Engineering Institute of Canada, October 18th, 1928

It seems appropriate before discussing the details of the subject of the lapped joint, or the Van Stone joint as it is probably more popularly known, to sketch briefly the engineering evolution of this type of pipe joint now so universally recommended for high pressure work in the power plant, oil industry, and in manufacturing processes in general.

Larger boiler units and prime movers have been consistently producing higher steam pressures and temperatures and thus have introduced many perplexing problems to the valve, fitting and piping designers. Today a leaky piping system or a blown gasket, causing a shutdown, is a very serious and costly matter as compared to that of former times. We can appreciate the importance of this last statement when we realize the increase in " commercial " steam pressures from perhaps 35 pounds per square inch in 1855 to and in excess of 1,400 pounds at present.

A brief historical review of the increase in steam pressures and temperatures will add background to the story of the development of pipe joints designed to hold these pressures. In the following statements no attempt has been made to record the early experimental development. In most cases the references are to installations typical of the advanced practice in their day, and this historical résumé, except for later modifications, is taken from the July 1925 issue of " The Valve World," the house organ of the Crane Company.

From 1855 to 1865 the meagre available records indicate that steam pressures ranged from 30 to 50 pounds. From an early issue of Harper's Weekly, dated August 31st, 1861, we find the following headline:—

> " Twenty-three gun boats to be built for the Government. Each boat to have two boilers, of Martin's patent, placed side by side. The boilers will be furnished with draught from a blower engine and a Dumphel blower.
>
> " Each boiler will be complete in itself so that they can furnish steam to both or either of the engines. A working steam pressure of 30 pounds above the atmosphere is required of them . . ."

In 1857 some experimental work was done with steam at 35 pounds and with superheat temperatures ranging from

Table No. 1.—Physical Qualities of Metal before and after Lapping.

	AS REC'D	AFTER LAPPING
TENSILE STRENGTH POUNDS PER SQ. IN.	53700	56300
YIELD POINT POUNDS PER SQ. IN.	27500	34600
ELONGATION PER CENT IN 2 IN.	43.0	41
PERCENT REDUCTION OF AREA	67.7	69.0

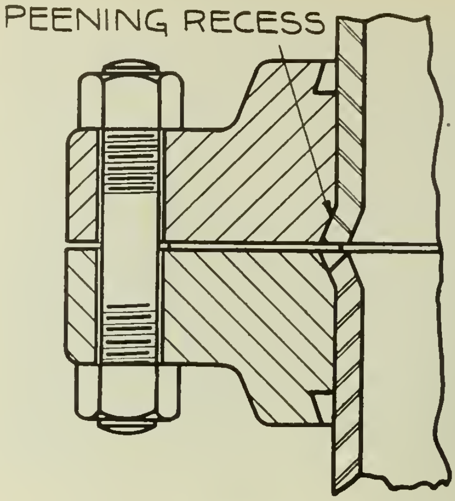


Figure No. 4.—Shrunk and Peened Joint.

410 to 490°F.; but in 1883, the use of superheated steam was discontinued, and the reason given was that the pressures had gone beyond 60 pounds. The Adams street station of the Commonwealth Edison Company, Chicago, was built in 1888, and operated at 125 pounds. About 1890, the Pennsylvania Railroad completed a power plant at Altoona, Pennsylvania, operating at 150 pounds.

Perhaps the next evidence of the increasing pressures was the Wabash avenue station, Chicago, of the Commonwealth Edison Company, built in 1891 and operating at 175 pounds. Other stations were erected by the same company in 1903 and 1912, to operate at 200 and 250 pounds respectively. A pressure of 285 pounds was used at a plant built by the Buffalo General Electric Company in 1917. The Joliet plant of the Public Service Company of Northern Illinois, built in 1917, and the Calumet station of the Commonwealth Edison Company, Chicago, built in 1922, operated at 325 pounds.

Several central stations were constructed during 1923 to operate at pressures ranging from 375 to 400 pounds. Notably among these are the Weymouth, (Edgar), station of the Edison Electric Illuminating Company, of Boston; the Waukegan station of the Public Service Company of Northern Illinois; the Saginaw river station of the Consumers Power Company, and the Grand Tower station of the Midwest Utilities Company. In 1925, the Crawford station of the Commonwealth Edison Company of Chicago and the Philo station of the Ohio Power Company were operating at 600 pounds. The highest pressures used on a large scale today are in the neighbourhood of 1,400-pound installations at the Lakeside station of Milwaukee Electric Company; Northeast station of the Kansas City Power and Light Company, and the Edgar station of Edison Electric Illuminating Company of Boston. Consideration is being given to the use of 2,000 pounds per square inch for central station work.

The use of superheated steam, which was discontinued about 1883, again became commercially successful about 1898 and since that time the temperature has increased to 750°F., which is the total temperature at the 1,400-pound stations operating today.

The great rise in pressures and temperatures has been by no means confined to the field of steam engineering, for there has been a more rapid and greater increase in the pressures and temperatures in the oil refineries and cracking plants. It was only about ten years ago that oil processes required pressures slightly above atmospheric pressure and temperatures up to 550°F. This was followed by pressure increases to 25, 80 and 110 pounds with temperatures running to 700, 800 and 900°F. New processes were developed, causing the rise in pressures to be very pronounced, starting from 150 and 250 pounds to 500, then 1,000 pounds, and today 1,500 pounds is popular practice. The extreme pressures found in process in the oil industry today approximate 1,500 pounds with attendant temperatures of 1,000°F. Serious consideration is in effect at present of using 3,500 pounds per square inch at 900°F.

In the earlier days of steam engineering, when 125 pounds per square inch was considered a relatively high pressure, the screwed or threaded pipe joint was in common use and was considered safe and reliable for any pressure

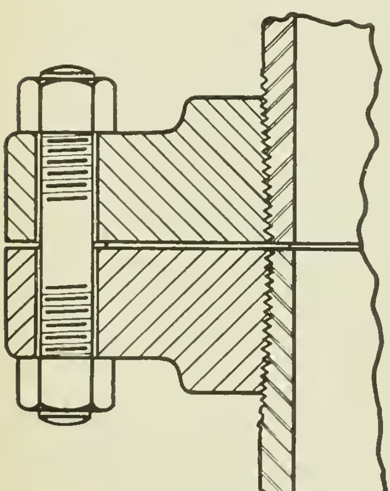


Figure No. 1.—Plain Screwed Joint.

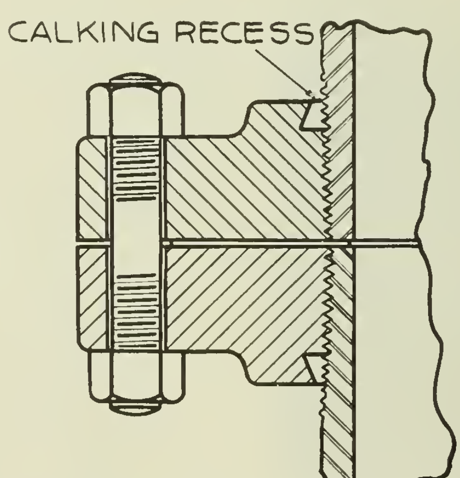


Figure No. 2.—Screwed and Calked Joint.

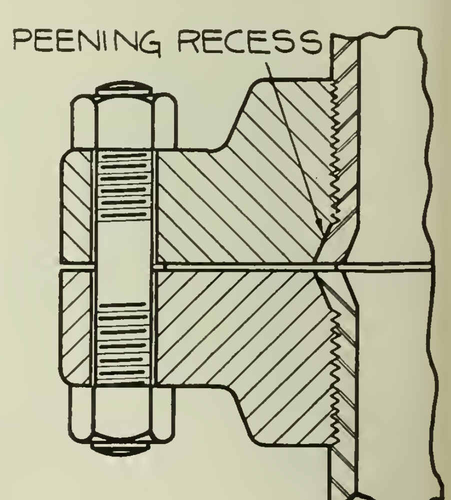


Figure No. 3.—Screwed and Peened Joint.

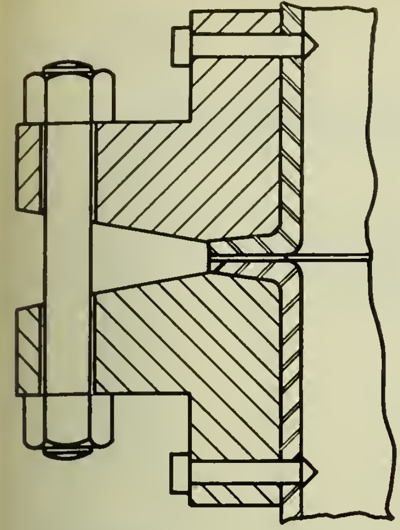


Figure No. 5.—Rockwood Joint.

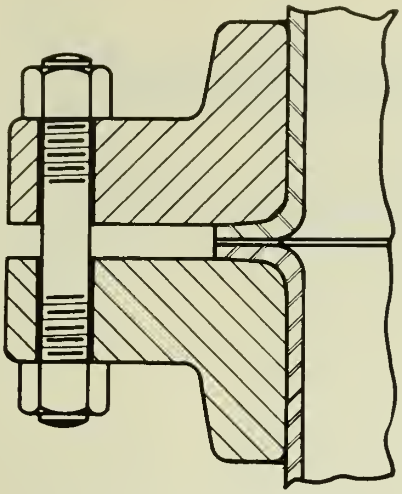


Figure No. 6.—Van Stone Joint.

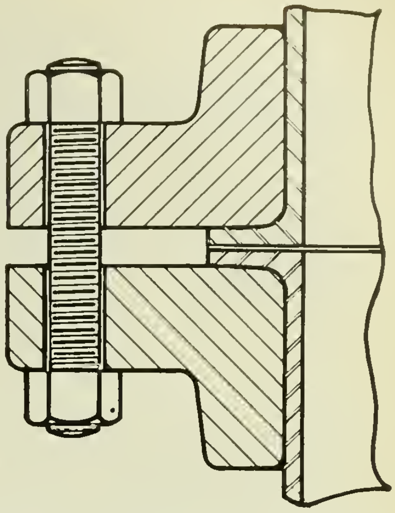


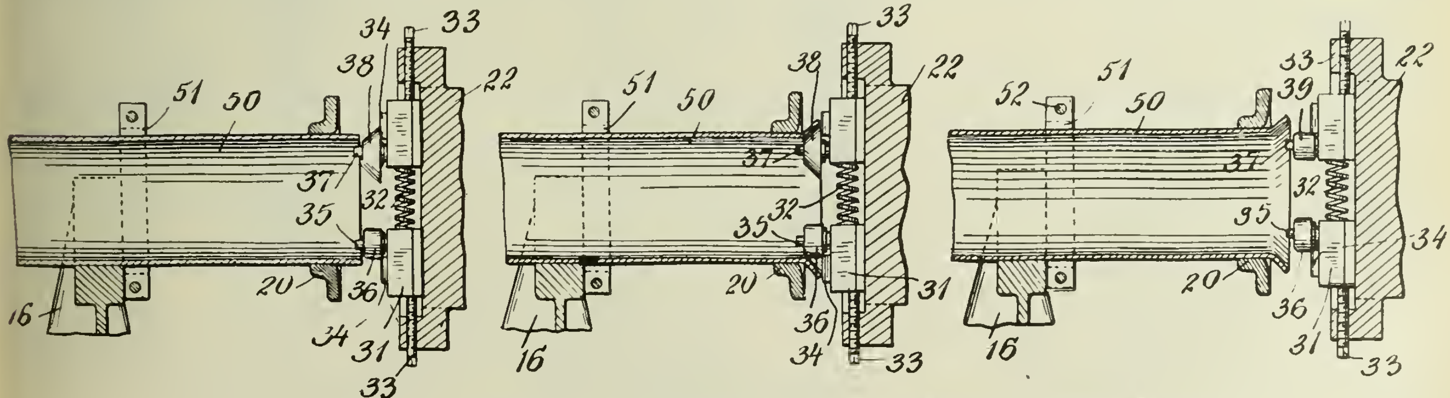
Figure No. 7.—Plain Face Cranelap Joint.

range then carried on the boilers. Originally the screwed flange was simply a flat ring tapped to fit the threaded pipe and provided with drilled holes for bolts. Later the hub was added to the flange for strength. (See figure No. 1 for typical joint with hubbed flange.)

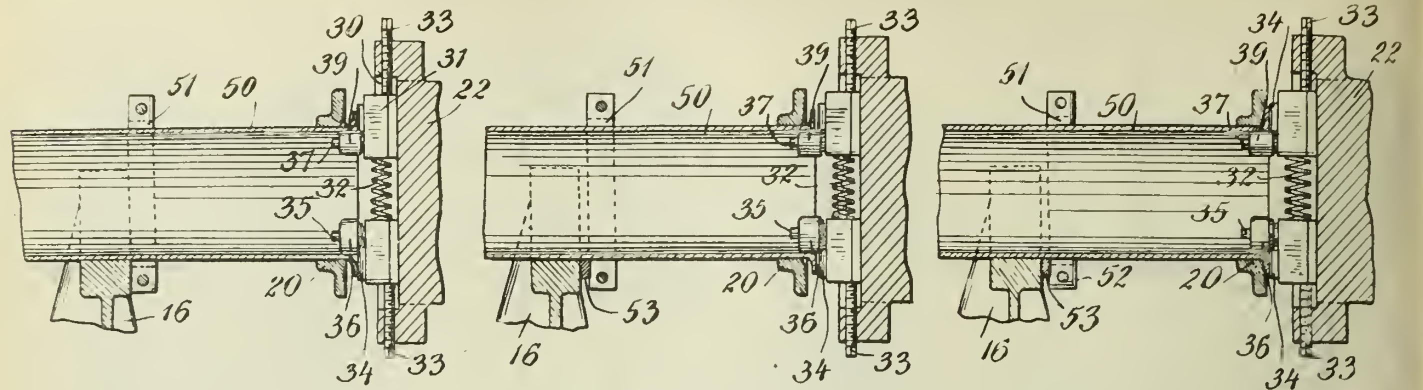
Originally the screwed joint differed from that shown in the illustration in that full face gaskets were used, extending from the inside edge of the pipe to the outside edge of the flange, covering the entire area of the face of the flange and end of pipe except for the bolt holes. This practice, according to records, seems to have been evolved from old time marine work. During the early nineties when higher pressures were considered, it was thought wise to reduce the gasket area. At that time it was felt that with these higher pressures the resultant load per square inch of the full face gasket would be small; and that a slight transverse stress produced by expanding pipes would open the joint on one side, thereby causing a leaky joint. The tongue and groove joint, which will be illustrated later, was introduced at this time. The groove also has the merit of protecting the gasket from displacement or being forced out in part by the pressure of the bolts. The gasket is also protected from being blown out if slightly relieved on one side. The disadvantage of the tongue and groove is that the gasket is not readily renewable without opening the space between the pipes several inches, which is not always possible.

The 1/16-inch raised face, which is very common practice today, also has its history. The raised face of extra heavy iron flanged material, as made today, has its diameter just inside of the bolt hole and is raised 1/16-inch above the remainder of the face of the flange; ¼-inch raised face of a lesser diameter is used on the higher pressure steel flanges to take care of interchangeability with male and female face. About 1896 and 1899 the raised face was a live subject among leaders in steam engineering. The tongue and groove was in practice for some time before the raised face was considered. The flat face joint with full gasket was the most popular joint in those days. Heretofore, the flat face joint was made on the lathe and boring mill without any subsequent grinding of any kind, and without any special tooling or pains whatever to make sure of a true bearing surface. Some joint faces were made about 3/16-inch wide, and by making the flange heavy enough to insure stiffness, the bolt pressure would come on the joint and not at the outer edge of the flange. The trouble experienced with this practice was that the outer edges were drawn together and sprung when the bolts were pulled up to make a joint on the outside edge, thereby causing leakage through the bolt holes. These excessively heavy flanges overcame this difficulty in that the rough faces would knit without springing the flanges, but this was costly and remedied the condition only partially. The raised face came into common practice about 1904 to overcome the use of these excessively heavy flanges and to insure a tight joint to take care of the pressures of the time, (250 pounds). The raised face was introduced in the form of a " narrow Chipping strip " as wide as deemed necessary for all pipes; the joint was so designed that the surfaces in contact were inside the bolt holes. It became regular practice to use 1/32-inch raised face and this was used almost exclusively until the adoption of the 1914 iron standards for flanges, when the 1/16-inch face became standardized.

With the advent of larger central stations and the



Figures No. 8, 9, 10.—Consecutive Operations Performed on Pipe during Flanging Process.



Figures No. 11, 12, 13.—Consecutive Operations Performed on Pipe during Flanging Process.

steadily increasing demand for superheated steam at higher pressures, manufacturers were called upon to furnish pipe joints that would insure a higher all around factor of safety than was previously possible with the screwed joint. The trouble experienced with screwed joints might be traced to the fact that when the pipe, which is screwed into the flange, expands circumferentially, it tends to return again to its original dimensions when cooled, but the flange in time, due to other strains, structural, for example, takes a permanent set and does not return again to its original dimensions, increasing slowly on the inside diameter. This space between the threads on the pipe and the threads on the flange results in slight leakage, which is increased, as time goes on, by the oxidizing and erosive action of the steam and water.

Several novel and fairly successful methods have been devised to guard against this leakage through the threads in an effort to make good the screwed joint for the increasing higher pressures. Favourable results for that time have been obtained by cutting a caulking recess in the hub of the flange. (See figure No. 2 for this type of joint.)

This type as illustrated has stood the test of time quite well. The pipe is screwed into the flange to a steam-tight bearing, and the recess is then filled with soft copper or other suitable metal, which is caulked firmly in place.

Another method of making screwed joints, to guard against leakage through the threads, is to roll or peen the end of the pipe into a peening recess at the face of the flange after making the flange tight on the pipe. Such a joint is known as a screwed and peened joint, as shown in figure No. 3.

A step nearer the Van Stone joint was made when the shrunk and peened joint was first used. In making this type of joint, the flange is accurately bored out to a diameter slightly less than the outside diameter of the pipe. When heated to a proper temperature the flange expands and is forced over the end of the pipe. In cooling the flange contracts and grips the pipe all around its outside circumference with tremendous force. The end of the pipe is allowed to project slightly beyond the face of the flange and is peened over into the recess. If so desired, a caulking recess can also be provided; if a slight leak occurs the recess can be caulked with soft copper. Figure No. 4 shows this form of joint.

As far back as June 20th, 1895, an article appeared in the magazine, "Engineering Record," in which Mr. George I. Rockwood describes, in a letter to the editor, his joint for higher steam pressures. This is the first written information we have found on the joint known today as the Van Stone joint. This letter brings out many interesting features that are used in the present day:—

Pipe Fitting for Heavy Steam Pressure

Worcester, Mass.,
June 18, 1895.

To the Editor of the Engineering Record:

Sir: Believing it would be of interest to your readers, I send you a sketch showing a form of pipe fitting that I have used successfully in some large sized steam piping subjected to a steam pressure of 150 pounds per square inch. The greater part of the piping now in use has, I believe, the flanges screwed

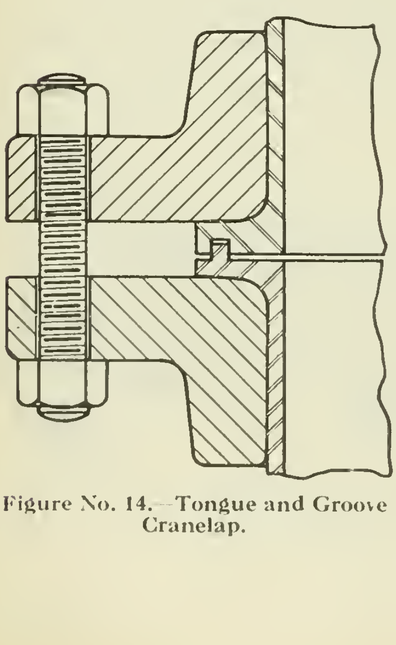


Figure No. 14.—Tongue and Groove Cranelap.

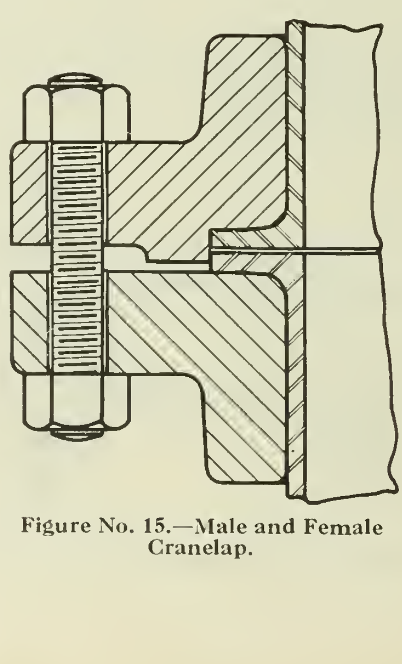


Figure No. 15.—Male and Female Cranelap.

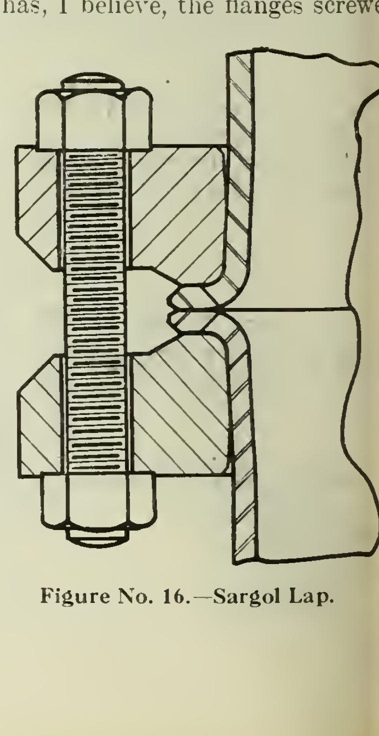


Figure No. 16.—Sargol Lap.

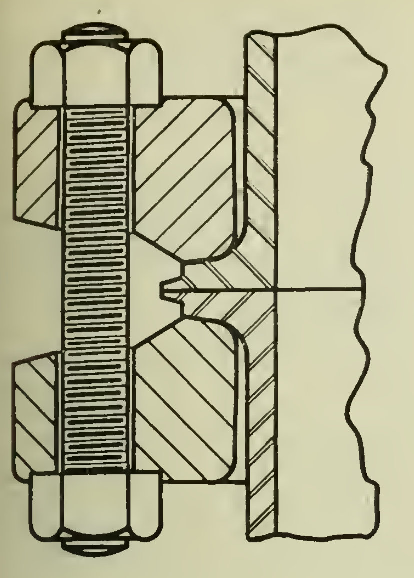


Figure No. 17.—
Square-corner Joint.

or riveted onto the ends of the lengths of pipe. Either method of fastening leaves something to be desired, as if any leakage occurs after the pipe is erected and the pressure on, the flange has to be removed and thrown away if screwed on, and if the rivet fastening be adopted and caulking is relied upon to make the joint then the pipe must at least be taken down before the leakage is stopped.

With the idea of partly overcoming these difficulties I made use of the flange shown in the accompanying sketch. A cast iron flange is bored out a rather close fit to the pipe, its face is turned to the section shown and the flange is then slipped onto the pipe and temporarily left some distance on from the end. The blacksmith then heats and flanges over the end of the pipe, (which must be a steel boiler flue, as iron pipe will not permit this flanging process), and moving the cast flange up to the heated end he moulds the two flanges together.

A very few ⅞-inch rivets are used to make the cast flange fast to the pipe, enough only to take any subsequent strains from the flanged end, it being thought unwise to allow the push and pull of the line to come upon the metal of the pipe after being so roughly treated as in the flanging process. I put six rivets into 10-inch pipe.

A length of tubing, after being thus flanged on each end, is placed in a lathe, straightened and faced. The outside portion of the face of the cast flange is beveled off as shown in order that a caulking tool may be inserted between the two faces to close up the joint made by abutting ends of pipe. Although I used corrugated copper gaskets, painted on each face with red lead and boiled oil to insure against leakage, yet if at any future time the joint gives any trouble, the mild steel edges of the pipe flanges are there and can be caulked.

A diameter of 10 inches is about as small as is practical to join together in this manner, although I have used the joint on 8-inch piping. The main object of the design is to avoid the possibility of a leak under the cast flange.

(Signed) George I. Rockwood.

Mr. Rockwood's pipe joint was patented in the United States April 6th, 1897. The joint as patented differs slightly from the original idea in that a bead is formed in the pipe, fitting a groove in the flange instead of the rivets. This was used to prevent longitudinal movement of the flanges in the process of making the joint. In the discussion of Mr. A. F. Nagle's article, "Pipe Flanges and Their Bolts," which is recorded in the 1899 Transactions of the American Society of Mechanical Engineers, Mr. Geo. I. Rockwood refers to his joint and mentions Mr. Van Stone in connection with the making of these joints.

The Rockwood joint, minus the bead or rivets, is in principle the "Van Stone joint" of today.

The differences between the Van Stone and Cranelap joints can be seen from figures Nos. 6 and 7. The improvement of the Cranelap joint consists in rolling the joint to a square corner surface at the inside edge of the lap, giving wider bearing surface for the gasket and at the same time eliminating a water pocket at the joint. The elimination of this pocket, which is always present with round cornered joints, means more even and uniform expansion and contraction throughout the joint. Corrosion is more apt to set in with the round cornered joint, due to lodging of sediment and condensate, which is present in all lines.

In making the Cranelap joint the flange is bored out to fit loosely over the outside diameter of the pipe and is placed some distance from the end. The end of the pipe is heated to the required temperature and then placed in a special machine where the rolling is done. The end of the pipe is flared out in the lapping process, the rollers forcing the pipe over and at the same time forming a square corner at the inside edge of the lap. The face to face dimension is then checked and if inspection shows that the lap is satisfactory the pipe is allowed to cool slowly. The face of the lapped over pipe is machined to a true gasket bearing surface, which will insure a steam tight joint.

Figure No. 8, taken from one of our basic pipe-flanging machine patents, shows the consecutive operations performed on the pipe while in this special constructed mechanism. As shown in this illustration, the pipe is set in the machine, projecting the end of the pipe, through the forming die, the correct amount to form the lap. The strap collar (*51*) is securely fastened to the pipe, abutting the collar against the stop-bracket (*16*). All the parts are so adjusted that the pipe will be held with its axis in alignment with the axis of the rotating disc (*22*). After the end of the pipe is heated to a good forging temperature it is placed in the machine with the heated end projecting through the forming die and the strap collar abutting the stop-bracket. The pipe is securely held to prevent turning.

The operator forces the carriage toward the rotating disc to make sure that the strap collar is securely held against the stop-bracket. The conical flaring roller is forced against the heated end of the pipe, bending the pipe outwardly as shown in figure No. 9.

As soon as the flaring of the pipe is done the carriage is drawn back away from the rotating disc and the conical roller is removed, putting in its place a cylindrical roller (*39*). Figure No. 10 shows the parts ready for the next step.

Again the carriage and pipe are forced toward the rotating disc. This time all of the rollers (*34, 36* and *39*) will act upon the pipe, forcing its heated end against the forming mould as shown in figure No. 11. A flange of desired shape and size will thus be formed.

But in order to perfect the flange and to increase its strength the process is carried on further. The carriage is again withdrawn and the mould (*20*) is loosened so that the flanged end of the pipe may be moved through the mould into the position as shown in figure No. 12. It will be noticed that a wedge (*53*) is thrust between the strap collar and the stop-bracket, the mould is tightened and the carriage is again advanced toward the rollers in the rotating disc.

The metal is forced between the mould and the rollers,

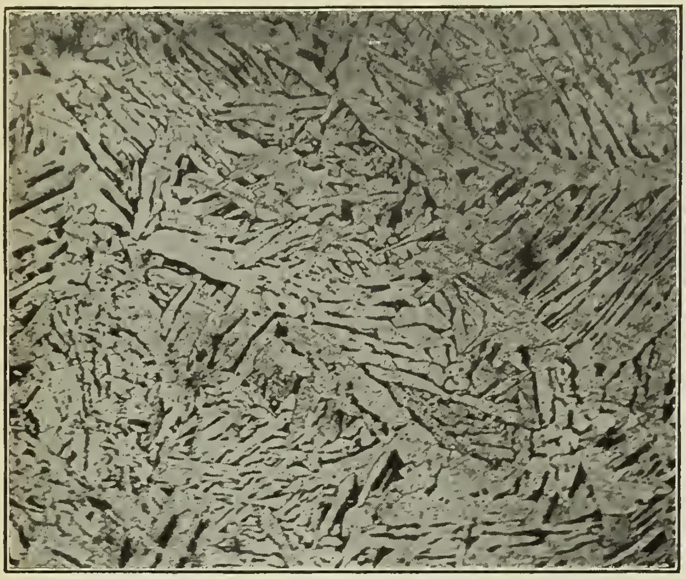


Figure No. 18.—Open Hearth Pipe before Lapping Operations.

thereby increasing the density and strength, as illustrated in figure No. 13. The pipe is removed from the machine and allowed to cool slowly.

The faces of these laps are made in several different ways. The best method of attaching flanges to piping used in power plants is so much a matter of individual preference that it is necessary to furnish pipe work with various styles of joints to conform with the ideas and experience of different engineers.

The square cornered Cranelap joint, (figure No. 7), was first introduced in 1911. In 1921 the full thickness lap was developed, which is made much stronger than the pipe even after refacing for the gasket bearing surface. A gasket is regularly furnished with this joint, although the manufacturer is prepared to furnish the faces with a smooth lathe finish ready for grinding to a metal-to-metal or ground joint if so desired by a customer. This joint with full metal thickness at the lap can be used successfully on the present day high pressures. The plain straight face Cranelap is in reality a raised face joint. The diameter of the lapped over pipe was not standard until in 1920 when it was suggested to use the diameter of the raised face as given for flanges approved by the American Engineering Standards Committee. Today this is regular practice.

Some engineers prefer the tongue and groove joint, (see figure No. 14). The dimensions for the small tongue and groove in the steel standards approved by the American Engineering Standards Committee are applied to the tongue and groove Cranelap, the lapping process of which has been developed to make the lap one and one-half times full pipe thickness, thereby insuring at least full metal thickness from the bottom of the groove to the back face of the lap. A flat metallic ring gasket is used.

Some of the present day piping is made with male and female joints. (See figure No. 15.)

Weld-sealed pipe joints without the interposed gasket have been used in many of the high pressure, high temperature central stations. Practically all the weld-sealed joints were made under the Sargol patent license until its recent expiration. The Sargol patented idea is shown in figure No. 16.

Welding lips on the Sargol joint are formed by machining the adjoining edges of the laps to a V-shape, into which additional metal is welded to form a seal. The back face of the lap is not machined in order to keep the " skin tension " of the material. A slight clearance is maintained between the outside diameter of the pipe and the inside diameter of the flange to permit swiveling around to line up the bolt holes. It will be noted from figure No. 16 that the Sargol joint has the round corners at the lap, and also that the pipe tapers; the object being to prevent complete rupture should the lap fail.

Some difficulties were encountered when welding the joint as shown in figure No. 16. In welding the Sargol joint, a filler rod is necessary to fill the V-shape gap. The welding requires a large amount of heating, and this intense heat concentrated at the extremities of the lap causes uneven expansion and contraction, thereby separating the flanges around their inner circumference.

In order to overcome this difficulty a thin lip, weld-sealed pipe joint was introduced about two years ago, as illustrated in figure No. 17. This lap is rolled in the flanging process similar to Cranelapping as described before.

No additional metal is required for welding as the long thin lips are simply fused together. This seal is very narrow and thin, thereby requiring little heat in the welding operation. These weld-sealed joints are usually tested under the full pressure intended before the welding takes place, the joint being metal-to-metal.

In all Cranelap flanges, whether it be the plain face, male and female, tongue and groove, or the thin lip-weld sealed joint, the flange is machined with a tapered bore three-quarters of an inch per foot to furnish clearance between the flange and the pipe when the flange is backed off, allowing for swiveling to line up the bolt holes. This is an advantage over the screwed joint. There is another significance and important purpose for this tapering; that is, in the lapping operation when the metal is being worked, the taper aids in drawing out the point of crystallization, giving a much finer grain structure to the lap.

Pipes from 2½ inches to 30 inches are lapped regularly. Pipe as small as ¾-inch and as large as 48 inches have been lapped on orders. The weights of the pipe depend upon the type of service and the pressures to which these pipes will be subjected. Standard, extra strong and double extra strong pipe can be lapped, and so can copper, wrought iron, wrought steel and some alloy steels, while chrome-vanadium and molybdenum steel tubing have been lapped successfully.

As to temperatures, it is necessary to obtain a good forging heat in order to upset and roll the ends of pipe to a square cornered lap.

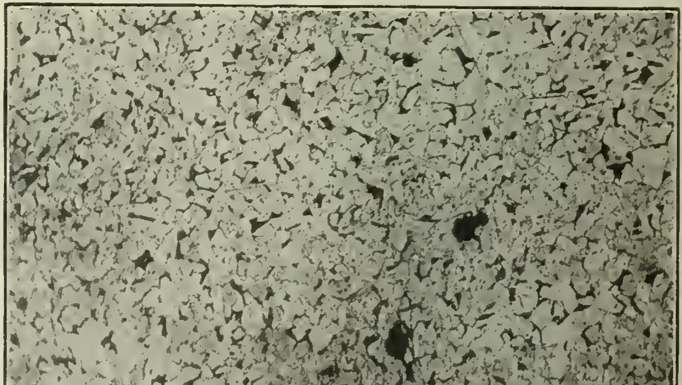


Figure No. 19.—Structure at Crotch of the Lap after Lapping Operations.

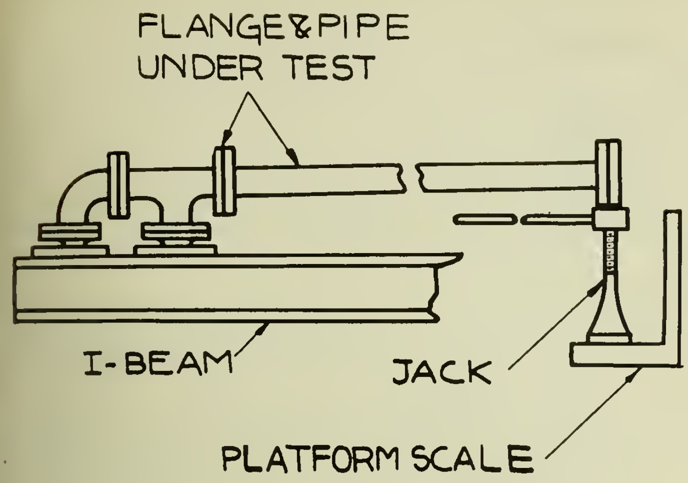


Figure No. 20.—Pipe Joint Flexibility Test.

Some years ago when the standardizing of fittings and flanges was a live subject, some question was raised as to the effect on the metal of the pipe at the lap and immediately adjacent thereto when considering the Van Stone joints. For years it has been our experience in general that the metal of the pipe is materially improved. In order to produce actual facts the Crane Company made a thorough study of the Cranelap joint from the physical and metallurgical aspect. The photomicrographic illustrations show the metal before and after lapping.

The section shown in figure No. 18 represents open hearth pipe as received before any lapping operations are performed. The crystals are somewhat needle shaped, irregularly arranged and not uniform. It is of particular interest to note the arrangement of the elements of the structure, its fineness and uniformity, as compared with that shown in figure No. 19.

The structure at the crotch of the lap, (figure No. 19), after the lapping operation, shows considerable improvement. The grain is finer and more uniform. The black spots in the lower right hand corner are not a result of working during the lapping operation but is the condition of the pipe as received. There is very little evidence, if any, of slag inclusion.

In order to further convince ourselves that the lapping operation does not injure the metal, but actually improves the condition at the joint, let us investigate the physical qualities before lapping and effects after. Tensile test bars per American Society for Testing Materials' Standard of 0.505-inch diameter were taken from a section of the lapped pipe shown in figure No. 19. The results as shown in table No. 1 are representative of the pipe metal shown in the photomicrographs.

The pipe is increased in strength at the lap but a short distance from the lap it is not affected by the lapping operation. The pipe appears to be slightly stiffer, as evidenced by the elongation figures. The fractures indicated a well worked metal and considerable ductility. The yield point is raised considerably.

To permit of a better understanding of the condition of the metal after Cranelapping the other tests will be briefly explained.

Brinell hardness tests indicated that lapping does not change the hardness of the metal as compared with the original condition of the pipe. Indentations were made respectively at the crotch of the lap, adjacent to the lap and some distance from the lap. These readings were taken to study across the section as well as the outside of the pipe.

Piping, no matter what the service may be, is subject to shock in some form. It is most essential that the joints be so designed and constructed as to resist shock. Some time ago a test was made in which several joints, namely, the screwed joint, the shrunk and peened joint, and the Cranelap joint, were made up on the end of respective pipes. Severe blows were applied with a sledge hammer to these joints; the Cranelap joint stood the test, holding its place, while the other two types were knocked off the pipe without much difficulty.

The material that goes into this lapped design should also resist shock. Therefore, an Izod impact machine was used to investigate the material of these various laps to resist shock; incidentally the homogeneity and ductility is also revealed in a qualitative and comparative sense only. The lapping affects the Izod impact value for a distance of six to nine inches back of the lap. Lapping increases the ability of the material to resist shock as much as three-fold in some cases.

To test pipe laps in a way equivalent to the service they are put to, when contracting or expanding forces are steadily pulling the pipe from its flanges, would necessitate the bolting of two lapped pipes together with flanges and applying a transverse or longitudinal force at the end of the pipes.

In reality, the type of joint that lends itself to the greatest flexibility under maximum strain is the safest and most preferable for high pressure and high temperature work. A test of this kind was made some time ago. Sixteen-foot lengths of pipe, having flanges screwed on, shrunk on, welded on and Cranelapped, were bolted to a well braced tee on a test rig, as best shown in figure No. 20.

An extra length of pipe was bolted to the length to be tested. A scale was used in connection with the jack screw in order to see just what effect a side strain or throwing out of line would have on the various joints. Thirty pounds per square inch of internal hydrostatic pressure was used in all cases.

Summarizing the results of this test we find that screwed joints failed before the other types, this failure taking place at the threads, due to a weakened section exposed outside of flange. Shrunk and welded joints, being rigid on the pipe, offer practically no flexibility if the pipe line is subjected to transverse strains, practically all the movement being taken care of by the stretch of bolts, compression of the gasket or actual bending of the pipe. Welding of pipe joints does not materially weaken the pipe back

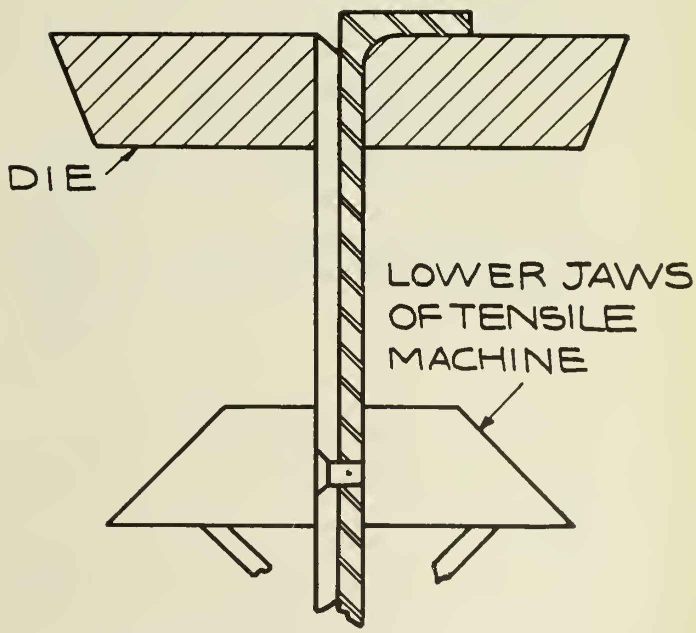


Figure No. 21.—Die Straightening Test.

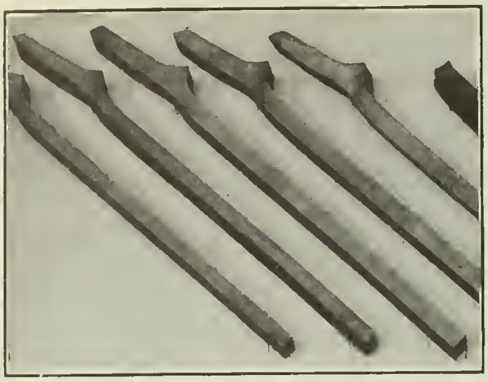


Figure No. 22.—Tensile Test Bars per A.S.M.E. Standard Taken from Section of Lapped Pipe.

of the flanges by the process in the Cranelap joints as our tests showed no signs of failure until the pipe was subjected to strains well beyond those which would occur in service.

In order to further study the effects on lapped joints by applying extremely large longitudinal forces, and yet make this test complete by accurately measuring the forces applied, strips were cut from the laps, machined to 1¼ inch wide and pulled in a tensile testing machine through a die, as shown in figure No. 21. The results are best explained by figure No. 22.

From this die straightening test it is only evident that the lapping leaves the pipe in a very satisfactory condition, permitting straightening without tearing the lap at the crotch.

Last year when the Crane Company was making certain investigations on lap welded pipe, numerous pipes were burst. The pipes were made up with the square corner Cranelap and bolted to blind flanges. Internal hydrostatic pressures as high as 5,000 pounds per square inch were reached before the bursting took place.

It can be seen from figure No. 23 that the break did not occur at the lap or adjacent thereto. The break in all cases had the same characteristic shape. This should be conclusive proof that the lapping operation does not put the pipe in a poorer condition.

Incidentally, an article that relates to this talk appeared in the June 12th, 1928, issue of " Power," written by Mr. I. W. Whittle of the Southern California Edison Company on " Pipe Joints That Will Hold at High Pressures and Temperatures." Mr. Whittle gives the advantages of the different present day welded pipe joints. The following is quoted from his statements on the square-corner joint:—

> " The square corner type joint is manufactured by upsetting and forming the lap against dies in a machine. The heels of the two laps form a continuous inner wall in which there will be no pockets for collecting sediment and condensate. This forms a rigid joint with no possibility of bellows action due to expansion in the pipe. There is also more metal in this joint to form a bearing surface for the abutting laps.
>
> " It is the opinion of engineers who favour the square-lap joint that the fibre structure of the metal will not be ruptured, and that there will be no slag inclusions in forming this square-lap joint when the metal is worked at the correct temperatures. The back of the lap, forming a bearing surface for the flange, is slightly tapered and faced off to insure the flange bearing first on the innermost part of the back face of the lap.
>
> " Relatively long tapered lips are provided on the outer edges of the adjoining flanges, and no additional metal is required for the first welding, as the metal lips simply are fused together. It is the contention of users of this method of welding that the thin section welding lip prevents uneven heating of the lap and a separation of the flanges around their inner periphery."

In concluding, it may be said by summing up all the results of the tests given herein, that Cranelapping pipe improves the condition of the metal at the lap and adjacent thereto. Further, that continuing widespread usage for severe service and exceedingly high pressures and temperatures has proven the reliability and safeness of the square-lap joint.

Figure No. 23.—Hydrostatic Pressure Tests on Selected Line of Pipe.

66-kv. Cables of Montreal Light, Heat and Power Consolidated

Humphreys Milliken, M.E.I.C., Chief Engineer,
L. A. Kenyon, A.M.E.I.C., Assistant Chief Engineer,
Electrical Department, Montreal Light, Heat and Power Consolidated,
and
D. M. Simons, Development Engineer,
Standard Underground Cable Company.

Paper read before the Montreal Branch of The Engineering Institute of Canada, April 21st, 1927

The Montreal Light, Heat and Power Consolidated has recently completed a 4,000-volt distribution substation in the heart of the city of Montreal where the density of the load is such as to require an ultimate station capacity of approximately 90,000 kv.a. two-hour rating. This station is known as the Vallee Street substation. In order to feed this station economically, it was found advisable to adopt a voltage of 66,000. This necessitated underground cables of this voltage, as the station is located in the underground district of the city.

A general diagram of this 66-kv. system is shown in figure No. 1. There is a double 66-kv. ring around the city consisting of two overhead 66-kv. circuits. One of the 66-kv. circuits is looped into each important substation in the city and, in certain cases, both of the 66-kv. circuits are carried into the same station. Each of the two rings is thus sectionalized at a substation and relayed so as to provide selective protection of the different sections, i.e., a fault on one section of the ring will open only the circuit breaker at each end of the faulted section, thus clearing only the section of the line which is faulted. The power will then flow around the ring in the other direction and there will be no interruption of supply to any substation.

The 66-kv. cables form a part of this ring and are therefore required to carry the load of Vallee station and, in addition, the load of one or more adjacent stations in case the ring is temporarily open circuited.

The length of the cable system is approximately 4,000 feet, the distance from the Vallee station to the overhead lines. The duct system so far constructed provides a duct space for three three-phase circuits, with one spare duct. The cables installed up to the present time consist of six single-conductor cables, constituting two three-phase circuits. When the third circuit is installed it will be arranged for connection in multiple with either of the two present circuits, according to which of the two present circuits is carrying the heavier load. (A diagram of connections is shown in figure No. 2.)

The cables at present installed are intended to supply the first half of the ultimate capacity of Vallee station. When the second half of the station is built the present cable system will be duplicated and connected to the second overhead ring.

Ducts and Manholes

The present 66-kv. duct system consists of ten ducts, two ducts wide by five ducts high, as shown in figure No. 3, which also shows a typical manhole and certain details. The conduits are 4½-inch fibre, with sleeve joints.

The station is located in an old section of the city

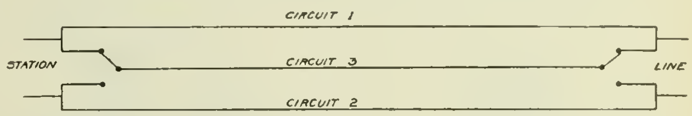


Figure No. 2.—Connections for Third 66-kv. Cable Circuit.

where the streets are very congested with existing underground obstructions. It was therefore necessary to place the 66-kv. ducts at an unusual depth to avoid obstructions. At some points it was necessary to go below the sewer levels. The deepest manhole is shown in figure No. 4.

The soil in several locations is very wet and, to take care of the unavoidable seepage, it was necessary to install sump pumps. These are arranged to operate automatically by means of a float valve, and are successfully preventing water from rising in the manhole. There are two corner

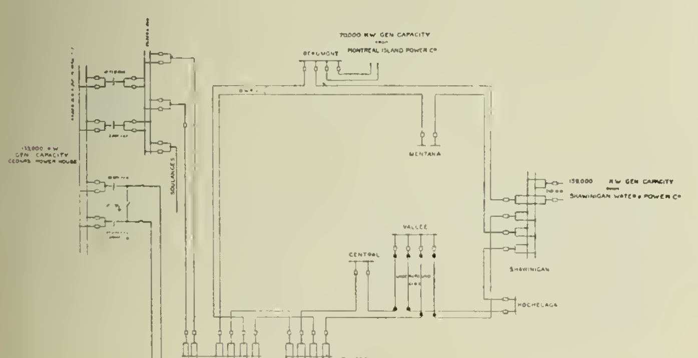


Figure No. 1.—Schematic Outlay for City of Main Transmission System and Substations.

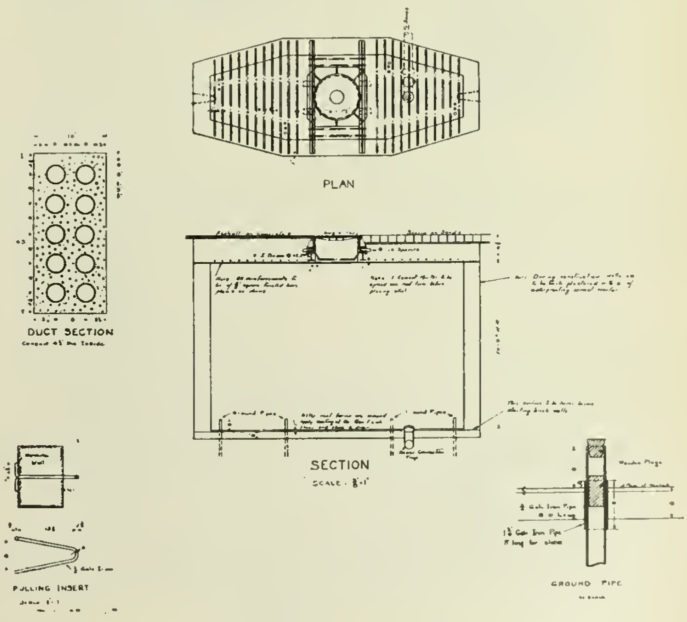


Figure No. 3.—Typical 66-kv. Manhole Details.

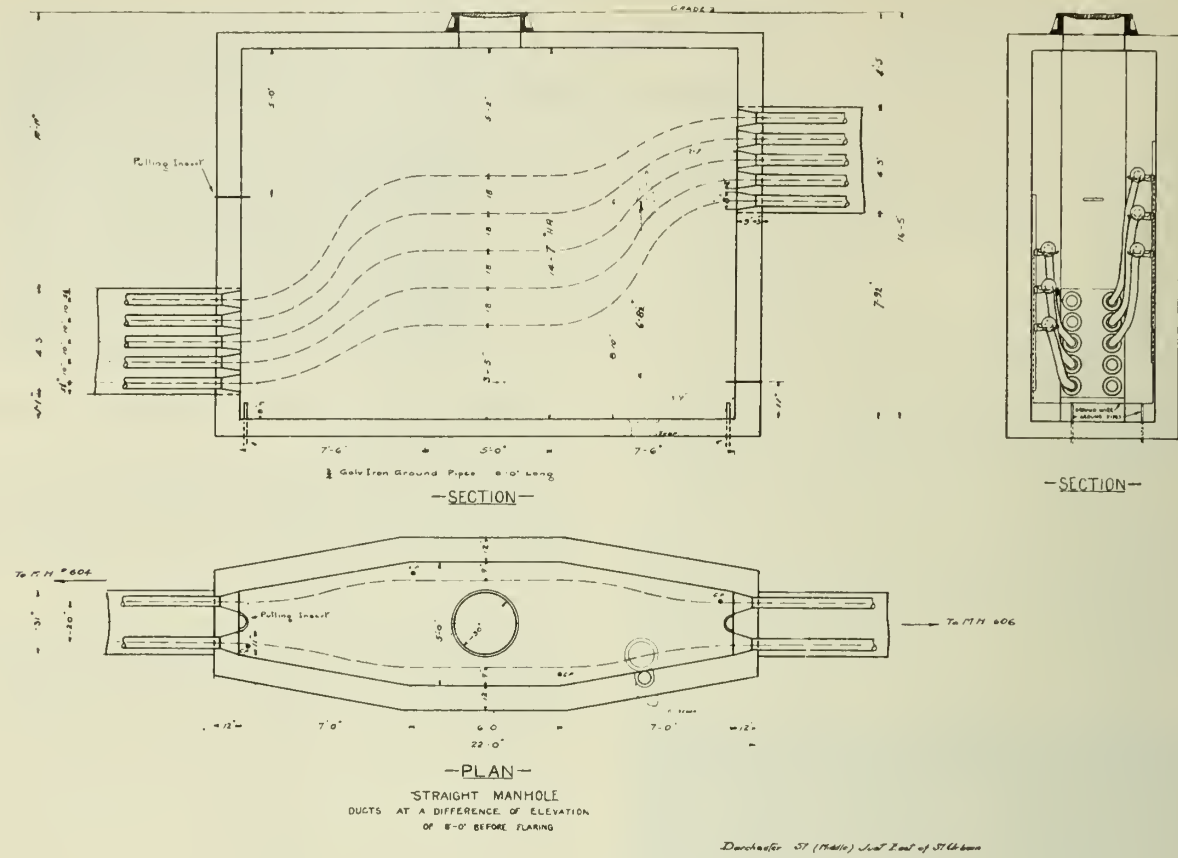


Figure No. 4.—Plan and Elevation of 66-kv. Manhole.

manholes in the system, one of which is shown in figure No. 5.

At the two ends of the line are specially large manholes, (see figures Nos. 6 and 7), to accommodate three-pole double-throw oil switches required for switching the future spare circuit in multiple with either of the two main circuits. Provision is made for operating these two switches electrically from Vallee substation.

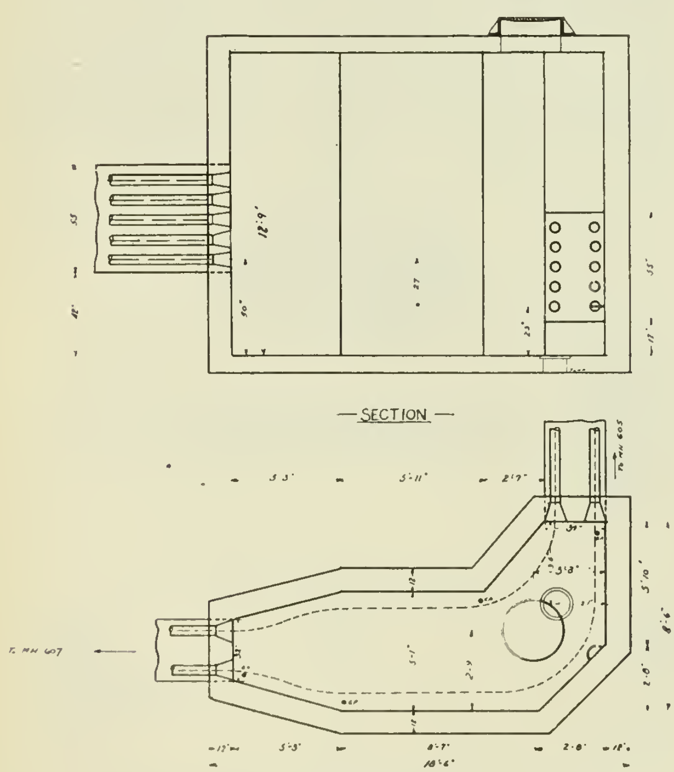


Figure No. 5.—Typical Corner 66-kv. Manhole.

66-kv. Cables

The cable is a single conductor, 750,000 c.m. strand, the conducting strands being laid around a spiral steel spring to assist in impregnation and in maintenance. The insulation thickness is 30/32-inch paper, surrounded with a 9/64-inch lead sheath.

Installation

Each length of cable was equipped in the factory with a pulling eye on one end, which saved considerable time in attaching pulling connections in the field. The cable was pulled in with a power winch on the regular cable truck. The maximum tension required to start a cable from rest was 2,780 pounds. The maximum tension to keep the cable in motion was 2,020 pounds. The average speed of pulling cable was 15 to 20 feet per minute. The length of pull was 308 feet straight away. A heavy grease was used for lubricating the cable during the pulling. The work was done during the month of December, 1926, with an outdoor temperature from 16°F. to 42°F. Each cable was pulled in within three hours after removal from the store room.

66-kv. Cable Joints

The line was completely jointed by the construction department of the Standard Underground Cable Company, using the design of joint developed by Mr. D. M. Simons, development engineer of the company.

As a preliminary to making the seventy-two joints on

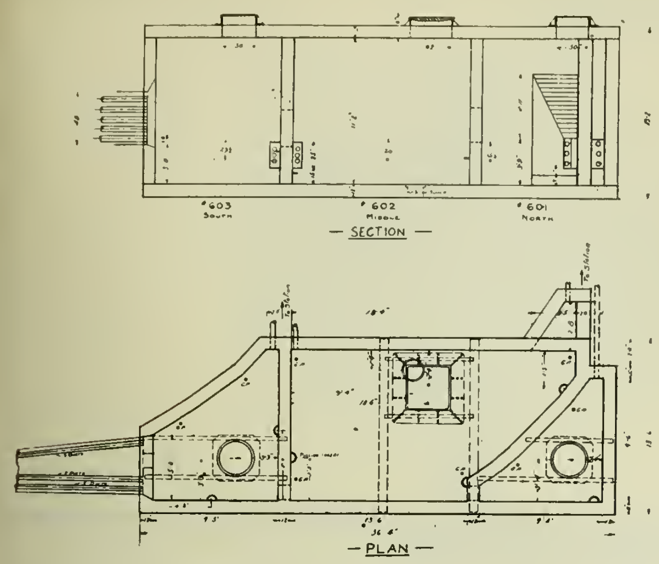


Figure No. 6.—66-kv. Manholes at Station End of Duct Line.

this cable the air in the manholes was heated and dried to a humidity of from 55 to 85 per cent. The heating was accomplished by means of an electric heater and gasoline furnaces and the air dried by passing it over calcium chloride crystals resting on shelves in a specially designed container. (See figure No. 8.)

Figure No. 9 shows the joint and indicates the various operations involved in its construction.

The ends of the cable to be spliced were trained to position and cut to length, after which the lead and paper for a distance of 1½ inches was squarely cut away by a special machine.

The two-piece lead sleeve was then slipped over the ends of the cable and a ⅜-inch cold rolled steel rod 18 inches long was pushed into each end of the hollow core cable for the purpose of preventing the compound from flowing out of the core during jointing.

The two ends of the cable were then joined together by

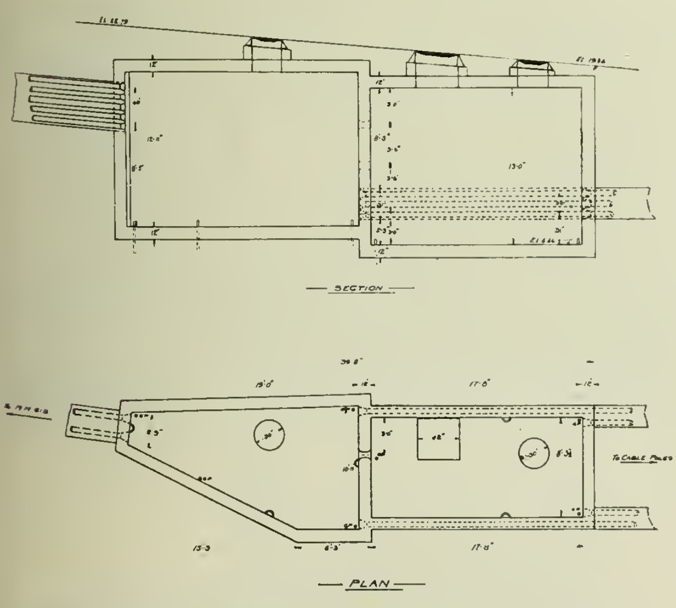


Figure No. 7.—66-kv. Manholes at End of Duct Line Connecting with Overhead System.

a slotted connector soldered into position and the lead sheath removed to a total length of 18½ inches from the centre of the joint.

The factory paper insulation was then removed to form nine 1½-inch steps and one 3½-inch step when a perforated metallized strip of paper 2⅜ inches wide was wrapped around the factory insulation and slipped under the lead sheathing for a distance of ¼-inch from the lead sheath.

Impregnated flax twine was used to fill up the small space between the connector and the paper insulation and form a smooth surface, after which impregnated paper tape was hand wrapped over the connector to a thickness approximately midway between the diameter of the second and third steps.

The remainder of the insulation was applied with a machine designed by the Standard Underground Cable Company and the lower half or frame of this machine was then fitted in place and bolted to the cable racks. Special impregnating compound at a temperature of 300°F. was poured over the joint to remove any trace of moisture from the insulation. The upper half or rotating part of the insulating machine was then installed, equipped with knives to cut the insulating paper to a proper width to fit the stepping as the machine rotated around the cable. This insulating roll of paper was 35½ inches long and the two strips of metal foil were attached to the roll of paper so that as the paper was wound on the joint, these metal strips made con-

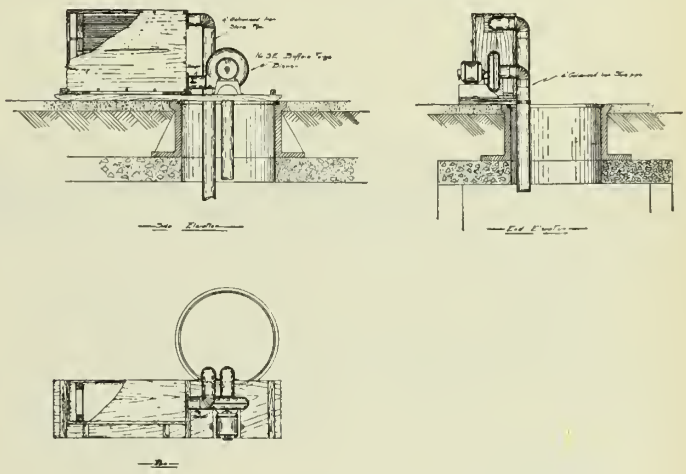
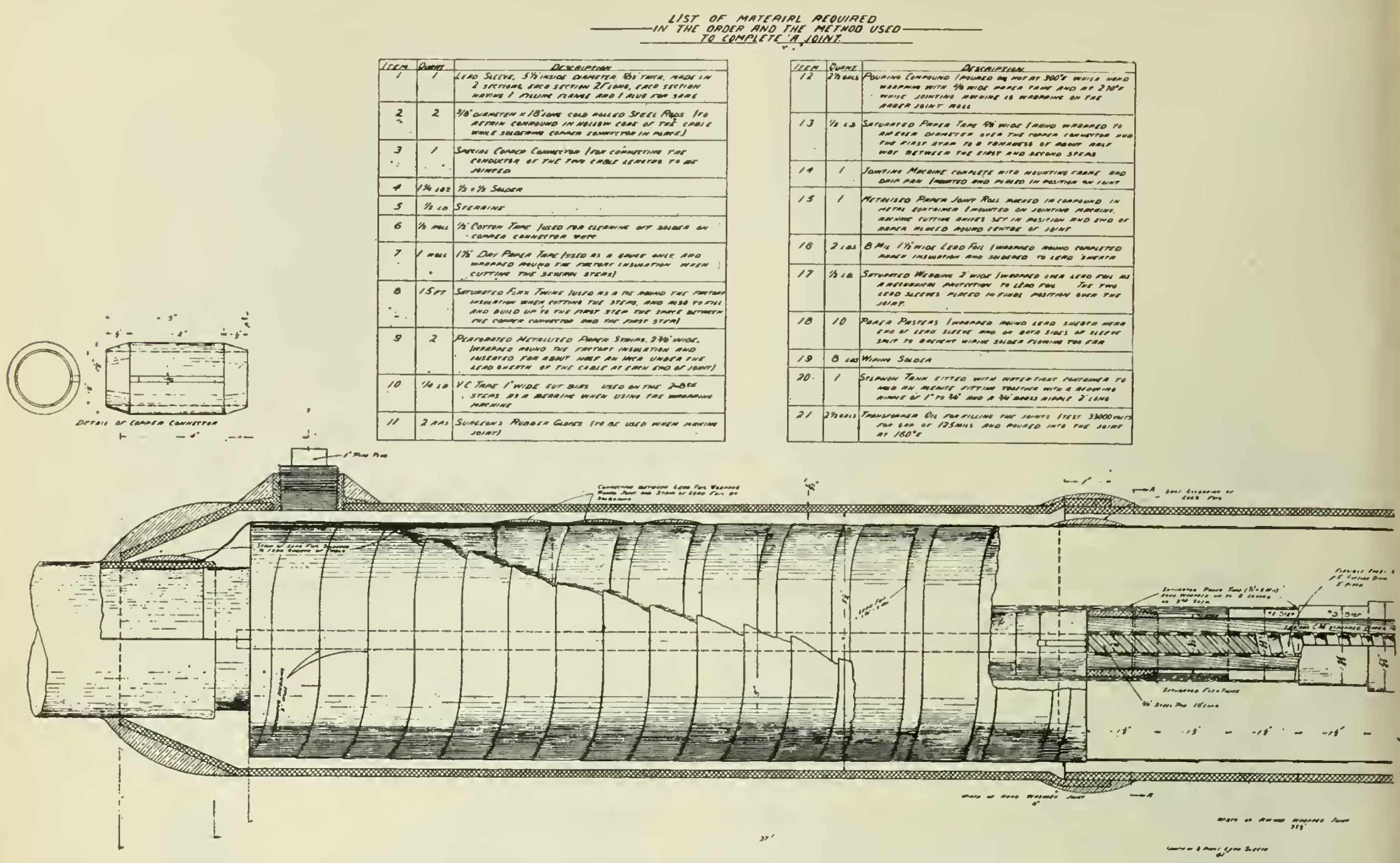


Figure No. 8.—Calcium Chloride Air Dryer.

tact with the perforated metallized strips of paper and gradually worked in toward the centre of the joint to a distance of about 10 inches from the edge of the paper. This had the same effect as a metallic cone shield, and reduced electrical stresses on the insulation.

During the process of wrapping, impregnating compound, at a temperature of 270°F., was poured on the joint at each revolution of the machine and, when the wrapping was completed a metal foil ribbon was placed in contact with the two strips of metal foil and wrapped around the joint and connected to the lead sheath by soldering. This removed all electric stresses from the oil surrounding joint.

A layer of impregnated webbing was wrapped around the joint to protect the metal foil. The two sections of the lead sleeve were then fitted together over the joint and a wiped joint made at each end of the sleeve and at the



Item	Quant.	Description
1	1	Lead Sleeve, 5½" inside diameter ⅜" thick, made in 2 sections, each section 21" long, each section having 1 filling flange and 1 plug for same
2	2	⅜" diameter × 18" long cold rolled Steel Rods (to retain compound in hollow core of the cable while soldering copper connector in place)
3	1	Special Copper Connector (for connecting the conductor of the two cable lengths to be jointed)
4	1¼ lbs	½ + ½ Solder
5	½ lb	Stearine
6	½ roll	½" Cotton Tape (used for cleaning off solder on copper connector note)
7	1 roll	1½" Dry Paper Tape (used as a gauge once and wrapped round the factory insulation when cutting the several steps)
8	15 ft	Saturated Flax Twine (used as a tie round the factory insulation when cutting the steps, and also to fill and build up to the first step the space between the copper connector and the first step)
9	2	Perforated Metallized Paper Strips, 2⅜" wide. (wrapped round the factory insulation and inserted for about half an inch under the lead sheath of the cable at each end of joint)
10	¼ lb	V.C. Tape 1" wide cut bias used on the 2-8th steps as a bearing when using the wrapping machine
11	2 prs	Surgeon's Rubber Gloves (to be used when making joint)
12	2½ gals	Pouring Compound (poured on hot at 300°F while hand wrapping with ⅛ wide paper tape and at 270°F while jointing machine is wrapping on the paper joint roll
13	½ lb	Saturated Paper Tape ⅛" wide (hand wrapped to an even diameter over the copper connector and the first step to a thickness of about half way between the first and second steps
14	1	Jointing Machine complete with mounting frame and drip pan (mounted and placed in position on joint
15	1	Metallized Paper Joint Roll packed in compound in metal container (mounted on jointing machine, machine cutting knives set in position and end of paper placed round centre of joint
16	2 lbs	8 Mil 1½" wide Lead Foil (wrapped round completed paper insulation and soldered to lead sheath
17	½ lb	Saturated Webbing 2" wide (wrapped over lead foil as a mechanical protection to lead foil. The two lead sleeves placed in final position over the joint.
18	10	Paper Pasters (wrapped round lead sheath near end of lead sleeve and on both sides of sleeve split to prevent wiping solder flowing too far
19	8 lbs	Wiping Solder
20	1	Sylphon Tank fitted with watertight container to hold an ebonite fitting together with a reducing nipple of 1" to ¾" and a ¾" brass nipple 2" long
21	2½ gals	Transformer Oil for filling the joints (test 33000 volts for gap of 125 mils and poured into the joint at 160°F

Figure No. 9.—Details of

middle where the two sections joined together. The sleeve was then filled with insulating oil and made watertight by screwing down a plug in one flange at one end of the joint and installing a sylphon tank at the other end of the joint. This sylphon tank was also filled with oil and acted as a storage tank to replace any oil absorbed by the joint.

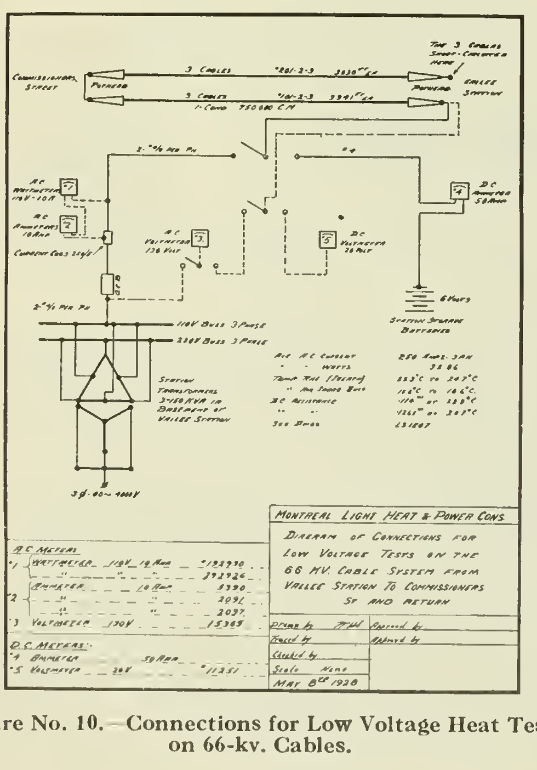


Figure No. 10.—Connections for Low Voltage Heat Tests on 66-kv. Cables.

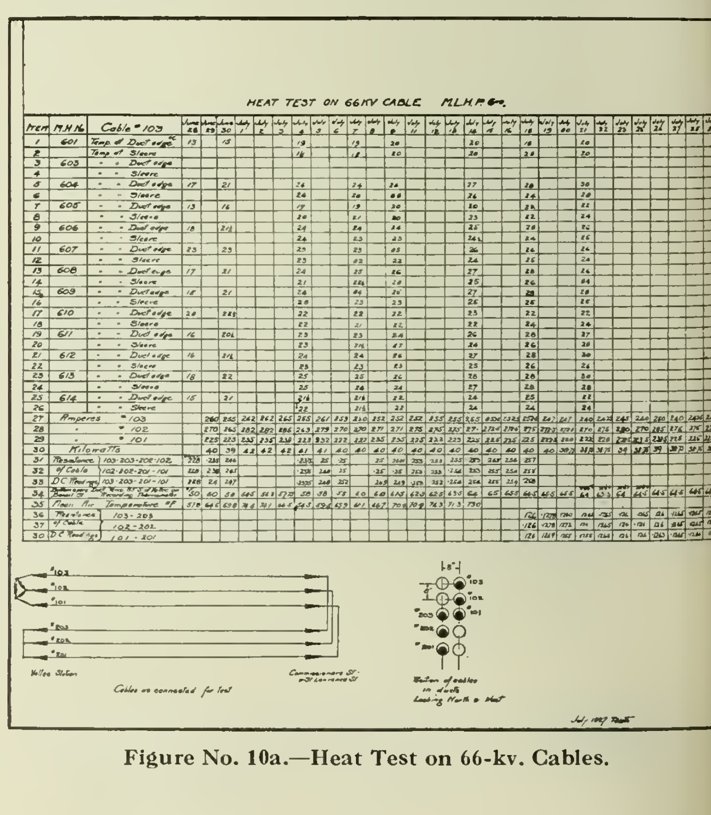
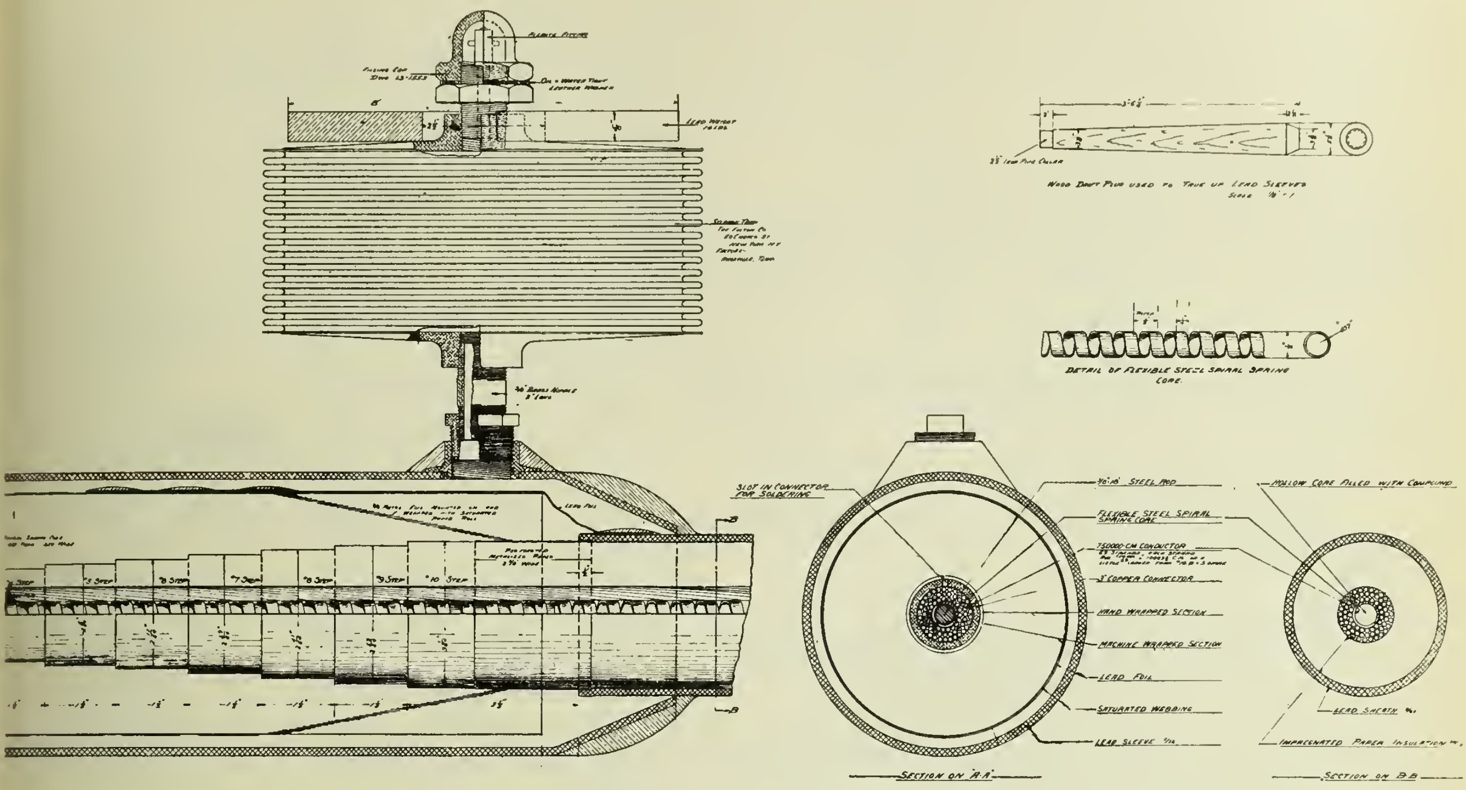


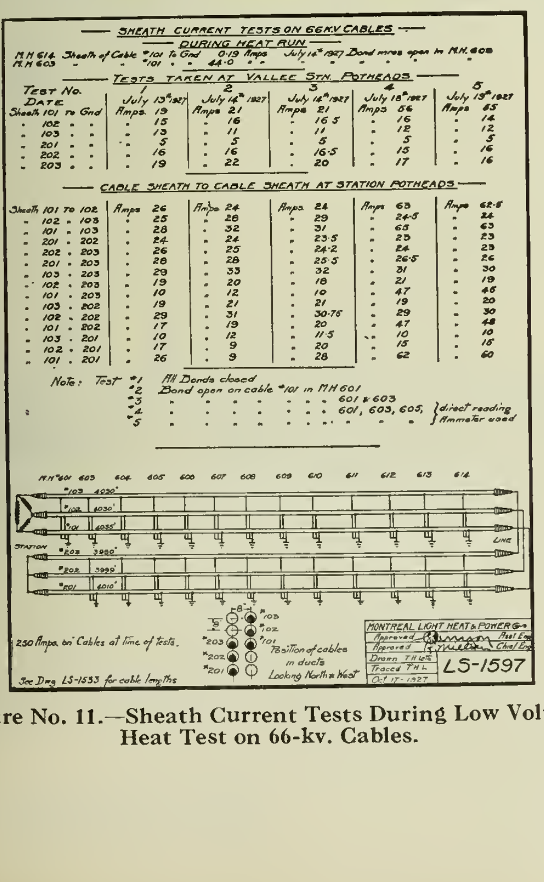
Figure No. 10a.—Heat Test on 66-kv. Cables.



66-kv. Cable Joint.

After the completion of the installation, a short circuit current of approximately 250 amperes, 60 cycles, 3-phase was put through the two circuits of cables in series for a period of twenty-eight days. The temperature in the adjacent empty ducts was read by a thermocouple during the heat run and the temperature of the copper in the cables was read by resistance during the heat run. (See figures Nos. 10 and 10A.) From the rise in temperature observed, calculations were made to determine the maximum safe current which these cables will carry in operation. This current was estimated at 350 amperes, which corresponds to the specified maximum operating temperature of 60°C., either circuit would be able to transmit the entire capacity with an ambient temperature of 20°C. This maximum operating current of 350 amperes corresponds to a continuous rating of 40,000 kv.a. for each of these circuits. This indicates that in case of a fault in one section of the ring either circuit would be able to transmit the entire capacity of 45,000 kv.a. for a period of time depending largely upon the load conditions which existed before the occurrence of the fault.

The heat run also served to give an indication of the behaviour of the sylphon reservoirs under rise of temperature. It was found that almost no movement of these reservoirs took place between the cold and warm temperatures of the cable. It was found, however, that several of the reservoirs had emptied, creating a considerable vacuum. The sylphons have been filled to a slightly higher level than previously and a leaden weight of 14 pounds has been placed on each sylphon. Arrangements have been made so that if oil again flows out of a reservoir the weight will ensure a sufficiently definite downward movement to close a signal switch and operate a signal in the substation which will inform the operator that a sylphon reservoir has emptied in a certain manhole. Immediate inspection will then be made to determine the cause of the reservoir empty-



SHEATH CURRENT TESTS ON 66 K.V CABLES
DURING HEAT RUN

M.H 614 Sheath of Cable #101 To Gnd 0.19 Amps July 14th 1927 Bond wires open in M.H. 603
M.H 603 " " #101 " " 44.0 " " " " " "

TESTS TAKEN AT VALLEE STN. POTHEADS

Test No.	1	2	3	4	5
Date	July 13th 1927	July 14th 1927	July 14th 1927	July 18th 1927	July 19th 1927
Sheath 101 to Gnd	Amps 19	Amps 21	Amps 21	Amps 56	Amps 65
" 102 " "	" 15	" 16	" 16.5	" 16	" 14
" 103 " "	" 13	" 11	" 11	" 12	" 12
" 201 " "	" 5	" 5	" 5	" 5	" 5
" 202 " "	" 16	" 16	" 16.5	" 15	" 16
" 203 " "	" 19	" 22	" 20	" 17	" 16

CABLE SHEATH TO CABLE SHEATH AT STATION POTHEADS

	1	2	3	4	5
Sheath 101 to 102	Amps 26	Amps 24	Amps 24	Amps 63	Amps 62.5
" 102 " 103	" 25	" 28	" 29	" 24.5	" 24
" 101 " 103	" 28	" 32	" 31	" 65	" 63
" 201 " 202	" 24	" 24	" 23.5	" 25	" 23
" 202 " 203	" 26	" 25	" 24.2	" 24	" 23
" 201 " 203	" 28	" 28	" 25.5	" 26.5	" 26
" 103 " 203	" 29	" 33	" 32	" 31	" 30
" 102 " 203	" 19	" 20	" 18	" 21	" 19
" 101 " 203	" 10	" 12	" 10	" 47	" 46
" 103 " 202	" 19	" 21	" 21	" 19	" 20
" 102 " 202	" 29	" 31	" 30.75	" 29	" 30
" 101 " 202	" 17	" 19	" 20	" 47	" 48
" 103 " 201	" 10	" 12	" 11.5	" 10	" 10
" 102 " 201	" 17	" 9	" 20	" 15	" 15
" 101 " 201	" 26	" 9	" 28	" 62	" 60

Note: Test #1 All Bonds closed
#2 Bond open on cable #101 in MH 601
#3 " " " " " " " 601 & 603
#4 " " " " " " " 601, 603, 605, } direct reading
#5 " " " " " " " " " " } Ammeter used

Figure No. 11.—Sheath Current Tests During Low Voltage Heat Test on 66-kv. Cables.

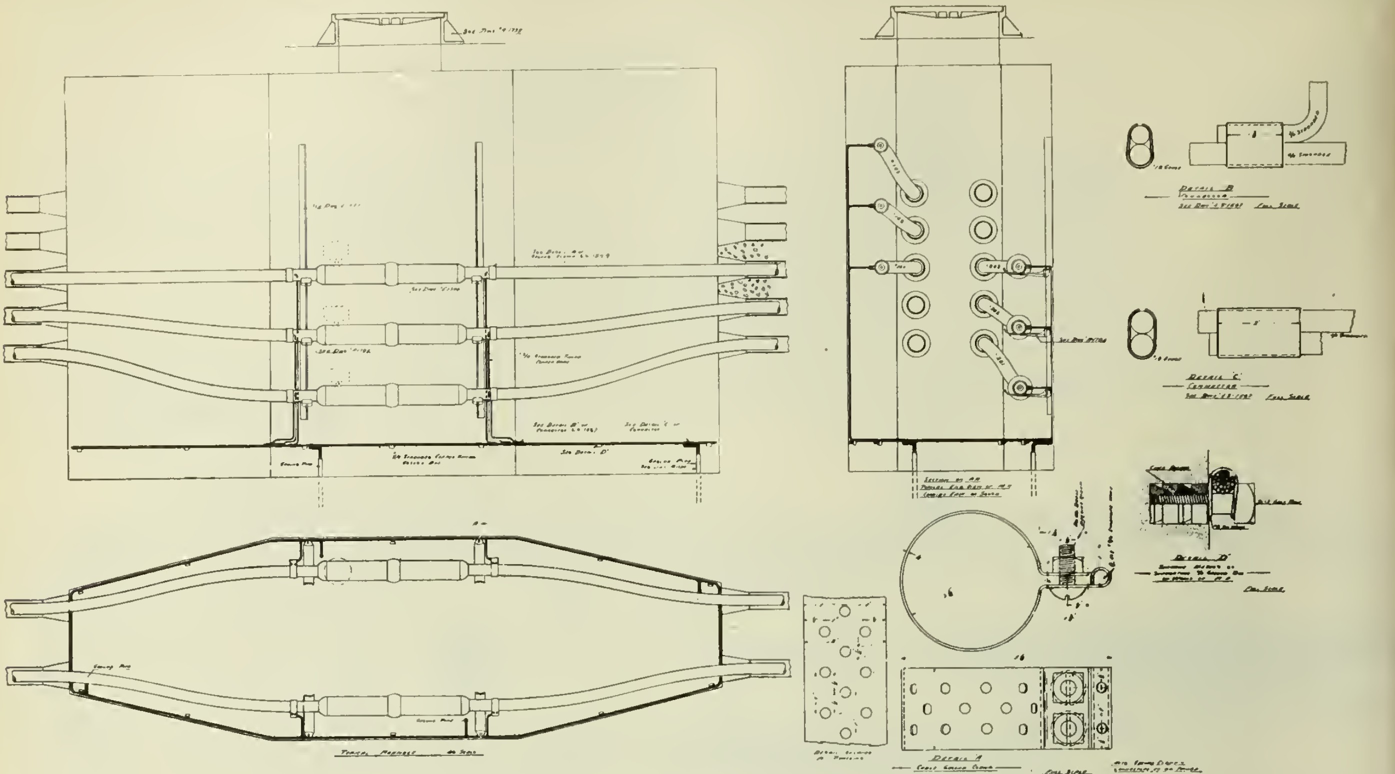


Figure No. 12.—Method of Grounding 66-kv. Cable Sheaths in Manholes.

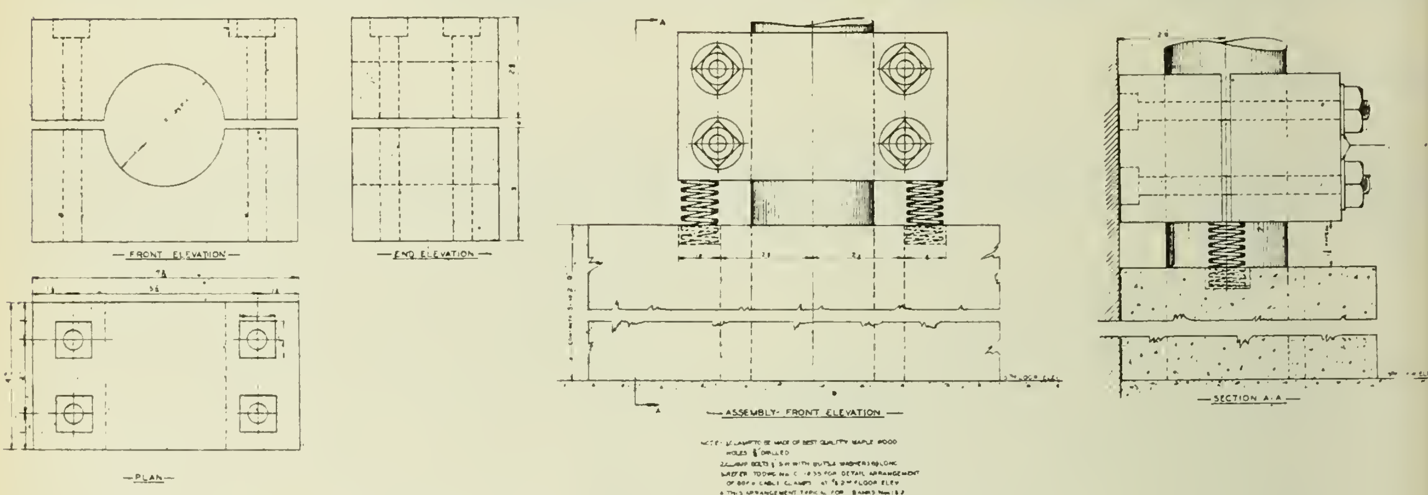


Figure No. 13.—Detailed Arrangement of 66-kv. Cable Clamp at Fifth Floor Elevation at Station.

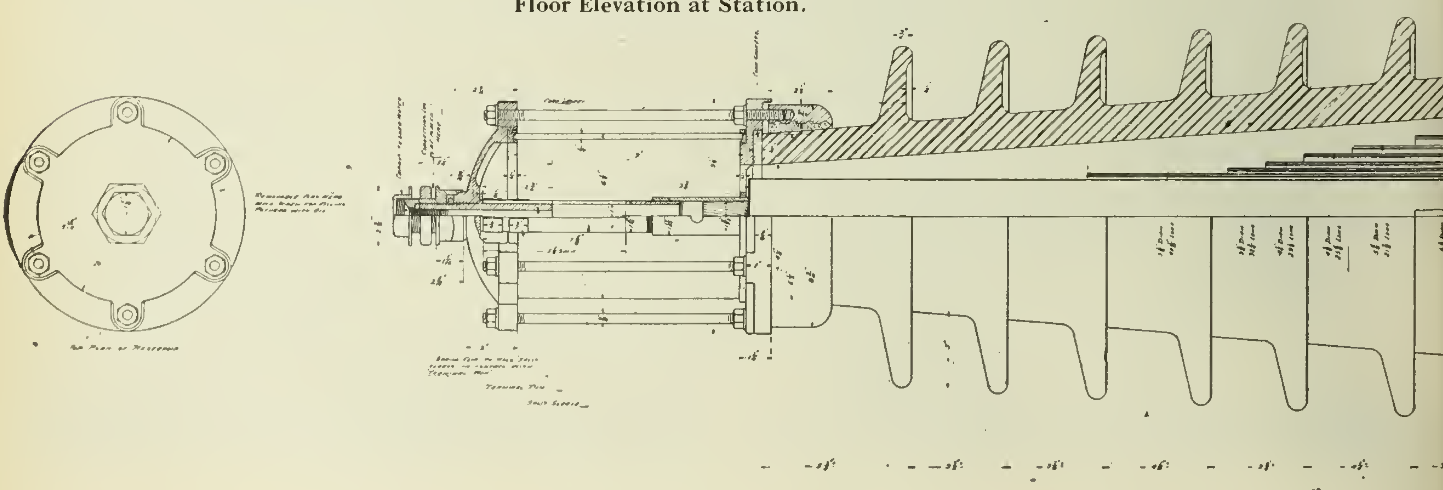


Figure No. 15.—Details of

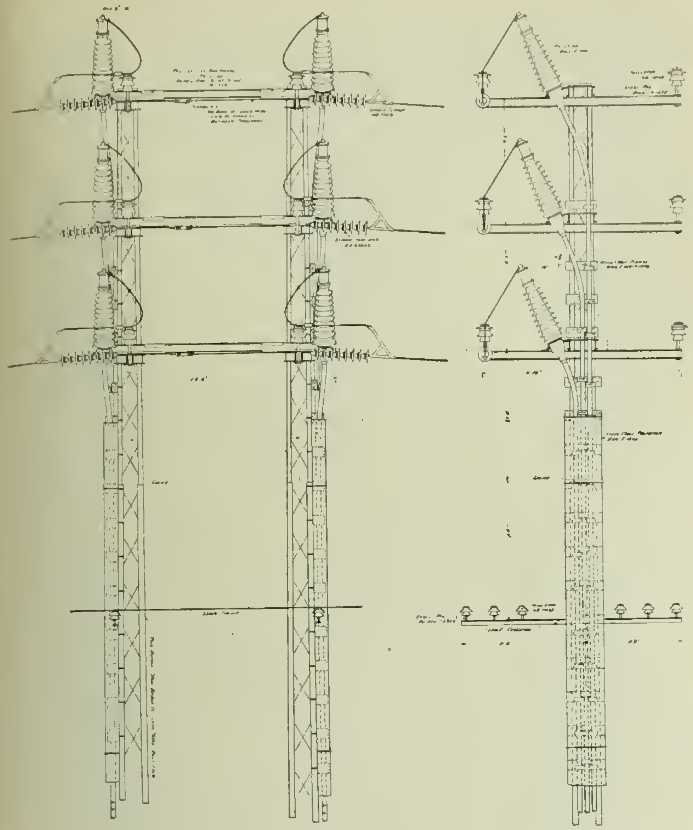


Figure No. 14.—66-kv. Cable Heads Connecting with Overhead System.

ing. In this way it is intended to detect any oil leak which may occur in a lead sheath of a joint or at any point in the lead sheath of the cable.

In order to fill a sylphon reservoir under pressure, each reservoir is equipped with an Alemite connection and the oil is pumped into the reservoir by a portable outfit. A brass cap is screwed over the Alemite connection to protect it from dirt.

Grounding of Cable Sheaths

All sheaths are grounded at each side of each cable joint so as to reduce to a minimum any current which might flow through the lead sheath of the joint. (See figure No. 11.) A diagram of the ground connections is shown in figure No. 12.

Description of Fireproofing Cables

The cables and joints in the manholes were wrapped half lap with asbestos listing 3 inches wide and 1/16-inch thick, saturated after installation with a solution of silicate of soda.

Cable Terminals

The cable terminals are rated at 110 kv., this extra rating seeming advisable on account of the importance of the line. They are oil-filled terminals with no auxiliary wrappings. The stresses at the base of the terminal are taken care of by concentric tubes of micarta which terminate in a correctly flaring copper ground shield.

At the substation the cables terminate on the fifth floor at a height of 62 feet above the cables in the street.

The weight of cable extending up to the fifth floor is supported at four points by a wooden clamp at each point, resting on steel springs for the purpose of evenly distributing the weight at the several points. (See figure No. 13.)

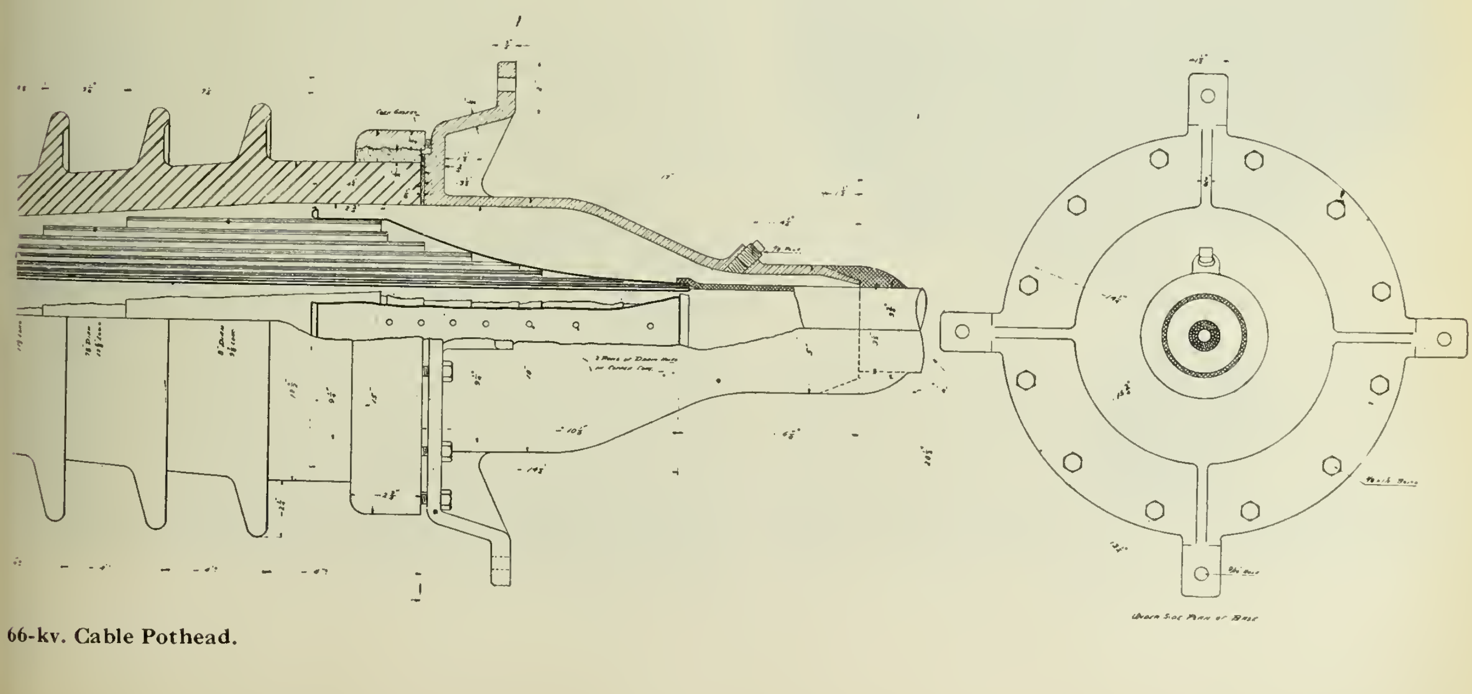
Where the cables join the overhead line the terminals are located at the top of pole, as shown in figure No. 14.

The underground fibre conduit extends with a 10-foot radius bend up to an elevation of 5 feet above the ground, protected by a concrete pier. From this point up the cables are supported by wooden clamps spaced an average of 24 inches apart and are protected from mechanical injury by galvanized sheet iron housing.

Tests

The cable specifications required a test of 219,000 volts d.c. for 15 minutes. All of the cables successfully stood this test.

The testing apparatus consisted of a 6-tube Kenotron set built by the General Electric Company, the wiring diagram of which is shown in figure No. 16.



66-kv. Cable Pothead.

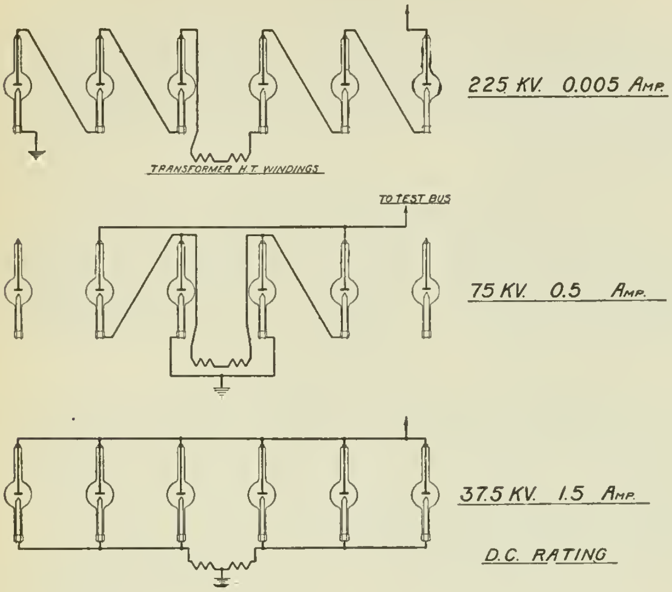


Figure No. 16.—Connections for Kenotron Test Set.

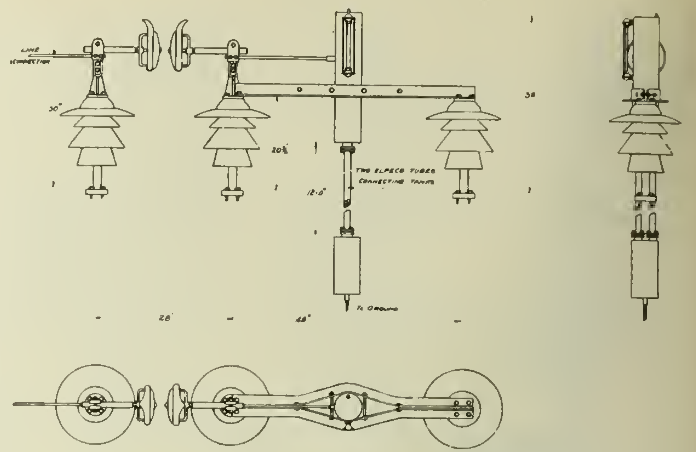


Figure No. 17.—Bennett Lightning Arrester.

Lightning Arresters

In order to protect these cables against possible damage from lightning, two arresters have been installed, one on each pole adjacent to the terminal poles. These are Bennett arresters supplied by the Electric Power Equipment Company of Montreal. (See figure No. 17.)

Operating Record

These cables have been in operation continuously since November 13th, 1927. No trouble of any kind has occurred on the cables or joints during the tests or in regular operation under load in the conduit construction in its entirety.

Waterwheel Driven A. C. Generators

The Effect of Operating Requirements on Design

John R. Dunbar, A.M.E.I.C.
Engineering Department, Canadian Westinghouse Company.

Paper read before the Hamilton Branch of The Engineering Institute of Canada, April 12th, 1928

An electric generator is a rotating machine which transforms mechanical energy, derived from a prime mover, into electrical energy. It consists, essentially, of a system of electro-magnets, known as the field, moving with relation to a laminated structure of low reluctance iron in which copper conductors are embedded, known as the armature. The magnetic flux from the field, cutting the armature conductors, induces in them an alternating voltage. This voltage appears at the terminals of the machine as an alternating or as a direct voltage, depending on the design of the generator. In d.c. generators and some very small a.c. generators the field is stationary and the armature revolves. The great majority of a.c. generators are now built with stationary armature and revolving field.

Type of Prime Mover Influences Design

Although it is not very generally recognized by users of electrical equipment, the type of prime mover that is to drive a generator has a considerable effect on the design of the generator, due to the inherent differences in the prime movers. A steam turbine runs at a high speed, usually 1,800 or 3,600 r.p.m., and this high speed requires a very special type of construction with cylindrical rotors. Steam engines and internal combustion engines operate at lower speeds, which permit the salient pole type of rotor to be used. The runaway speed is about 25 per cent above normal speed. With internal combustion engines it is necessary to supply an amortisseur winding on the generator, on account of the large fluctuations in the crank effort. In the case of waterwheel driven generators, the normal speeds are of the same order as for steam engines, but the runaway speed is from 85 to 125 per cent above the normal speed. This requires special provision to be made in the design of the generators. Thus each kind of prime mover introduces its own problems and, in order to supply machines suitable for various drives, it is necessary to use several types of construction.

Waterwheels may be divided into two general classes, horizontal shaft and vertical shaft. In turn, the generators may be driven from the waterwheel by means of belts, chains, gears, or by direct coupling to the shaft of the waterwheel. All generators which are to be driven from horizontal shaft waterwheels are horizontal shaft themselves, and belted units are usually horizontal shaft whether driven by horizontal or vertical shaft turbines. Generators geared to vertical shaft turbines may be horizontal or vertical, but those direct coupled to vertical shaft turbines must be of the vertical type. Thus there are the following types of waterwheel driven alternating current generators: horizontal shaft, either belted, chain driven, gear driven, or coupled, and vertical shaft, either gear driven or coupled.

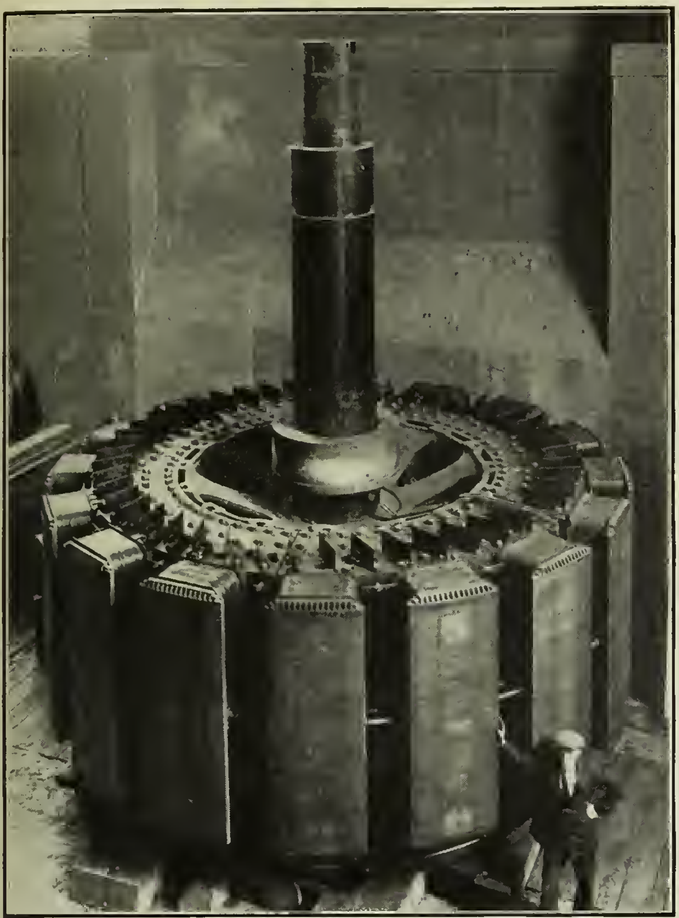


Figure No. 1.—Laminated Rim Rotor for Large High-Speed Waterwheel Generator.

The type of drive has no effect on the electrical design, provided the other characteristics are suitable; that is to say, the electrical parts of a generator rated at 500 kv.a. 6,600 volts, 450 r.p.m., and originally designed to be direct connected to a high speed vertical shaft waterwheel, may be used for belt drive from a low speed horizontal shaft waterwheel, to give the same rating. Of course, the mechanical parts would be different.

Rating Requirements

Before the electrical design of a generator can be proceeded with, it is necessary to know the rating, together with any special conditions which have to be met. The rating includes kilovolt-amperes, power factor, volts, phase, cycles, revolutions per minute and temperature rise. Of these the temperature rise and power factor are the only ones that require further comment.

The permissible temperature rise is determined by the insulating material and by the kind of rating. The normal kind of rating is the continuous rating without overload capacity, but frequently it is advisable to use a different kind of rating; for example, if the load is of such a nature that it would be 25 per cent greater during a two-hour period than it is during the rest of the day, a slightly smaller generator could be used, by using a continuous rating with an allowance for 25 per cent overload for two hours. In some cases the consulting engineer feels that it would be advisable to use a lower temperature rise than the maximum permissible for the type of insulation. The kind of rating and the margin between the actual guaranteed rise and the maximum permissible rise is a matter for the consulting engineer to determine, but the maximum permissible rise depends on the kind of insulation used and is determined by the designing engineer.

Insulation

Two kinds of insulation are used, class "A," which consists of cotton, paper and similar materials, impregnated with a varnish, and class "B," which consists of mica, asbestos and similar materials, which are held together by organic materials for binding purposes only.

When class "B" insulation is used on armature or field coils an observable temperature rise of 80°C. is permissible, when measured by embedded detectors or by the change of resistance method in the case of field coils. For class "A" insulation the permissible observable rise is 60°C. If thermometers are used, then the permissible observable rise is 10° less than the above, except in the case of bare strap field coils when the thermometer is actually in contact with the copper. In some cases class "A" insulation is used in the armature and class "B" in the field, so that it is quite reasonable to have different temperature guarantees on the armature and on the field.

Effect of Power Factor on Design

The power factor of the generator has two effects on the size of the machine. First, for a certain rating of waterwheel the generator kv.a. rating is higher for a lower power factor; for example, a 10,000-h.p. waterwheel would require

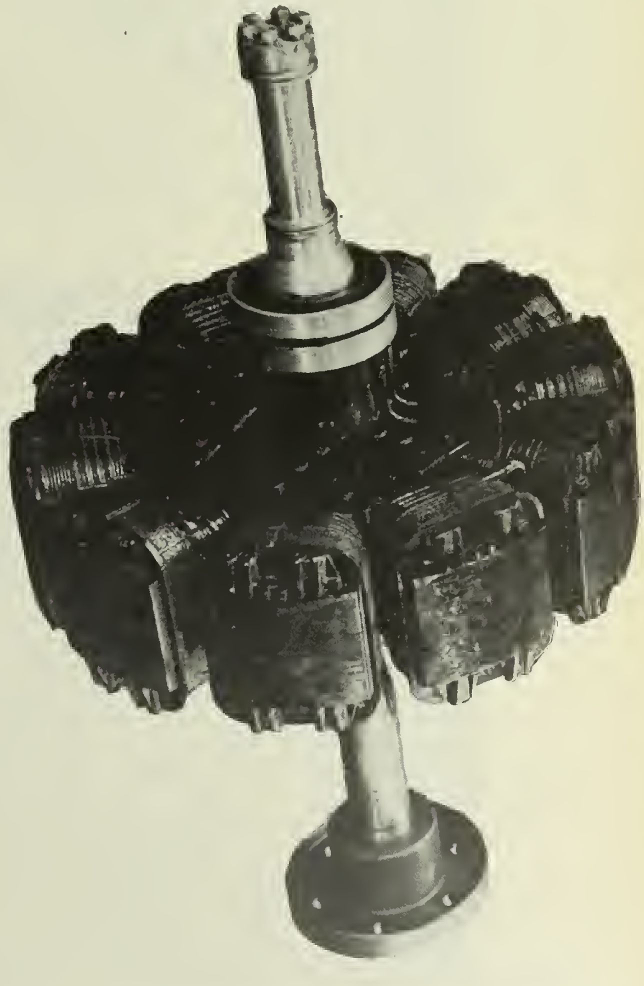


Figure No. 2.—Laminated Spider Rotor for Small Waterwheel Generator.

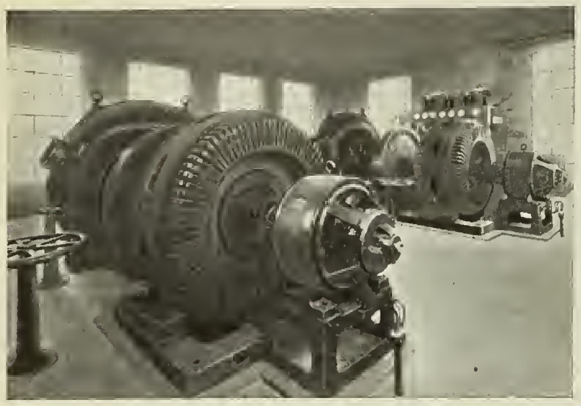


Figure No. 3.—Two 1,000-kva., 60-cycle, Horizontal Shaft Generators in Windsor Power House of Avon River Power Company.

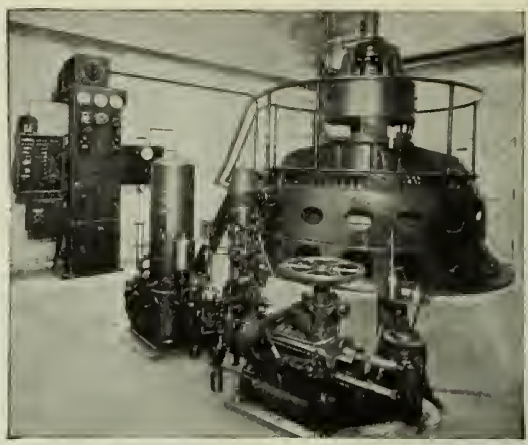


Figure No. 5.—Small Vertical Shaft Automatically Controlled Generator.

an 8,000-kv.a. generator at 90 per cent power factor, but the rating would be increased to 9,000 kv.a. if the power factor were reduced to 80 per cent. In addition, the field current for a certain kilovolt-ampere output is higher for a lower power factor. Both these results combine to require a larger machine for a lower power factor.

Special Conditions

Some of the special conditions which affect the electrical design are: Special requirements for operation or tests, high values of fly wheel effect, and special requirements regarding regulation, short circuit currents or stability.

Naturally if higher values of test voltage than standard are specified, then extra insulation must be added to take care of the special requirements.

A normal design of generator gives a certain value of fly wheel effect. It is possible to increase the fly wheel effect by adding weight to the rotating field up to a certain point, but above that point it becomes uneconomical to attempt to increase the fly wheel effect by adding weight. If this point is reached then it is necessary to redesign the generator completely, using larger diameters and narrower widths. That is, exceptionally high fly wheel effect requirements affect the electrical design by increasing the diameters necessary.

The characteristics which are included under regulation, short circuit currents and stability, depend on the reactance of the generator and upon the air gap. If good regulation is required, so that the change in voltage will be small when there is a variation of load, then a low reactance machine with a large air gap is required. If the short circuit currents are to be kept low, then a high reactance generator is required. If the generator is to feed a long transmission line and there is likely to be trouble from the ends of the transmission line falling out of synchronism, or if it will be required to operate on an unloaded transmission line, which would draw leading current from the generator,

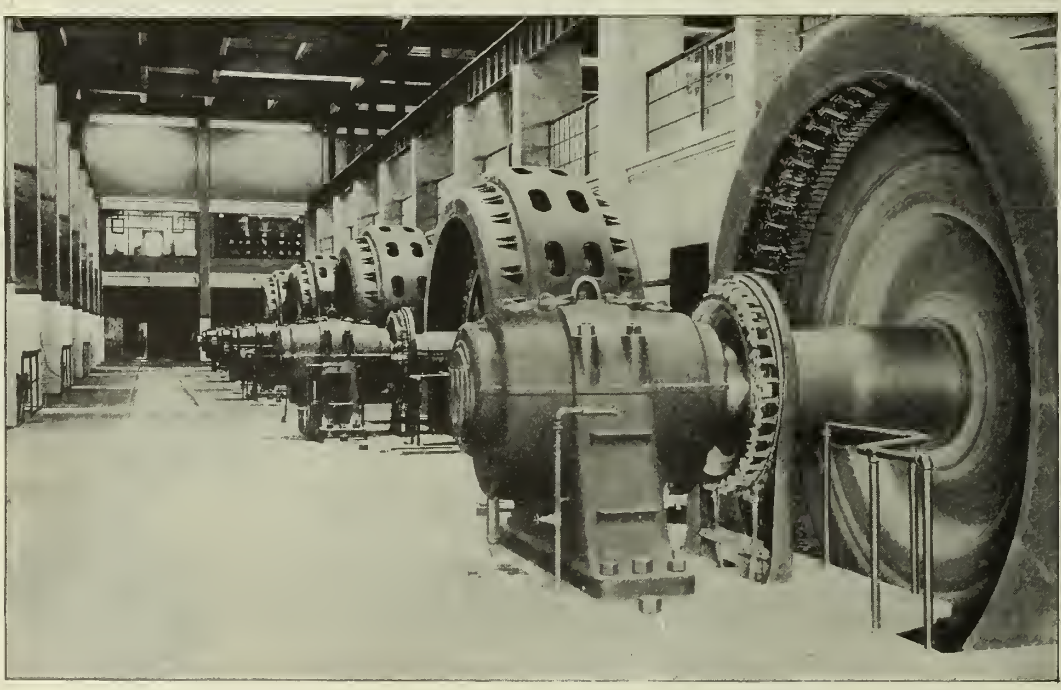


Figure No. 4.—Five 15,000-kva., Horizontal Shaft Generators in Shawinigan Water and Power Company's Plant on St. Maurice river, Shawinigan, Que.

then a low reactance generator with a large air gap is necessary. If, however, it is desired to operate the generator at times of light load as a synchronous condenser to increase the power factor of the load on other generators, then a small air gap is required.

Features of Mechanical Design

The details of the mechanical design are, of course, interlinked with the electrical design, but there are some features that affect the mechanical design more than they do the electrical design.

The peripheral speed of the rotor has a considerable bearing on the rotor design. The speed for which the rotor must be designed is the speed at the maximum possible overspeed. The field poles may be fastened to the spider by means of bolts or dovetails, bolts being used for the lower speeds and dovetails for the higher speeds. The type of spider construction is also affected by the speed. At low speeds cast iron or cast steel may be used. As the speeds get higher castings are too unreliable and it is necessary to adopt a different construction. For some of the smaller generators the spider may be forged integral with the shaft. On slightly larger generators the spider may be built up of thin laminations or of boiler plate and on still larger generators a cast steel or boiler plate centre may be used with a rim built up from thin steel laminations.

Occasionally it is found that the overspeed is so high that no suitable rotor design can be devised. When this is the case it is necessary to distort the electrical design so as to use a less economical machine on a smaller diameter.

The above discussion will show how various operating requirements affect the design of the generator and in some cases how different requirements are conflicting. It assists the designing engineer materially if he has full information regarding the operating conditions, but if no data are available it is necessary for him to assume reasonable values and design the most economical generator, taking into consideration only such data as he has available.

Figure No. 6.—Ten 30,000-kv.a., Vertical Shaft Generators in Isle Maligne Plant of the Duke Price Power Company.

Aeroplane Flight

Types of Aircraft, Forces Effecting Flight, and Factors Governing Stability

C. C. Langstroth, A.M.E.I.C.
Atlantic Sugar Refineries, Saint John, N.B.

Paper read before the Saint John Branch of The Engineering Institute of Canada, October 18th, 1928

Aeroplanes are the most highly developed type of the "heavier than air" type of aircraft. Others of this type are the helicopter and the orthinopter. All these are distinguished from the "lighter than air" ships by the fact that they depend upon dynamic forces for their sustention in the air, while the latter type are sustained by the flotation of a light gas.

Lighter than air craft are divided into classes according to structural differences and are known as rigid, semi-rigid and non-rigid.

The rigid type is distinguished by an aluminum alloy frame covered with fabric and supporting the several gas balloonettes inside. Passenger, cargo and engine compartments are either contained in the frame or rigidly suspended from it. The German Zeppelins, the English R-33 and the American Los Angeles are examples of the rigid type. The rigid airship is the liner of the near future and both England and Germany have ships now that will, within a matter of months, attempt regular trans-Atlantic passenger services.

The semi-rigid type of airship has a metal framework along the bottom of the gas bag. This frame acts as a ship's keel and the accommodation is affixed rigidly. The ships of the Italian Arctic expeditions were of the semi-rigid type.

A non-rigid airship is a really self-propelling balloon held in shape only by the pressure of the gas that floats it, and carrying its useful load slung beneath it by ropes. It was used in the war for patrol duty and known as a "Blimp."

In common with "heavier than air" craft the "lighter than air" ships depend upon the thrust of air screws for their forward motion and upon planes for manoeuvring at least in part.

Airships require large crews to navigate and land them and are difficult to handle near the ground. Hydrogen, the first widely used flotation gas, is highly inflammable and an ever present hazard. The post war development of the mooring mast and the war time discovery of new sources of the uninflammable light helium will probably do much to make the airship a practical means of transportation.

Of the "heavier than air" machines, the orthinopter is an attempt to imitate mechanically bird flight with flapping wings. This type has so far been shelved by the simpler structures of the aeroplane and the helicopter.

The helicopter has for its distinguishing characteristic airscrews on vertical axes that support the machine in the air while other airscrews working normally on horizontal axes impart forward motion. Experiment with the helicopter has persisted in spite of many disappointments on account of the advantages of nearly vertical ascent and descent in alighting on and leaving restricted areas.

Aeroplanes are classified by the following characteristics:—

(1) "Tractor" or "pusher" depending on whether the machine is drawn by the airscrew or pushed by it. In multi-engined machines both types of airscrews may be used.

(2) "Monoplane," "biplane," "triplane" and so forth by the number of main lifting planes.

(3) A land machine normally alights on the ground.

(4) A seaplane is one that normally comes to rest on the water and takes the form of a land machine with floats in place of wheels on the landing gear.

(5) A flying boat is a seaplane whose fuselage has the function of a float when resting on the water.

(6) An amphibian is an aeroplane fitted for alighting on both land and water.

A Spanish engineer has lately brought a helicopter, which he calls an "Autogiro," to a stage of development that allowed him to fly it from London to Paris. This event has been hailed by some authorities as one comparable to the first flight of a plane across the English channel.

The aeroplane depends, for its suspension in the air, on the reaction of the airstream caused by the machine's forward motion, on fixed planes or aerofoils. The forward speed necessary to give the machine lift sufficient to sustain it is so great that a run on the ground, (or water), is necessary to accelerate the machine when taking off, and on alighting to reduce its momentum.

The word "airship," according to English and Canadian authorized practice, refers to a self-propelled lighter than air craft and cannot be properly applied to an aeroplane.

Both land machines and seaplanes have been fitted with skiis for alighting on snow and have been successfully used.

Forces Effecting Flight

Successful aeroplane flight is accomplished by maintaining in equilibrium four primary forces: thrust, drag, lift and gravity. Thrust is the force exerted by an airscrew when turned by the engine. An airscrew follows generally the same aerodynamic principles as any other aerofoil and is really a pair of rotary planes. An important characteristic of the airscrew is the helical wake of turbulent air that it heaves when working.

Drag is the head resistance of an aerofoil or aeroplane as it moves through the air. In an aeroplane drag has three components:—

(1) The "passive" drag of the surfaces at right angles to the air flow.

(2) The "active" drag caused by the reaction of the lift and control surfaces.

(3) The "skin friction" of all surfaces exposed to the flow.

Drag represents a direct power loss and its reduction is important in aeroplane design. The passive resistance is reduced to a minimum by a device known as stream lining.

When a stream of fluid flowing against a body is parted and brought together in such a way that the fluid flows smoothly, setting up the least possible turbulence, the body offers minimum of resistance to the fluid flow. The bodies of birds and fish are natural examples of this principle. In a properly streamlined body it is possible to reduce the air resistance to one-quarter that of a thin flat plate representing the same section to the air stream.

Abrupt changes in shape in aeroplane structures tend to make the air turbulent when the machine is in flight. To reduce the passive head resistance all the structure possible is kept inside the fuselage and wing structures while all bracing wires and struts are carefully streamlined.

Lift is the reaction on a plane or aerofoil of the airflow past it, the lift being measured normal to the airflow. The ratio of the lift to drag or drift forces are the measure of aerofoil efficiency. This ratio decreases as the angle of the plane to the direction of the airflow is increased; the angle between the plane and the direction of the airflow being known as the angle of incidence. Flat planes were early abandoned for lifting on account of their low lift drift ratio, experiment having shown that a curved or combered wing section gave greater lift for the power expended.

It is a fact that the upper surface of a combered aerofoil section has more influence than the lower on the lift, in good aerofoil sections as high as 70 per cent of the lift being obtained on the upper surface of the wing.

The flying angle of incidence of a plane varies between a minimum and a maximum, where other conditions being equal horizontal flight may just be accomplished; between these angles, about midway, lies the optimum angle or that of greatest climb and efficiency.

When the maximum angle of incidence is exceeded in an aeroplane, the plane stalls. That is, the machine loses flying speed to the extent that it becomes uncontrollable and falls. It will continue to fall out of control until enough speed has been attained to make the control surface effective. Stalling is not the direct result of engine failure; a machine may be kept under control without the engine running by setting it at its gliding angle, giving a scope of six times the machine's height in the air in all directions to make an emergency landing.

One of the most important recent developments for aeroplanes is a device that hinges on the leading edge of the wings and prevents the machine from being lifted above its maximum flying angle, so that the machine must stay under control.

The useful component of lift is that which works against gravity and is known as the horizontal equivalent.

Stability

An aeroplane must have its lifting and control surfaces so arranged that in flight it has a measure of inherent stability; that is, it must tend to fly straight on an even keel without pitching. The extent of the stability designed into a machine depends upon the purpose of the machine. A large weight carrying plane would have a strong tendency to right itself while a small fighting machine must be balanced on a pin point.

For the purpose of discussing the factors governing stability, an aeroplane may be considered as turning about three axes each at right angles to the others and all running through the centre of gravity. The longitudinal axis is considered as being parallel to the axis of the airscrew. The lateral parallel to the general line of the wings and the normal axis is vertical when the machine is in flying position.

Combered aerofoils have no longitudinal stability, but when the angle of incidence is increased or decreased by a change in the direction of the airflow against them they tend to keep on increasing or decreasing the incidence angle.

This tendency on the part of the main planes of an aeroplane is offset by a smaller surface placed behind the main plane and known as the tail plane. The spars of the tail plane are parallel with those of the main planes but the tail plane has a different angle of incidence from the main planes.

All tail surfaces are affected by the slip stream of the airscrew, when the engine is on; the wash from the airscrew causes the air to flow by the tail surfaces with a greater velocity and in a different direction from that which it takes when the power is off. This makes the rudder and elevator control less sensitive in a glide than when under power.

Lateral stability is attained by five devices:—

(1) The wings are set at an angle to each other in such a way that the horizontal equivalent of the low wing is greater than that of the upper when the machine rolls. This practice is not altogether successful, as in order to get enough difference on the lift of the two wings considerable lift is sacrificed when the machine is level.

(2) The incidence of the planes is decreased toward the ends, resulting in more effective aileron control.

(3) The tendency of the airscrew to turn the machine in the opposite direction to the airscrew is offset by increasing the incidence on the wing that tends to fall.

(4) The keel surface is arranged so that it is divided about the longitudinal axis in such a way that a side gust will not tend to make the machine roll.

(5) The relation of the centre of gravity and the centre of lift must be such that neither a pendulum or a top heavy effect is obtained.

Stability about the normal axis is a matter of disposal of the keel surface. When an aeroplane is turned about the normal axis the keel surface is not large enough to keep the machine from side slipping outwards and this may alter the attitude of the wings so that there is not sufficient lift to sustain the machine. To overcome this outward side slip, a machine is tipped inward or banked so that the lift aids the keel surfaces and keeps the machine in equilibrium.

To obtain a stable machine both flying and gliding, the centre of thrust in an aeroplane should be placed below the centre of drag and the centre of gravity ahead of the centre of lift. These four forces form two couples that neutralize each other when the machine is in flight and when the thrust is removed by throttling the engine make the machine tend to assume a gliding position.

The control surfaces of an aeroplane are the ailerons, the elevators and the rudder; these, with the engine, are used in the manoeuvring of the machine.

The ailerons are flaps hinged to the trailing edge of the main planes, usually near their ends. They give control about the longitudinal axis of the aeroplane. As the ailerons on the right wings turn up, those on the left turn down, causing the plane to bank toward the upturned aileron.

The elevators are a pair of flaps hinged to the trailing edge of the tail plane. By changing the effective incidence of the tail plane the elevators cause the nose of the aeroplane to rise or fall.

Both ailerons and elevators are manipulated by a control column which has a universal joint at its lower end, allowing it free motion in all directions through a small angle. This control column is so arranged that the plane tends to follow its direction of movement.

The rudder is a plane hinged to turn on an axis at right angles to the tail plane. The rudder controls turns of the aeroplane about its normal axis. It is operated by the feet through a rudder bar pivotted at the centre and secured to the floor of the cockpit of the machine.

THE

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VOLUME XI DECEMBER 1928 No. 12

Proposed Amendments to By-laws

In accordance with Sections 74 and 75 of the By-laws, the following amendments, proposed by Council, are presented for consideration by corporate members of The Institute, and will be discussed at the Annual General Meeting:—

Section 8 (Waiving of Examinations for the Class of Associate Member)

It is proposed to amend the last sentence of the second paragraph of Section 8 as follows:—

As at present " 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."

Amend to read " Any or all of these examinations may be waived at the discretion of the council if the candidate is forty-five years of age or over, and has held a position of professional responsibility for ten or more years."

Sections 27 and 28 (Consideration of Applications for Admission or for Transfer)

In accordance with the recommendations of the Committee appointed by Council to study and report on the question of changing the present method of dealing with applications for admission or for transfer, it is proposed to amend Sections 27 and 28 to read as follows:—

Section 27. " Immediately upon receipt of an application the secretary shall forward a copy thereof to the secretary of the branch, if any, to which the applicant belongs. The executive committee of the branch shall thereupon make such inquiries concerning the applicant as it deems to be advisable, and shall recommend to the council the action that it considers should be taken with reference to the application.

" At stated periods to be determined by the council there shall be issued to corporate members whose addresses are known a list of new applicants for admission or for transfer, containing a concise statement of the record of each applicant and the names of his references, with a request that members transmit to the secretary any information in their possession which may affect the classification or eligibility of the applicant.

" The secretary shall also forward to each member of council a concise statement of the record of each applicant and the names of his references on a form on which space shall be provided for each councillor to make his recommendation regarding the applicant. The forms shall be mailed to councillors at least thirty days before the applications referred to are dealt with by council. Each form must be signed by the councillor returning it, but it is not necessary that he should express a recommendation regarding all or any of the applicants."

Section 28. " The council shall consider all the information with reference to each application, making further inquiries if deemed expedient, and shall then decide whether the application shall be accepted, and if so, to what class of membership the applicant shall be admitted. Before reaching this decision, however, not less than twenty-five of the forms referred to in Section 27 must have been returned to the secretary, and the recommendations contained in these forms must be placed before council. If five or more members of council oppose the admission or transfer of an applicant he shall not be elected, otherwise a majority of three-quarters, or more, of those present at a council meeting shall determine the classification of the applicant, with or without examination, and thereby constitute his election, subject to examination if so required.

" A rejected candidate shall be notified promptly that his application has not been accepted, and he may renew his application for admission or transfer at any time after the expiration of one year from the date of his notification.

" Application for membership in the class of Student shall be passed upon by council without the formality of notification to all councillors."

Section 29 (Notification of Election)

It is proposed to amend this Section by substituting the word " election " for " admission " in lines one and three, the section then reading as follows:—

Section 29. " On the election of a candidate, he shall be notified by the secretary and he shall then be entitled to the privileges of membership. Membership shall date from the date of election."

SECTION 34 (SCHEDULES OF FEES)

In accordance with a resolution passed at the Plenary Meeting of Council, it is proposed to increase the annual fees payable by Members by $3.00, Associate Members by $2.00, and Juniors by $1.00, the amended Section 34 to read as follows:—

Section 34. "The annual fees payable by Montreal Branch residents shall be as follows:—

		If paid on or before March 31st.
Members	$17.00	$16.00
Associate Members	13.00	12.00
Juniors	8.00	7.00
Students	2.00	1.00
Affiliates	11.00	10.00

"The annual fees payable by all other branch residents shall be as follows:—

Members	$14.00	$13.00
Associate Members	11.00	10.00
Juniors	6.00	5.00
Students	2.00	1.00
Affiliates	11.00	10.00

"The annual fees payable by branch non-residents and non-residents shall be as follows:—

Members	$12.00	$11.00
Associate Members	9.00	8.00
Juniors	5.00	4.00
Students	2.00	1.00
Affiliates	11.00	10.00

"Honorary Members shall be exempt from annual fees.

"In accordance with the above schedules, if paid on or before March 31st of the current year, a deduction of one dollar will be allowed on the annual fees of all grades."

SECTION 73 (JOURNAL OF THE INSTITUTE)

In order to give effect to Council's decision to make The Journal subscription optional to Students it is proposed to amend Section 73 to read as follows:—

Section 73. "The annual subscription for The Journal of The Institute for members of The Institute shall be two dollars, and shall be paid by members of all classes, with the following exceptions:—Honorary Members, Life Members, and members who have compounded their fees, who shall receive The Journal gratis, and Students who shall have the option of subscribing to The Journal at the above rate. The annual subscription to The Journal for non-members of The Institute shall be three dollars. All subscriptions shall be payable on the first day of January in each year."

Meeting of Council

A meeting of Council was held at eight o'clock p.m. on Friday, November 16th, 1928, with President Julian C. Smith in the Chair, and nine other members of Council present.

The minutes of the meeting held on October 15th, 16th and 17th, 1928, were approved with two amendments.

The financial statement of The Institute for the period ending October 31st, 1928, was submitted and approved.

The attention of Council was drawn to the importance of the World Engineering Congress which is to be held in Tokyo in October 1929, and to the fact that the leading engineering societies of the world are taking measures to be represented at this Congress. A small committee was appointed to consider a desirable course to be adopted by The Institute in this connection.

A progress report was presented by the Publicity Committee suggesting that the matter of publicity be brought particularly to the attention of the Branches, and that the Branches be requested to submit suggestions.

Arrangements were made for a delegate to represent The Institute at the inauguration of the new President of the Stevens Institute of Technology, Hoboken, N.J.

Discussion followed as to the amendments to the By-laws which are to be proposed by Council for the consideration of the membership at the Annual Meeting. Proposals to amend Sections 8, 27, 28, 29, 34 and 73 were approved for this purpose. These are printed elsewhere in this issue.

One resignation was accepted and three special cases were dealt with.

The following elections and transfers were effected:—

Elections		Transfers	
Associate Members	8	Assoc. Member to Member	3
Juniors	4	Junior to Assoc. Member	3
Students Admitted	158	Student to Assoc. Member	4
		Student to Junior	15

Twenty-two applications for admission and transfer were scrutinized and classified for the ballot returnable December 18th, 1928.

The Council rose at eleven-thirty p.m.

THE ANNUAL GENERAL AND GENERAL PROFESSIONAL MEETING

HAMILTON, Ont.

WEDNESDAY, THURSDAY AND FRIDAY, FEBRUARY 13th, 14th and 15th, 1929

PRELIMINARY PROGRAMME ANNOUNCEMENT

WEDNESDAY, FEBRUARY 13TH:
- 9:00 a.m.—Registration.
- 10:00 a.m.—Annual General Meeting.
- 1:00 p.m.—Luncheon.
- 2:30 p.m.—Annual General Meeting Continued.
- 4:30 p.m.—Ladies' Tea.
- 8:00 p.m.—Illustrated Lecture and Smoking Concert.

THURSDAY, FEBRUARY 14TH:
- 9:30 a.m.—Technical Sessions.
- 1:00 p.m.—Informal Luncheon.
- 2:30 p.m.—Visits to Engineering Works.
- 8:45 p.m.—Reception and Supper-Dance.

FRIDAY, FEBRUARY 15TH:
- 9:30 a.m.—Technical Sessions.
- 2:30 p.m.—Technical Sessions.
- 7:30 p.m.—Annual Dinner of The Institute.

PRELIMINARY LADIES' PROGRAMME ANNOUNCEMENT

WEDNESDAY, FEBRUARY 13TH:
- 9:00 a.m.—Registration.
- 1:00 p.m.—Luncheon.
- 4:30 p.m.—Tea.
- 8:00 p.m.—Illustrated Lecture.

THURSDAY, FEBRUARY 14TH:
- 1:00 p.m.—Informal Luncheon.
- 8:45 p.m.—Reception and Supper-Dance.

FRIDAY, FEBRUARY 15TH:
- 7:30 p.m.—Ladies' Dinner.

OBITUARIES

John Frederick Flint Cahan, M.E.I.C.

It is with deep regret that we record the death of Captain the Hon. J. F. Cahan, M.E.I.C., assistant minister of highways in the Nova Scotia government, and son of C. H. Cahan, K.C., M.P., for St. Lawrence-St. George ward, Montreal, which occurred at Halifax, N.S., on November 8th, 1928, from complications arising out of spinal injuries received during the war.

The Hon. J. F. Cahan was born at Halifax, N.S., in 1889, and after receiving his early education at the high school of that city he entered Dalhousie University, from which he received his degree of Bachelor of Engineering. Subsequent to completing a post-graduate course in engineering at McGill University, in 1910 he was appointed resident engineer of the building of the University of Saskatchewan, which post he occupied until 1912. In 1912 he was superintendent and construction engineer for the Western Canada Power Company, Ltd., engaged on pumping installation, construction of dams and extension of the company's power house. In 1915 he enlisted for overseas service as lieutenant in the first Canadian Pioneer Battalion and was promoted to the rank of captain. At Courcellette, in 1916, Captain Cahan received severe wounds, as a result of which he was confined to the hospital for several years. Like his father, Captain Cahan was a Conservative in politics. He was elected to the Legislative Assembly of Nova Scotia on June 25th, 1925, becoming a member of the Executive Council without portfolio in the Rhodes Cabinet. He served under the Hon. Percy Black, Minister of Highways. Captain Cahan joined The Institute as an Associate Member in 1914.

An Appreciation

by

The Hon. Percy C. Black

Minister of Highways, Province of Nova Scotia

The Honourable John F. Cahan was born in Halifax thirty-nine years ago. Here he spent his boyhood and attended Dalhousie University. From there he proceeded to McGill University where he continued his study of engineering. After his graduation as an engineer, he became interested in engineering development in western Canada. It was by reason of the practical experience and training he there received that he was so eminently qualified to take the positions he held in the Highways Department and the Power Commission of Nova Scotia since 1925.

When the Great War broke out in 1914 Captain Cahan was amongst the very first Canadians to enlist. For he belonged to that noble company of mankind whose ears are attuned to the high call of service and his response was as immediate as it was eager. In a memorial address to our Soldier Dead, delivered by him at Yarmouth in 1923, he said:—

> "Of what like were these men whose names we find written here? They were youths standing on the threshold of opportunity, with the whole enticing panorama of life spread before their eager eyes. And what an enchanting vista life presents to youth! But for these men this was but a vision of desire which was ever to remain unfulfilled. Harshly insistent struck the note of war, and by a deep stirring within, each one knew that the call would be for him. And so they donned the irksome equipment of war, gave up their personal liberty that we might be free, and with but 'one longing, lingering look behind' bade goodbye to all that they held most dear, and turned their faces to the unknown. Then they endured all things bravely; the terrible hardships of war, things heard that man should not hear, things seen that human eye should not look upon; and at last drank the bitter cup to its very dregs. Think of it, the splendid unutterable pity of it! and let no heart be too worldly to be touched, nor any eye too proud to shed a tear."

JOHN FREDERICK FLINT CAHAN, M.E.I.C.

It was at the battle of Courcellette in 1916 that Captain Cahan received a terrible wound which inflicted an irreparable injury to his spine. The wound caused intense suffering which he bore unflinchingly for six long years, displaying during that period of pain a patience and even a cheerfulness that demonstrated the splendid fibre of the man. An intimate friend of the family writes:—"Three times he was practically given up for dead, but that same valiant spirit which was planted deep in his breast made him fight on and he came back as it seemed by sheer force of a determination to live and get well."

In 1922 a surgical operation brought some measure of relief from pain. His anguish was assuaged to the point where he could once more make use of his mental powers. He turned his mind to public life as he saw there an opportunity to put his fine mental gifts to excellent service. He welcomed the nomination of Yarmouth county in 1925, and on being elected he joined the government of Nova Scotia and thus became my colleague in the Department of Highways.

In his address at Yarmouth from which I have already quoted, Captain Cahan said:—

"He who would say 'I love my country' must be willing to die for it, knowing that life without liberty is a curse. But also he must be willing to live for it, and to him whatsoever affects its welfare must be of paramount interest and concern. The village, the town, the province are the nuclei of the nation, and he who has added one iota to their betterment is in very truth a patriot, and has been of service to the commonwealth at large. All men cannot be great, but every man can be a patriot. Each one must see that nothing in the communal life of the village is neglected, that education is fostered in every way, that civic affairs are never viewed with indifference, and that no one is chosen for public office, whether municipal, provincial or federal, whose chiefest concern is not the public good."

Now, after close association with John F. Cahan over a period of more than three years, I wish to testify that every official word spoken and official action taken by him were directed by a single aim—the public good. Nothing else mattered. His devotion to duty, which flamed out in him at the commencement of the war, continued to burn just as brightly when he volunteered for peace-time service in 1925. I never saw a man throw himself more wholeheartedly into his work. It became almost a passion with him. His trained mind readily grasped the essential details of his office. Having mastered these he grappled with the various problems and difficulties that always confront responsible heads of government departments, and his acute discernment and sound judgment proved to be well-nigh invaluable assets.

Now we who were closely associated with this man had two main reasons for satisfaction. One was that Nova Scotia had obtained so fine a type of public servant; the other that his work was re-acting so favorably on himself. His health improved as his interest grew. Soon it absorbed him to the point where for hours at a time he could forget his physical ills and the irksomeness of a wheel chair. At length it was apparent to us that Cahan lived in and for his work. It meant vastly more to him than just a means of livelihood. It was his life.

That was the situation with him when with high spirits he entered upon the political campaign of last September, satisfied that he had put his utmost effort into the advancement of his county and his province. He fought with amazing vigour and those of us who realized his circumstances hoped with all our hearts for his success. He did not complain at the result. His indomitable will, too strong for his broken body, held to the fixed purpose of again serving his county. We who knew and loved and honoured him find it difficult to understand the viewpoint of those who were primarily responsible for his tragic defeat. He, on the other hand, realized with clear vision that in the public service, as on the field of battle, the real reward comes not in personal advancement but in the realization of duty well done.

Let us keep steadfastly in mind that it is to men like the late Captain J. F. Cahan that we owe the freedom we now enjoy. He leaves behind him a record of unswerving devotion to his country at whose feet he laid his youth, his health, his talents and his life. It is our high privilege in so far as in us lies to emulate the example of this great Nova Scotian. In his own words:—

"This freedom to which you have fallen heir has been obtained at a great price; the price of unselfish devotion and self-sacrifice, and if you in your turn would hand it on, it demands the same from you."

Edward V. Johnson, M.E.I.C.

Members of The Institute will learn with regret of the death of one of The Institute's earliest members, Edward V. Johnson, M.E.I.C., which occurred at his home in Ottawa on October 5th, 1928.

Mr. Johnson was born at Fredericton, N.B., on October 7th, 1845, and was a son of the late James Johnson, commissioner of customs. He received his education at Fredericton, N.B., and at a college in the United States. His first engineering work was as chainman with the Intercolonial Railway, with which he became connected in May of 1869. Two years later he joined the engineering staff of the Canadian Pacific Railway as assistant leveller, and in 1872 was transferred to the company's head office, where he was

EDWARD V. JOHNSON, M.E.I.C.

placed in charge of the draughting office. Shortly after this he was appointed to the staff of the Department of Railways and Canals at Ottawa, where he was again in charge of the draughting office. In 1900 he was promoted to the position of assistant inspecting engineer, and two years later he became inspecting engineer.

On retiring from the department in 1921 after over fifty years service, Mr. Johnson took up his residence in Oakville, Ont., but returned to Ottawa in 1926.

Mr. Johnson was present at the first organization meeting of the Canadian Society of Civil Engineers, and is entered on the membership roll of The Institute as having been admitted as a Member on February 24th, 1887. He was a member of Council during the years 1902 and 1907, and was made a Life Member of The Institute by Council on November 25th, 1924.

PERSONALS

George W. Fuller, M.E.I.C., consulting engineer, of the firm of Fuller and McClintock, New York City, was elected president of the American Public Health Association at the annual meeting of that association held recently in Chicago.

Wm. Smaill, M.E.I.C., chief engineer of the Northern Construction Company and J. W. Stewart, has assumed the direction of the work which his company is doing in connection with the construction of the Windsor-Detroit tunnel.

A. B. Cooper, M.E.I.C., general manager of Ferranti Electric, Ltd., has just returned from a trip to the west coast. As a vice-president of the American Institute of Electrical Engineers, Mr. Cooper was the guest of the Regina and Vancouver sections of that institute.

D. H. McDonald, A.M.E.I.C., engineer in the Department of Public Works, Canada, Halifax, N.S., has been granted leave of absence for six months to take charge of the construction of a highway on the Island of Montserrat, British West Indies.

A. R. Greig, M.E.I.C., professor of mechanical engineering at the University of Saskatchewan, was reappointed as representative for the senate of the University at the meeting of the Saskatchewan Association of Architects which was held at Saskatoon, Sask., on October 29th last.

A. M. Moon, S.E.I.C., who graduated from the University of Toronto in 1924 with the degree of B.A.Sc., is now connected with the Vocational School, Peterborough, Ont. Mr. Moon was formerly at the Technical School, Niagara Falls, Ont.

J. G. Schaeffer, A.M.E.I.C., formerly a member of the city engineer's staff of Regina, Sask., has been appointed resident engineer for Underwood and McLellan, in connection with the new townsite of Flin Flon, Man. Mr. Schaeffer graduated from Queen's University in 1923, with the degree of B.Sc., and has been connected with the city engineer's department at Regina since that time.

W. L. Dawson, A.M.E.I.C., has severed his connection with the Northern Electric Company, Ltd., Montreal, and has accepted a position as patent attorney with the Bell Telephone Laboratories, Inc., New York City. Mr. Dawson, who is a graduate of Queen's University of the year 1913, has been with the Northern Electric Company since 1919, occupying in turn the positions of telephone switchboard engineer, research engineer and communication engineer. He was on active service overseas from 1915 to 1919, having the rank of Major, and being wounded in July 1916.

G. A. Gaherty, A.M.E.I.C., formerly manager of the Calgary Power Company, has been made president of that organization, and will move his headquarters from Montreal to Calgary. Mr. Gaherty will, however, retain his post as chief engineer of the Montreal Engineering Company, the parent organization of the Calgary Power Company. Mr. Gaherty, it is understood, will also have an office at Regina, Sask., where he will act for the Royal Securities Company in connection with the acquisition of power franchises and construction of power transmission lines on the prairies.

A. G. Moore, S.E.I.C., who was formerly on the staff of the electrical department of the Asbestos Corporation of Canada, Thetford Mines, Que., has recently entered the employ of the Shawinigan Water and Power Company, Ltd., at Shawinigan Falls, Que. Mr. Moore, who graduated from the Nova Scotia Technical College in 1925 with the degree of B.Sc., was for a time located at Wilkinsburg, Pa., with the Westinghouse Electric and Manufacturing Company, on their students' test course, and was later attached to the engineering staff of the Bell Telephone Company of Canada, at Montreal, Que.

C. Oldrieve Thomas, A.M.E.I.C., a member of the staff of the Dominion Bridge Company, Montreal, has been granted patents on a metal-to-metal flexible shaft coupling without springs or back-lash. Since coming to America from the Old Country in 1904, Mr. Thomas has had extensive experience in structural steel and other engineering work, having been connected at various times with the Canadian Westinghouse Company, Ltd., the Algoma Steel Corporation, the Canada Car and Foundry Company, Fraser and Chalmers of Canada, the Montreal Light, Heat and Power Consolidated and Canadian Vickers Limited.

Burton M. Hill, M.E.I.C., has been appointed manager of the Maritime provinces for F. J. Fairhall and Associates, Limited, Investment Trust Bankers. Mr. Hill will make his headquarters at Saint John, N.B. He is a graduate of

BURTON M. HILL, M.E.I.C.

civil engineering of the University of New Brunswick, and has had twenty years of experience in construction and consulting, railway, highway and bridge engineering. He was formerly Minister of Public Works of the province of New Brunswick and is president of Lewis-Connor and Sons, and a director of Connor Bros., Black's Harbour, N.B.

H. W. R. Shepherd, A.M.E.I.C., formerly resident engineer with the Foundation Company on the construction of the Ghost river dam for the Calgary Power Company, is now connected with the Northwestern Power Company at Whitemouth, Man. Mr. Shepherd, who was formerly connected with the James Ruddick Construction Company in Quebec City, and at one time resident engineer for the highway department of the province of Alberta, was overseas with the Alberta Dragoons and the Second Battalion of Canadian Engineers from 1914 to 1919.

Horace L. Seymour, M.E.I.C., who for the past two years has been resident engineer for the Town Planning Commission of Vancouver, B.C., has been appointed as director of town planning for the province of Alberta, and will undertake his new duties on January 1st, 1929. A provincial town planning board has been appointed in Alberta, and Mr. Seymour will be the engineering executive official of this board. Mr. Seymour, who obtained the degree of B.A.Sc. from the University of Toronto in 1913, was at one time special lecturer in town planning in the Department of Civil Engineering at that university, and prior to leaving for Vancouver, was engaged in consulting work in Toronto.

W. H. Riehl, A.M.E.I.C., City Engineer of Stratford, Ont.

W. H. Riehl, A.M.E.I.C., was recently appointed city engineer of Stratford, Ont. Following his graduation from the University of Toronto in 1920, with the degree of B.A.Sc., Mr. Riehl was for several months connected with the Grand Trunk Railway, but in October 1920 he became assistant engineer of the city of Stratford, where he remained until 1925 when he was appointed engineer of the town of Brampton, Ont., which post he has held up to the present time.

F. W. Gray, M.E.I.C., Receives Appointment

F. W. Gray, M.E.I.C., has been appointed assistant general manager of the Dominion Coal and Dominion Iron and Steel Companies. From the time of his arrival in this country from England, in 1904, until 1918, Mr. Gray was connected with the Dominion Coal Company, acting as assistant to various general managers, later becoming assistant to the president of the Nova Scotia Steel and Coal Company. From 1919 to 1921 he was editor of the Canadian Mining Journal and Iron and Steel of Canada, and in 1921 he became assistant to the vice-president of the British Empire Steel Corporation. From 1923 to the present time Mr. Gray has been assistant to the president of the British Empire Steel Corporation.

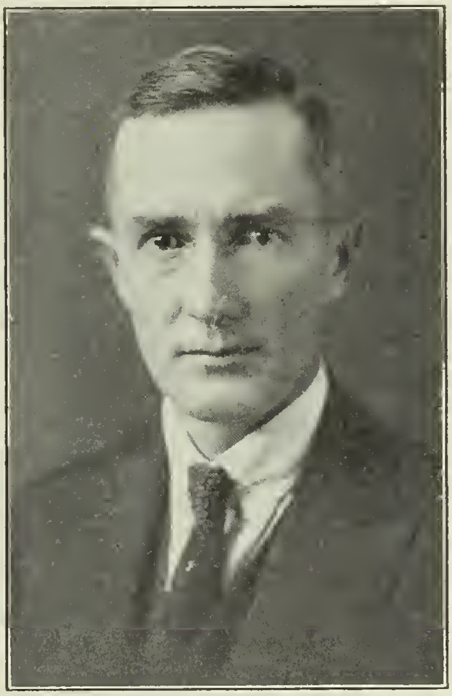
F. W. GRAY, M.E.I.C.

Appointed Chief Engineer of Dryden Paper Company

Selwyn H. Wilson, A.M.E.I.C., is now chief engineer of the Dryden Paper Company, Ltd., at Dryden, Ont. Mr. Wilson, who was overseas with the Canadian Engineers and Artillery from 1915-19, is a graduate of McGill University of the year 1922. On graduation he was employed by the Department of Railways and Canals at Cornwall, Ont., with a precise levelling party, and in December 1922 became attached to the Riordon Pulp Corporation at Temiskaming, Que., on draughting and designing work. From 1923 to 1925 he was assistant to the chief forester of the St. Maurice Pulp and Paper Company, Ltd., at Montreal, following which he joined the staff of the Riordon Pulp Corporation, Ltd., at Hawkesbury, Ont., as maintenance engineer, later becoming assistant to the chief engineer, and in 1927 he accepted the position of mechanical engineer with the Canadian International Paper Company at Hawkesbury.

A. Ross Robertson, A.M.E.I.C., Appointed to Dominion Bridge Company

A. Ross Robertson, A.M.E.I.C., has been appointed manager of the Ontario division of the Dominion Bridge Company. Following his graduation from the University of Toronto in 1909 with the degree of B.A.Sc., Mr. Robertson joined the engineering staff of the old Canada Foundry Company, Ltd., later taken over by the Canadian Allis-Chalmers, Ltd. In 1912 he became sales engineer for Messrs. McGregor and McIntyre, Ltd., Toronto, with which firm he has been connected up to the present time with the exception of the period 1915-1919, when he was overseas with the Canadian Expeditionary Force, having the rank of lieutenant and later captain. When the company was reorganized last March, and the name changed to McGregor-McIntyre Structural Steel, Ltd., he was appointed vice-president, following the retirement of J. H. McGregor, and R. L. McIntyre assumed the presidency.



A. G. TAPLEY, A.M.E.I.C.

Chief Engineer of Halifax Harbour Commission

A. G. Tapley, A.M.E.I.C., assistant engineer in the Department of Public Works, Canada, at Halifax, N.S., has been appointed chief engineer of the Halifax Harbour Commission. Mr. Tapley will have charge of all the engineering work recommended by the commission in connection with harbour construction and maintenance. His 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 he again became connected with the Intercolonial Railway. From 1909 until the present time he has been with the Department of Public Works of Canada as assistant engineer, having previously been located in Saint John, N.B. It will be recalled that Mr. Tapley was awarded the Gzowski Medal for his paper entitled "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, having served on the executive of the Saint John Branch in 1921, and as chairman of the branch in 1922.

ELECTIONS AND TRANSFERS

At the meeting of Council held on November 16th, 1928, the following elections and transfers were effected:—

Associate Members

ANDERSON, Charles, mech'l and struct'l dftsman., Hamilton Bridge Co., Ltd., Hamilton, Ont.

FULTON, Edward Arthur, B.Sc., (C.E.), (Univ. of Man.), res. engr. on constrn. of waterworks plant for City of Kingsport, Tenn.

FORD-SMITH, Percy, gen. mgr. and president, Ford-Smith Machine Co., Ltd., Hamilton, Ont.

McFADYEN, Andrew James, B.A.Sc., (Univ. of Toronto), 59 Alloway avenue, Winnipeg, Man.

McGEE, Thomas Aloysius, M.E., (Polytech. Inst. of Brooklyn), res. engr. of Furnace Engineering Co. of Canada, and vice-president and chief engr., F. W. Pennock & Co., Montreal, Que.

MIESCHER, William Albert, C.E., (Polytech. Inst., Zurich), asst. engr., Alcoa Power Co., Ltd., Arvida, Que.

PARKER, John Spence, B.A.Sc., (Univ. of Toronto), gen. mgr., The Gatineau Electric Light Co., Ltd., Ottawa, Ont.

ROBSON, William Gordon, B.Sc., (E.E.), (Univ. of Man.), sales engr., Otis-Fensom Elevator Co., Ltd., Hamilton, Ont.

Juniors

ADLINGTON, Wilfred Ernest, B.Sc., (Mass. Inst. Tech.), with J. T. Donald & Co., Ltd., Montreal, Que.

GELDARD, Percy Walter, (completed third year, Applied Science, Univ. of Toronto), 93 Boon avenue, Toronto, Ont.

GRUNSTEN, Arne William, B.A.Sc., (Univ. of Toronto), struct'l designing engr., H.E.P.C. of Ontario, Toronto, Ont.

WRIGHT, Noel Mithsdale, B.Sc., (Univ. of Illinois), sales engr., Ferranti Electric, Ltd., Montreal, Que.

Transferred from the class of Associate Member to that of Member

STAIRS, Gordon Salter, B.Sc., (N.S. Tech. Coll.), sales mgr. and engr., L. E. Shaw, Ltd., Avonport, N.S.

SWAN, Hamilton Lindsay, asst. engr. i/c Yale District, Dept. Public Works, B.C., Merritt, B.C.

WEBB, Christopher Everest, B.A.Sc., (Univ. of Toronto), district chief engr., Dominion Water Power & Reclamation Service, Vancouver, B.C.

Transferred from the class of Junior to that of Associate Member

GAUTHIER, Paul Gillies, B.Sc., (McGill Univ.), Alcoa Power Co., Ltd., Kenogami, Que.

ROSE, Hugh Grant, B.A.Sc., (Univ. of Toronto), field engr., Ensley Works, Tennessee Coal, Iron & Railroad Co., Birmingham, Ala.

WILLIAMS, Arthur Samuel, B.Sc., (Univ. of Man.), chief operator, Manitoba Power Co., Ltd., Great Falls gen. station, Great Falls, Man.

Transferred from the class of Student to that of Associate Member

LAWTON, Frederic Lewis, B.A.Sc., (Univ. of Toronto), asst. to supt. of operation, Duke-Price Power Co., Isle Maligne, Que.

LAYNE, John Graham, B.Sc., (McGill Univ.), plant investigation work for J. T. Donald & Co., Ltd., Montreal, Que.

MacKENZIE, Donald Gordon, B.Sc., (McGill Univ.), consultg. and contracting engr., Montreal, Que.

WELSH, Dean Thomas, B.A.Sc., (Univ. of Toronto), res. engr. i/c of constrn., Driftwood-Smooth Rock Falls Road, Dept. of Northern Development, Ontario Govt.

Transferred from the class of Student to that of Junior

BIELER, Jacques Louis, B.Sc., (McGill Univ.), asst. engr., Dominion Oilcloth & Linoleum Co., Montreal, Que.

CREIGHTON, Thomas Whitelock, (Diploma, R.M.C.), transitman, Kenora Divn., C.P.R., Kenora, Ont.

EMERSON, Theodore Roosevelt, B.A.Sc., (Univ. of Toronto), instr'man, terminal engr.'s office, C.N.R., Toronto, Ont.

GRINDLEY, Frank Llewellyn, B.Sc., (Univ. of Alta.), res. engr. on constrn., C.N.R., western region, Edmonton, Alta.

HARBERT, Edward Thomas, B.Sc., (McGill Univ.), engr. to sales dept., Canadian Ingersoll-Rand Co., Ltd., Montreal, Que.

HARRIS, Arthur Clifford, B.Sc., (N.S. Tech. Coll.), struct'l bridge and machine detailing, Nova Scotia Steel & Eastern Car Co., New Glasgow, N.S.

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KURTZ, Harold John, B.Sc., (Queen's Univ.), dftsman., Tropical Oil Co., El Centro, Colombia, S.A.

McCORMACK, Donald Neill, B.Sc., (Univ. of N.B.), dftsman., Dexter P. Cooper, Inc., Welchpool, Campobello, N.B.

McGILLIS, Lester, B.Sc., (McGill Univ.), operating engr., Brazilian Hydro-Electric Co., Parahyba development, Rio de Janeiro, Brazil.

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ROBERTS, Frederic Morley, B.Sc., (Queen's Univ.), asst. to engr. on pulp and paper mill electrification, also cement mill electrification, General Electric Company, Schenectady, N.Y.

SMYE, Gordon Renfrew, B.A.Sc., (Univ. of Toronto), asst. to chief chemist, Firestone Tire & Rubber Co., Hamilton, Ont.

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VAN KOUGHNET, Edward Matthew, (Diploma, R.M.C.), estimates on transmission lines, design and const., hydrology, Canadian & General Finance Co., Ltd., Toronto, Ont.

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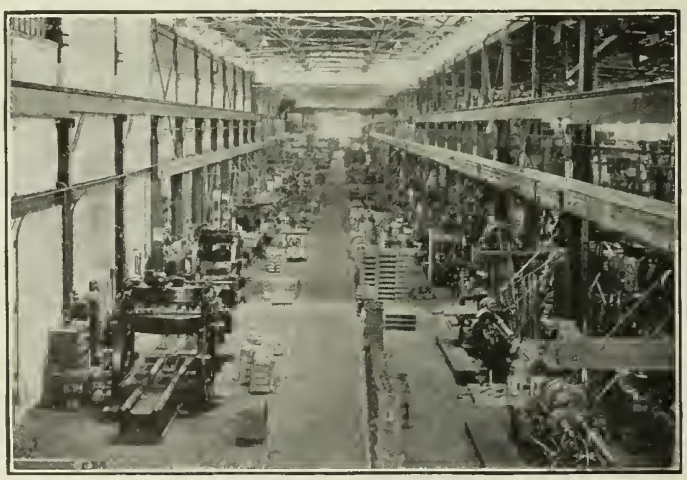
TAYLOR, John Boyd, (Queen's Univ.), Blythe, Ont.
THOMAS, James Leslie, (Queen's Univ.), 161 Alfred street, Kingston, Ont.
TIMM, Charles Ritchie, (McGill Univ.), 343 Lansdowne avenue, Westmount, Que.
TUCK, Joseph Howard, (Queen's Univ.), 249 Barrie street, Kingston, Ont.
UNSWORTH, Arthur, (Univ. of B.C.), 4696 3rd avenue west, Vancouver, B.C.
VROOMAN, Charles Ronald, (Univ. of Man.), 158 Mayfair avenue, Winnipeg, Man.
WALKER, Robert S., (Queen's Univ.), 161 Alfred street, Kingston, Ont.
WALKER, William Deans, (Queen's Univ.), Kingston, Ont.
YONG, Mark, (Queen's Univ.), 157 Princess street, Kingston, Ont.

The Annual General Professional Meeting

at HAMILTON, ONTARIO

February 13th, 14th & 15th, 1929



Machine Shop of One of the Manufacturing Plants to be Visited.

Plan now to be present

The following are some of the industrial plants which may be visited during the Annual Meeting in Hamilton.—

Hamilton Bridge Company, Limited
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Steam Plant of Dominion Power and Transmission Company, Limited
City Sewage & Water Works Pumping Station

Full details of the Programme will be published in the next issue of the Journal.

BOOK REVIEWS

Impurities in Metals, Their Influence on Structure and Properties

By Colin J. Smithells. Chapman and Hall, London, 1928. Buckram, 6 x 9½ in., 157 pp., figs., tables, plates, $4.50.

The author considers the influence of "impurities" or "minor constituents" on the structure and physical properties of metals and alloys. His method is fundamental and scientific. He begins by describing the structure of pure metals and alloys as revealed by the microscope and by X-ray analysis; he then shows the changes in structure that result from the presence of minor constituents, which may be small amounts of other metals, non-metallic solid elements such as sulphur and carbon, gases such as oxygen, hydrogen and nitrogen, slag and other non-metallic inclusions. In connection with the changes of structure, the author discusses the influence of these impurities on the mechanical properties, the electrical properties and the corrosion of metals and alloys.

The book is clearly written; it contains a large amount of valuable information regarding the effect of impurities, and this information is arranged to show the underlying principles instead of being a catalogue of unrelated facts. The book is well printed and illustrated, and it will be very useful to engineers and others who wish to make a thorough study of the influence of impurities on metals and alloys.

A. Stansfield, M.E.I.C.,
Professor of Metallurgy,
McGill University.

The Falls of Niagara

By Glenn C. Forrester. D. Van Nostrand Company, New York, 1928, buckram, 9 x 6 in., 155 pp., maps, plates, diagrs., $2.50.

Mr. Forrester in this compact volume of one hundred and fifty-five pages gives in a very readable form the story of Niagara falls. He does not claim to put forward any new facts, but he has gathered together from the scattered papers written by the many distinguished geologists who have made exhaustive studies of the region a great body of most interesting information, and he presents in the form of a continuous narrative, free from all confusing technicalities, the life history of the falls from their birth to the present day. The story thus unfolded is of striking interest, but the reader can from it form but little idea of the immense amount of detailed and painstaking research which had to be carried out before this simple narrative could be written.

The Niagara river flows out of lake Erie at Buffalo and into lake Ontario at Youngstown. As it leaves lake Erie it is about 600 feet above sea level, but where it enters lake Ontario it is somewhat less than 300 feet above the sea, so that during its course from one lake to the other it falls about 300 feet. This descent is made in a series of rapids and falls with one great vertical drop,—that at Niagara falls, which are 160 feet high.

The chief interest of Niagara falls from a scientific standpoint was concentrated in the fact that it was expected that they would prove to be a sort of geological time-clock,—one that would furnish, to a certain extent, a means of measuring geological time in terms of human years.

In the time immediately preceding the advent of man in North America the continent was covered by a great ice sheet, such as that which now spreads over Greenland. The thickness of this ice sheet is conservatively estimated at 3,000 feet. At that time the surface features of practically the whole northern portion of our continent were completely hidden beneath this great mantle of glacial ice. This period is known as the "glacial age."

In the glacial age the Niagara river was, of course, nonexistent. There came a time, however, when the intense cold commenced to ameliorate and the ice gradually melted away, commencing at the southern border where the climate was mildest. The ice sheet thus commenced to recede,—the water from the melting of this enormous mass of ice gathered itself together in a series of lakes and rivers and established a new drainage system on the land area which was thus laid bare. The waters of this system first discharged southward into the Ohio river. When, however, the ice receded as far as the shallow depression in which the Niagara river now runs out of lake Erie, the present Niagara river came into being and ran out of lake Erie into lake Ontario, larger then than at present and in its larger extension known as lake Iroquois, falling down into this lake over the Niagara escarpment at Lewiston. The river at once began to cut its way back through the plain, thus starting the Niagara gorge. This process it has continued from that remote period to the present time. During this period the river has cut its way back for a distance of seven miles. The International Niagara Control Board has found by very careful measurements that the average rate of recession of the falls at the active part of the crest of the Horseshoe has been 3.7 feet per year since 1842, when the first accurate survey of the crest of the falls was made. It might seem a mere matter of simple arithmetic to divide the distance of seven miles by the amount of the annual recession,—namely, 3.7 feet,—and thus ascertain the number of years which have elapsed since the great glacial ice sheet retreated from southern Ontario.

But this, like many other problems, is much less simple than it looks. The late Mr. G. K. Gilbert, after a careful study of the falls many years ago, stated that there were some twenty-three factors which affected the result and for which corrections would have to be made before the number of years which had been occupied by the recession could be determined. Thus it has been ascertained that the volume of water precipitated over the fall has varied greatly at different times, and thus the recession has been much more rapid at some times than at others. The river runs over strata that are not horizontal but are gently inclined upstream. Some of these strata are softer and therefore more quickly eroded than others. During the recession, the river has thus encountered a varying degree of resistance to its task. Again, when the river reached the locality where the whirlpool is situated it encountered the old filled up valley of a Niagara river, which in pre-glacial times had run across the country in a course which is transverse to that of the present river. The falls, when they reached the soft alluvial deposits in this old valley, cut through them very quickly, but how quickly cannot be determined. In the present state of our knowledge accurate corrections for these and for all the other factors which complicate the problem cannot be made, and hence the study of Niagara falls has not given, as was hoped at one time, an accurate measurement of the time which has elapsed since the close of the glacial age in southern Ontario, a problem which has, however, been more recently solved by attacking it from quite another direction.

This interesting subject cannot, however, be pursued further in this brief review; the reader must go to the book itself, where he will also find an interesting account of some of the geological agencies which have been at work in shaping the Niagara story, then an account of the great ice sheet and of the birth and development of the Great Lakes, which were incidents in its retreat; of the various companion falls which at first were associated with Niagara and which were gradually dispossessed by the latter and dried up by the lowering of the waters, and finally a discussion of the question of the future recession of the falls and what old age has in store for them.

F. D. Adams, Hon.M.E.I.C.,
Montreal, Que.

Distribution of Electricity by Overhead Lines

By William T. Taylor, Charles Griffin & Company, Ltd., London, 1928, buckram, 6 x 9½ in., 265 pp., tables, diagrs., illus., $6.50.

The author in his preface clearly states that it is "general overhead distribution practice" which is covered by this book. The book will be found to treat this subject in an interesting manner, and bears much internal evidence of an intimate acquaintance with the actual conditions met with in the operation of such systems. It discusses in a pleasant argumentative fashion the necessity of the design being carried out so as to give a convenient and safe system at a cost reasonably related to its earning power.

The author, it appears, is an enthusiastic advocate of the three-phase four-wire system and claims its superiority over all other systems for a very wide range of service. He advises its use for secondary distribution at lamp voltage, as well as for primary distribution at moderate voltage, and the inference is to be drawn that its field of usefulness extends to the extra high voltage networks, which are engaging much public attention in Britain owing to the projects of the Electricity Commission. In his preface the author speaks of this system as "a *novel* line distribution system." Its novelty may be apparent to the British reader not acquainted with practice on this side of the Atlantic, but it is quite generally employed for primary distribution in Canada; and in the United States its use for this purpose nearly equals that of all other systems combined.

The book contains chapters on the structural features, design and installation of wood pole lines, and also on the operation and maintenance of such lines. The seeker after information on these matters will find here a far more complete and authoritative treatment of this part of the problem than is usually found in books of this comprehensive type.

E. G. Burr, A.M.E.I.C.,
Assistant Professor of Electrical Engineering, McGill University.

Practical Designing in Reinforced Concrete

By M. T. Cantell, Part I. E. & F. N. Spon, Ltd., London, 1928, buckram, 6 x 9 in., 277 pp., illus., $3.75.

In the present book, which is the first volume of a two-volume work, the author presents an elementary discussion of reinforced concrete design and practice to suit more particularly those whose mathematical training has not been very extensive. While the author presents the work as a possible engineering college text book, it is scarcely so suitable for that purpose as numbers of other books that might be named. It is rather more a volume for a technical high school, as we know such in this country.

The book, which is not divided into chapters and therefore lacks somewhat in convenience, contains a large number of unnumbered articles on varieties of topics connected with concrete and reinforced concrete. At the outset there is a discussion of the properties of the materials involved, resistance to earthquake, hurricane and fire, mixing and depositing, removal of forms, deterioration of concrete, waterproofing and many allied subjects. There then follows a presentation of the elements of design of reinforced concrete beams, slabs, floors and columns. A small amount of space is given to the subject of concrete piles. The work concludes with a statement of the formulæ employed with demonstrations of their derivation.

While the volume is well printed, there are certain errors, typographical and otherwise, which no doubt will disappear in a second edition. For example, the reinforced concrete railway viaduct illustrated on page 243 is not located at Richmond, England, but at Richmond, Virginia. The illustrations are legible but lack the perfection of detail that characterizes the illustrations in technical books published on this continent.

C. R. Young, M.E.I.C.,
Professor of Structural Engineering, University of Toronto.

Reinforced Concrete Bridges

By W. L. Scott, assisted by C. W. J. Spicer, 2nd Edition. Crosby, Lockwood & Son, London, 1928, buckram, 6 x 9 in., 220 pp., tables, diagrs., plates, $6.25.

In this, the second, edition of a work published in 1925, the author has made some slight additions at the end of the volume, consisting of seven figures and an addendum to the Appendix the book has not been changed, with the possible exception of correcting typographical errors.

The work as it stands is a useful discussion of reinforced concrete bridge work. Chapters are devoted to loading and wind pressure, temperature and shrinkage effects, influence lines, arch bridges, girder bridges, bow-string girder bridges, temporary and permanent hinges, foundations and abutments, description of bridges and an appendix.

The book is a judicious blending of the mathematical and practical aspects of the design of the structures forming the subject matter. Illustrations are drawn entirely from European examples, and more especially from the particular works undertaken by the author's firm, Considère Constructions, Limited. It is regrettable that in a book which purports to deal with the general subject of reinforced concrete bridges, there is no mention of such epoch-making structures as the great arch at St. Pierre du Vauvray and the still more remarkable three-arch bridge at Plougastel, not to mention the Cappelen memorial bridge at Minneapolis.

While every engineer having to do with reinforced concrete bridges should possess a copy of this work, there is not sufficient difference between the second edition and the first to warrant the purchase of the later edition if the earlier one is available.

C. R. Young, M.E.I.C.,
Professor of Structural Engineering, University of Toronto.

Exemples de Calculs des Constructions en Béton Armé

Léon Cosyn, Librairie Polytechnique, Ch. Béranger, Paris et Liege, 1928. Buckram, 6 x 8½ in., 454 pp., diagrs., $2.60.

The author, who is well-known in France and Belgium as principal architect of the Belgian state railways, has compiled a handbook covering the designing and detailing of reinforced concrete structures. Particular attention is given to the various members making up the framework of multistorey buildings.

Retaining walls, bridges, hydraulic structures and bins are also treated in a general way.

The influence of framing arrangements upon the cost of the finished structure is stressed, and several chapters are devoted to the development of the economical design of floor panels. Although the relative costs of materials and labour are different in this country, the methods of analysis presented should be valuable to engineers engaged upon commercial designing anywhere.

The seven divisions of the book are as follows:—

- First Part:—Lay-out, design and cost of falsework and forms.
- Second Part and Third Part:—Tension and compression members.
- Fourth Part and Fifth Part:—Simple bending, bending and direct stress.
- Sixth Part:—Miscellaneous structures.
- Seventh Part:—Tables.

In part four, an exhaustive study is made of concrete foundations on piles. The rather involved action of stirrups in such members is clearly explained. Footings comprising from one to seven piles are treated by means of worked-out examples, where material will be found which is seldom available in current text-books.

The numerous examples given throughout the book are similarly worked out, and one is impressed with the attention given to the detailing of each reinforcing bar with reference to anchorage, bond stress, crushing of the concrete, etc. Such points, affecting the ultimate strength of structures, are often neglected or overlooked in some of the modern treatises.

J. F. Brett, M.E.I.C.,
Designing Engineer, Montreal Water Board.

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- The Institution of Mechanical Engineers: Proceedings, 1928.
- The Institution of Municipal & County Engineers: Handbook, 1928.
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Civil Engineering as Applied in Construction, L. F. Vernon-Harcourt.
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Published by Neo-Technic Research Corporation:
Engineers, 1928.

Correspondence

Zaria, Nigeria, October 28th, 1928.

The General Secretary,
The Engineering Institute of Canada,
Montreal, Que.

Dear Sir:—

I am sending you three photographs which may be of interest to railway construction men in Canada.

No. 1 shows part of the track-laying train, which consists of four wagons of rails, four of sleepers, one of fittings, one tank wagon, one wagon of telegraph material and one tool van.

No. 2 shows rails and sleepers being carried out from train—the rails are B.S. 60-lb., 33 feet long and the sleepers are South African pattern steel.

No. 3 shows rails being bolted to the sleepers. This is done with T-bolts and clips. The clips are two sizes to enable gauge to be widened on curves.

The Zaria-Gusau branch construction is 140 miles in length and taps an excellent cotton growing country. It runs from Zaria in a northwesterly direction to within a short distance of the French Sudan.

The labourers are Mohammedan and pagan natives and supervision is carried out by European engineers and foremen and native overseers and gangers.

With best wishes, I remain,

Faithfully,

R. D. Thexton, A.M.E.I.C.,
Engineer-in-charge,
Zaria-Gusau Construction.

Map of Southwestern British Columbia

A geological map of interest to the people of British Columbia has just been issued by the Geological Survey, Department of Mines, Canada. It is published on a scale of eight miles to one inch and covers an area in the southwestern part of the province of British Columbia extending from the coast, including Vancouver island, east as far as Lillooet and from the International boundary north to some distance beyond Chilko lake and Fitzhugh sound. The main geographical features are shown, the geology is indicated in colours, and the localities in which the most important economic mineral deposits have been found are shown by legible symbols.

Geological Maps of Northern Manitoba

Reprints of two geological maps of parts of northern Manitoba have been published. One is a map on a scale of three miles to one inch of the Athapapuskow lake region and covers a section of country extending from Amisk lake in Saskatchewan to Elbow lake in Manitoba, including the Flin Flon and Mandy mines. The other is a map on a scale of two miles to one inch of the Reed and Wekusko lakes region and covers a section of country extending from Reed lake east to some distance beyond Herb or Wekusko lake. Copies of these maps may be had on application to the director, Geological Survey, Ottawa.

A compact and yet comprehensive handbook on reinforced concrete building design has been issued by the Portland Cement Association under the title of "A Handbook of Reinforced Concrete Building Design." The tentative building regulations for reinforced concrete of the American Concrete Institute, appearing in the 1928 proceedings of that body, and Mr. Arthur R. Lord's paper on "Design and Cost Data for the 1928 Joint Standard Building Code," which was presented before the above-mentioned institute this year, have been reprinted to form this handbook. In presenting to the engineering profession the first edition of this publication, its sponsors have endeavoured to eliminate variables which limited the utility of former publications in this field. The handbook embodies tables and diagrams for the design of structural members of buildings in accordance with the provisions of the Joint Code, and the design practice which is presented offers a means of obtaining a degree of economy consistent with the quality of the concrete used. Copies of this handbook may be obtained from the Portland Cement Association, 33 West Grand avenue, Chicago, Ill., at a cost of $1.00 each.

The Canadian Ohio Brass Company, Limited, Niagara Falls, Canada, has just published a sixteen-page booklet with complete descriptions and illustrations of the new 250- and 600-volt lightweight portable electric arc welding machines for use on mine track circuit bonding and general repair work. The principle of unit construction of the resistance elements in these machines is fully described. Besides ordering information, brief illustrated reference is made to the various types of rail bonds manufactured by that company. Copies of the welder booklet will be furnished upon request.

Canada Gypsum and Alabastine, Limited, have issued a new booklet on Gypsum Partition Tile and its many uses in modern construction. It is believed that this booklet, which has been designed to serve as a reliable and handy reference on the subject, will fill a long-felt want, on the part of architects and engineers of to-day, for a comprehensive study of the many phases of gypsum tile construction. Copies of this booklet may be obtained upon request from the head office of Canada Gypsum and Alabastine, Limited, at Paris, Ontario.

Railway Construction Work in Nigeria.

BRANCH NEWS

Border Cities Branch

Orville Rolfson, A.M.E.I.C., Secretary-Treasurer.
R. C. Leslie, Jr.E.I.C., Branch News Editor.

The speakers of the evening at the October meeting of the Border Cities Branch were O. E. Fleming, K.C., president of the Canadian Deep Waterways Association, and Mr. E. G. Odette, member of parliament for East Essex.

The St. Lawrence River Development

Mr. Fleming was the first speaker. He traced the development of the St. Lawrence canal systems from the earliest times, pointing out how inevitable further development was. The Canadian Deep Waterways Association is engaged in the business of assisting the government in its study of the St. Lawrence question, by collecting relative information and by broadcasting the same to the public.

Mr. Fleming set forth the main points which are raised in objection to Canadian participation in an international project for the improvement of the St. Lawrence. One of the objections is that because the city of Chicago is diverting water from the Great Lakes system we should not make any move toward mutual canalization. The answer to this is that because of an agreement entered into in 1909 by the International Joint Commission we granted the right to withdraw a certain amount of water. However, the amount has been greatly exceeded and has been the subject of litigation in the United States Supreme Court, and Chicago has been ordered to cease the excessive diversion. Because of sanitary considerations it is impossible to stop it at once without serious consequences, and therefore a gradual scaling down of requirements is in progress. The War Department receives a report at the end of each year on the steps taken to treat the Chicago sewage. To date the city has lived up to the schedule, and it is confidently expected that even before the St. Lawrence canal system is begun the excessive diversion at Chicago will be stopped.

A second objection raised is that there should be no foreign capital, that is, foreign government capital, invested in Canadian waterways, as would be the case if the recommendation of the Canadian National Advisory Committee were followed. The committee has recommended that the purely Canadian section of the river be developed by Canadian money and the international section by the United States. The objection to this is overruled by the two precedents which we have for similar action. The Livingstone channel in the Detroit river and the St. Clair Flats canal were built and are maintained by the United States, and yet Canada has lost no police rights over her part of these waters.

Mr. Odette followed Mr. Fleming and gave some interesting thoughts on the subject. He showed that the provinces of British Columbia and Alberta were turning to Vancouver as an outlet for their products, while Manitoba was interested in the Hudson Bay route. The government, he thought, was generally in favour of the scheme, but could not, of course, proceed without feeling that public sentiment was strong for the work. Mr. Odette thought that the offer of the financiers to construct the canal should be accepted. In his opinion, whatever disadvantages there might be in granting such rights to a private corporation were more than offset by the industrial advancement which would follow quickly upon the building of the canal and which would benefit all concerned.

The Hydro-Electric Power Commission of Ontario

Dr. F. A. Gaby, M.E.I.C., chief engineer of the Hydro-Electric Power Commission of Ontario, was the speaker at the November meeting of this branch, held on Friday, November 9th, in the Prince Edward hotel, Windsor.

Dr. Gaby explained the structure of the Hydro organization and traced its growth from its inception in 1906 to its present standing as a great distributor of power. The system is a co-ordination of power developments serving some 550 municipalities in Ontario, 233 of which are rural townships. There are five main points of note about the system, as follows:—

1. The wholesale generation of electricity is under the Hydro-Electric Power Commission, a body appointed by the government and whose engineering staff is entirely free from political interference.
2. Distribution within the bounds of a municipality is taken care of by a local commission appointed by the electors of the town.
3. The commission is financed by a provincial government loan, paid back over a period of forty years.
4. Municipal commissions financed by municipal debentures or loans from the provincial commission.
5. The cost of supplying electricity is proportioned to the various units each year and the rates for the ensuing year set.

In 1912 the system served twelve municipalities, with a supply of 10,000 horse power and a total investment of $10,000,000. By the acquisition of the plants of the Ontario Power Company and the Electrical Development Company, the development at Queenston and a contract with the Gatineau Power Company for 260,000 horse power and other developments throughout Ontario, the available developed horse power has been increased until it now stands at about one million. Of this total, 870,000 horse power is in the Niagara system, the remainder being made up by the other seven systems operated by the Commission. The total investment in local systems is $97,000,000, in the provincial system $212,000,000, making a grand total of $309,000,000. The number of consumers of hydro-electricity in 1912 was 34,000, as against 526,000 users in 1928.

Dr. Gaby showed views of the transmission lines, the Niagara and Queenston power plants, the Chippawa canal and the huge switching station recently completed at Leaside. This switching station receives the power over the 230-mile transmission line from the Gatineau river at 220,000 volts and feeds it into the Niagara system, stepping the voltage down to 110,000 in the process. A reel of moving pictures was shown illustrating the type of country through which the Gatineau-Toronto line was built, the methods of transporting steel to the site, sometimes as much as twenty miles from a railroad, and also the method of erecting the towers. The method used in locating this line was a great success. An airplane flew the length of the proposed line taking pictures of the country for a width of five miles. These pictures were then put together and the line plotted in the office. The line is so straight that in its whole length there are only two angles, both of which are less than four degrees.

The Detroit section of the American Society of Mechanical Engineers joined with us in this meeting, and the occasion was one of good-fellowship. A hearty invitation was extended to our members to attend the meetings of the A.S.M.E. in Detroit.

On Saturday afternoon, November 10th, the members of the branch visited the property of the Canadian Steel Corporation at Ojibway to see the first of the tubes for the Detroit-Windsor subway. These tubes are being built by the Canadian Bridge Company, of Walkerville.

Lethbridge Branch

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

The first meeting of the season under the auspices of the Lethbridge Branch was held in the Marquis hotel on Saturday evening, October 20th. Dinner was served at 6.30 p.m. when over forty members and visitors were present.

During the dinner the Rainbow orchestra contributed selections which were much appreciated. Mr. George Brown, A.M.E.I.C., gave a violin solo, assisted by Mrs. Brown at the piano. The popularity of these well-known artists was demonstrated by the repeated encores they received from those who were fortunate enough to hear them. The solos sung by Mr. William Stott were beautifully rendered, and those present extended their hearty thanks to the soloist, also to all those who so generously and unselfishly gave of their time and talent.

In introducing the speaker of the evening, Mr. J. D. Baker, who is plant superintendent of the Alberta Government Telephones, mention was made of the part Mr. Baker played in the development of telephone communication in Alberta, and particularly of the high class standard of service given by the department. Mr. Baker was associated in the early days of Alberta's development with the Bell Telephone Company, which was purchased by the provincial government and which has been successfully equipped, maintained and operated since. The popularity of the speaker among the members of his staff was stressed, and which is the envy of other operating companies.

Recent Development in Telephone Communication

Mr. Baker's subject, "Recent Development in Telephone Communication," was highly technical at times, but with the aid of lantern slides and the public address system which was operated by Mr. Mason, assistant transmission and equipment engineer, his hearers were able to follow in detail the problem of voice transmission. In part, the speaker drew attention to the wave structure of certain notes produced by various instruments, also by the voice. These wave structures were demonstrated by oscillograms. In comparing the values of power used, the speaker made reference to power men, calculating in terms of kilowatts, whereas telephone engineers had to contend with power values in micro-watts and milliamperes.

The elementary stages of sound wave production in front of a transmitter was illustrated, whereby varying electrical currents created by the carbon of the microphone flowed to the receiver at the other end of the circuit and there reproduced by the diaphragm to the original sound of the voice.

The introduction of repeating coils increased the economic value of physical lines, thereby creating extra circuits without the necessity of stringing additional wires.

Further development was made possible by the introduction of composite apparatus which further increased the number of derived circuits. By its use three telephone and four telegraph circuits were obtained over two pairs of line. Until the advent of the vacuum tube, telephone communication was retarded on account of the excessive high line attenuation. Long distance operation was not commercial over what is termed thirty standard cable miles. By the use of telephone repeaters, space, as far as telephone transmission is concerned, has been annihilated, speech being now possible throughout the entire globe. The carrier system, or wired wireless, is a further development in the art of communication. A carrier current circuit is a method of communication in which voice currents are modulated on a high frequency channel, and after amplification are transmitted over the physical toll line to the distant station, where the feeble currents arriving are again amplified, demodulated and directed into their respective circuits by means of electrical filters. The existing carrier operating between Calgary and Edmonton was the first installed in the British Empire and the fifth in existence. Lethbridge will become a carrier terminal point early in 1929. The use of this carrier will then make possible to transmit over two physical lines to Calgary; three regular telephone circuits; four telegraph, and two carrier telephone circuits.

Long distance lines are now used on large " hook-ups " in connection with radio broadcasting. A recent example of this was demonstrated on July 1st, 1927, when all the principal radio stations in Canada were connected with broadcast from Ottawa parliament buildings. The power level was maintained by use of one-way amplifiers distributed at strategic points along the circuit.

A further up-to-date service has been provided for the people of this province in the purchase of a public address system, by means of which large audiences may be addressed without effort on the part of the speaker. This apparatus was successfully used on the occasion of the recent visit to the province of His Royal Highness the Prince of Wales, when he spoke to a crowd of 10,000 people in Calgary.

The lecture was very much appreciated by the audience, and a hearty vote of thanks was accorded to Mr. Baker for the valuable information " broadcasted " to his hearers.

November Meeting

A well-attended meeting of the Lethbridge Branch assembled at the Marquis hotel on November 3rd, when the members met their old friend, J. T. Watson, A.M.E.I.C., who later in the evening gave them a splendid description of the steam plant of the East Kootenay Power Company, at Sentinel, Alberta.

During the dinner, the Rainbow Orchestra rendered delightful selections and helped in the community singing led by Mr. F. Teague, who also entertained with two well rendered vocal solos.

After the general business was concluded, Mr. Watson was accorded a welcome on his return to active participation in the affairs of the branch, and he then proceeded to explain the details of the stand-by plant, as given in the following paper.

The Steam Stand-by Plant of the East Kootenay Power Co.

The East Kootenay Power Company, Ltd., having their head office at Fernie, B.C., supplies power and light to the industries and towns from Kimberley, B.C., to Hillcrest, Alberta, the consumers including several of the large collieries of the Crow's Nest field. With rapid developments around Kimberley and the mining districts of the Crow's Nest pass, it became evident early in 1926 that additional power would be required to augment the supply from the company's two hydro-electric stations located at Aberfeldie, on the Bull river, and Elko, on the Elk river.

After careful consideration by the engineering department of the Power Corporation of Canada, Ltd., the holding company, it was decided to construct a steam plant as an auxiliary source of supply during periods of low water at the hydro-electric stations. The design and construction were carried out by the Power Corporation of Canada, Ltd., and ground broken for the construction camp in August 1926. The plant started operation in July 1927, slightly under one year from the commencement of the work.

The site chosen was at the eastern end of Crow's Nest lake, about one mile west of Sentinel flag station on the Crow's Nest branch of the Canadian Pacific Railway. This has proved to be an ideal location for a plant of this kind, having an ideal supply of clean cold water for condensers and boilers, convenient access to the above-mentioned railway for coal delivery, and the close proximity to the Crow's Nest pass steam coal fields, no doubt being deciding factors in the choosing of the site.

The building is of steel frame and brick construction and large enough for two 5,500 continuous maximum rating steam turbo generators, only one being at present installed, and served by an overhead crane of 20 tons capacity with electrically operated hoist. The turbine and alternator with direct connected exciter were built by C. A. Parsons and Company, Newearth-on-Tyne, England, the turbine being a single-cylinder reaction type exhausting into a surface condenser.

The ventilation of the alternator is known as the closed system, contained wholly within it and the foundation, the air being re-circulated through cooling units of the radiator type, provision being made through emergency air inlet and discharge doors for ventilation from outside should any accident happen to the closed system.

Auxiliaries such as circulating pump, service air and oil cooling and fire pumps are located in a pump pit to the east of the present unit and midway between this and the future unit. The pump room is below normal low water level in the lake, consequently the pumps are primed at all times.

The boiler room adjoins the turbine room and contains two Robb stay-bolt header, cross-drum water tube boilers rated at 665 h.p. each. Space is provided for a third boiler which is being installed at the present time.

The boilers are fired by powdered coal supplied by Simplex unit pulverizers of the impact type. This, the writer believes, is the first plant in the province of Alberta to use powdered coal and probably the only one west of Winnipeg. Experience gained during sixteen months at this station proved that this is an ideal system for burning high ash coal, providing the fusive point of the ash is not too low to cause slagging. Ratings up to 225 per cent could be maintained from coal having an ash content of 24 per cent and 10,800 B.t.u.

The necessary steam flow meters, recording and indicating thermometers, CO_2 meters, draught gauges and damper control are mounted on instrument boards located in the firing aisle and are necessary for the economical operation of the boiler plant.

All 6,600-volt breakers are installed in the basement of the turbine room; the transformer banks and high tension breakers being located outside, forming an outdoor substation. Here the voltage is stepped up from 6,600 to 66,000 volts and tied into the two-system transmission lines running from Kimberley to Hillcrest.

The operation of this plant has proved to be all the engineers responsible for its design anticipated, being efficiently reliable and well adapted for stand-by service. The powdered fuel equipment burners and furnaces are a very interesting feature of the installation. A large number of outside engineers interested in steam plant design have visited this plant since its installation, and invariably devote most of their attention and remarks to the fuel and furnace equipment.

The heat balance of the station is adequate, and provision has been made to take care of this important part of plant economy for any addition that may be necessary.

At the close of the paper, Mr. Watson was asked numerous questions, and the ready replies showed the speaker to be well versed in his subject. A hearty vote of thanks was accorded Mr. Watson for his good spirit in filling, at short notice, a breach occasioned by the absence of the speaker originally arranged for.

Moncton Branch

V. C. Blackett, A.M.E.I.C., Secretary-Treasurer.

An extremely lucid and comprehensive address on " Some Legal Aspects of Railway Engineering " was given before the branch by the Hon. Ivan C. Rand, regional counsel, Canadian

National Railways, Moncton, on the occasion of the first supper-meeting of the season, held in the Y.M.C.A. on October 25th. H. J. Crudge, A.M.E.I.C., chairman of the branch, presided. During the evening several very enjoyable vocal solos were rendered by Mr. Roy B. Metzler.

Some Legal Aspects of Railway Engineering

In his opening remarks, Mr. Rand confessed to a certain envy of the engineering profession. The lawyer is concerned solely with man-made regulations, which are constantly changing with the ever-changing social and economic standards of the people. The engineer, however, deals with, and is always striving to discover, the fixed and immutable physical laws of the universe, a fact which tends, more than anything else, towards intellectual honesty.

Railway law in Canada, and especially in the Maritime provinces, is very complicated. This is due in large measure to the varied character of the original ownership of the roads. In the case of government railways the ownership was vested in the Crown, and numerous immunities pertaining to Royalty were enjoyed by these lines. For example, previous to 1887, no government railway could be held responsible for loss of life or other accident due to negligence of its employees.

Referring to expropriation, the speaker said that, not withstanding the basic right of the individual to hold what is his own, the law gives the railways the somewhat arbitrary power to seize, at will, land required for their operation. The regulations under which this may be done are, however, very strict. The higher courts are always sympathetic to the rights of private ownership, and cases were cited where the finest legal technicalities were invoked to protect the individual from loss.

As a general rule, it is possible to collect land damages due to railway construction but not to railway operation. A continued trespass for more than twenty years raises the presumption that some legal right was granted in the beginning. This is known as prescriptive right. As an example, the presence of a railway embankment might cause the annual flooding of waste land. Should this continue without protest for twenty years, the owner, deciding later to cultivate the land, would have no legal recourse against the railway for any damage he might suffer by reason of the flooding.

The question of easements, or the effect which the expropriation of land may have on adjoining properties, was treated in detail by the speaker. In conclusion, an explanation was given of the relationship that exists between the railways and the public in the matter of highway crossings.

A hearty vote of thanks, moved by G. C. Torrens, A.M.E.I.C., and seconded by G. E. Smith, A.M.E.I.C., was tendered Mr. Rand by the chairman.

Montreal Branch

C. K. McLeod, A.M.E.I.C., Secretary-Treasurer.
Wm. McG. Gardner, A.M.E.I.C., Branch News Editor.

Anticosti Island Development

A romantic representation, illustrative of the marvellous possibilities that exist within our great Dominion, was ably described in two splendid papers on the "Anticosti Development," when on October 25th the branch was addressed by J. H. Valiquette, A.M.E.I.C., manager, Anticosti Corporation, and T. B. Fraser, S.E.I.C., resident engineer.

Opening with a narrative of the discovery and history of Anticosti, Mr. Valiquette proceeded to sketch the extent of its natural resources, referring especially to its wealth of timber.

In this respect the geological characteristics have favoured a dense growth amounting to possibly some 14,000,000 cords; a fine forest which the natural isolation of the island has saved from the ravages of fire.

Many interesting means have been developed for bringing out the cut and preparing it for shipment. These are fully presented elsewhere in this issue.

Fur, fish and game abound, the latter mainly deer, having increased to such an astounding extent during the past thirty years that today the 100,000 available constitute a valuable meat resource.

In expressing his appreciation of the large assembly present to hear the papers, Mr. Valiquette referred to the weekly meetings of some twenty years ago when twenty members constituted a normal attendance.

Mr. Fraser followed with a paper on the fine development of the harbour at Ellis bay to serve the larger undertaking assumed by the corporation. This has been likewise produced in this issue.

In opening the discussion Councillor O. O. Lefebvre, M.E.I.C., complimented the supervising engineers on the achievement of transferring the heavy wooden cribs from the mainland to the island without the slightest mishap.

Chairman F. C. Laberge, M.E.I.C., attested the pleasure and appreciation of the meeting in a vote of thanks, closing with a wish to view the development at closer range.

The meeting was presided over by A. Plamondon, A.M.E.I.C.

Heat, Rust, and Acid Resisting Steels

On October 30th members of the branch were the guests of the American Society for Steel Treating, Montreal Chapter, at a meeting in the chemistry building, McGill University, when an excellent lecture on "Heat, Rust and Acid Resisting Steels" was delivered by Dr. W. H. Hatfield, director, Brown-Firth Research Laboratories of Sheffield, England.

Prospecting by Physical Methods

What might well be described as a most informing and delightfully scientific lecture provided the branch with a profitable evening's enjoyment when, on November 1st, Dr. A. S. Eve, F.R.S., presented a splendid address and demonstration on devices for "Prospecting by Physical Methods."

After touching briefly upon several excellent magnetic and gravitational balances now in use to detect the presence and location of salt domes and ore bodies, the speaker described a process of discovering these same deposits with considerable accuracy by means of the vertical oscillogram or seismograph.

In this process some 300 pounds of t.n.t. explosive are fired at a depth of twelve to twenty feet below ground. The resultant shock is registered on a battery of these seismographs situated three to four miles away upon which the time of the explosion has already been recorded by radio signal. Subsequent study of the varying time intervals at each seismograph serves to indicate the nature of the medium through which the sound was transmitted. This method, based upon the density and elasticity of the intervening material, has been developed to such high precision that experienced companies are now spending up to $30,000 a month on explosions alone.

Of several electrical methods available for ore prospecting, one of the oldest is the Stronsberg process. This process depends for its success on the fact that surface water in the neighbourhood of sulphur bearing ores transmits the galvanic currents created by these ore bodies to a delicate potentiometer capable of measuring small variations in voltage. A very realistic demonstration of this simple and inexpensive method was given by Dr. Eve, using porous pots containing copper sulphate as the ground terminals.

Another good method is known as Lundberg's parallel wire process. In this method two wires are pegged down, parallel to each other but some distance apart. Current supplied to one will flow through the ground toward the other, but at any point the fall of potential will be related to the character of the transmitting material. An interesting experiment thereupon illustrated lines joining points of equal potential diverging from each other to pass round an ore body. A variation of this process developed by Dr. Eve and his associates known as the leap-frog method, is a simpler and easier version, giving splendid results.

A peculiar coincidence noticed with these methods that must be guarded against is the ability of water to simulate ore.

Another electrical process known as the horizontal loop or geophysical method depends upon the possibility of detecting re-radiation. Still another device described as Lundberg's two-coil method, consisting in grounding two coils and listening in on the connecting telephone circuit.

An interesting development resulting from research on terrestrial magnetism by the Carnegie Institute is a successful process for detecting ore bodies located at a considerable depth below the surface. This was described by Dr. Eve as a joyful method in that it merely consists in winding the handle of a megger and measuring the drop of potential across the middle third intervals of four equidistant ground stakes. A deduction from this resistivity method by Romney places the depth of the ore body as equal to the stake interval.

Simple surveys carried out by these methods at a cost of a few hundred dollars may yield results which will save many thousands of dollars in diamond drilling for ore bodies, oil deposits, and rock foundations for dam sites.

A hearty vote of thanks, proposed by Councillor Fraser S. Keith, M.E.I.C., was presented to Dr. Eve by N. L. Morgan, A.M.E.I.C., the presiding chairman.

REMAKING THE MAP OF CANADA WITH THE AERIAL CAMERA

The remarkable progress in the science of aerial photography as applied to the mapping of unexplored regions proved itself an intensely interesting topic when presented by the student section of the branch on November 15th. On that occasion the speaker of the evening Flying-Officer J. Moar, R.C.A.F., in a splendidly illustrated paper, discussed the methods now being employed to "Remake the Map of Canada with the Aerial Camera."

Due to the prevalence of lakes and water courses in the undeveloped north country and to the obvious advantage of an unobstructed view, a powerful seaplane of the pusher type is now employed on the majority of these aerial surveys.

This class of plane is well suited to photograph from the air by the oblique method, which method lends itself to the photographing of areas having little or no control; also it is the most economical, and therefore has been the method used most extensively in Canada up to the present. To facilitate the work the camera has been mounted on the combing of the cockpit in such a manner that it may be quickly moved in the arc of a semicircle to take successively, one picture directly on the line of flight and one to each side, at approximately 45 degrees with that line.

In spite of the skill of the pilot and the accurate calibration of the navigating instruments, the operating conditions are such that it is necessary to run periodic ground traverses which can be utilized to control the scale of the maps prepared from the photographs.

The compilation of these maps has been facilitated by the preparation of ingenious grids or perspective diagrams that may be superimposed upon the prints.

Chief among the difficulties encountered in the prosecution of this work is unsuitable weather. Often it becomes necessary to wait patiently for several weeks to obtain one photographic day. Haze caused by the refraction of light from water vapour, smoke from forest fires, or dust in the atmosphere reduces the sensitiveness to detail by diminishing the light contrasts of distant objects on the earth's surface.

To remedy this condition it has been found possible to employ filters of dyed gelatine which eliminate the components of light particularly responsible for this disturbing influence.

For such exacting conditions, the care and choice of high-grade films is of primary importance and considerable experience is essential in their selection.

Where possible, the aerial party consists of three men, the pilot, giving all his attention to maintain the plane on the desired line at a constant altitude; the navigator meanwhile determines the drift and ground speed, times the pictures and selects the control points used in guiding the plane, while the mechanic, acting as the camera man, takes the pictures.

Complete supplies are taken in on the plane, with the exception of the gasoline which must usually be sent in by canoe considerably in advance of the aerial party.

An interesting discussion ensued, led by Prof. A. Kelly, M.E.I.C., and Councillor Geo. R. MacLeod, M.E.I.C., in which the relative merits of the oblique and vertical methods were compared and the accuracy and cost of the photographic survey cited.

Chairman H. R. Montgomery adjourned the meeting with a rising vote of thanks.

Niagara Peninsula Branch

R. W. Downie, A.M.E.I.C., Secretary-Treasurer.
C. G. Moon, A.M.E.I.C., Branch News Editor.

In conjunction with the Buffalo Engineering Society and the Buffalo section A.I.E.E. this branch enjoyed an afternoon and evening meeting on October 25th. Members met at the plant of the Lackawanna Steel Company about 3.00 p.m., and were shown around by courteous officials or allowed to roam at will. There was plenty to see; in fact an afternoon was all too short a period of time in which to properly absorb the details of such an immense enterprise.

There were seven blast furnaces, twenty-four open hearth furnaces, four Bessemer converters and twelve rolling mills in which all kinds of structural shapes and plates were being manufactured, light rails, heavy rails, sheet piling and special shapes, including the B-section 36-inch I-beams, G-section 290 lbs. per foot, and H-16, 427 lbs. per foot.

Then there were the repair shops, the nut, bolt and spike shops, and the drive motors, eight or ten feet in diameter, which reversed themselves and their directly-connected rolls with the ease that a child spins a hoop.

The grounds must be a mile or so in length and quite a few members stated that they had had a good afternoon's exercise by the time they got back to the cars.

Just at present the plant is running close to capacity, which is about 160,000 long tons of open hearth a month.

After a well-earned and appreciated meal at the Statler the meeting was addressed by Mr. G. A. Richardson of the U. S. Steel Company, who accompanied in a versatile and truly remarkable manner a series of moving pictures which gave the story of steel from the ore-fields to the finished product. "Accompanied" is the right word to use, for he carried along his explanations coincidently with the film views, and thus gave his audience a splendid conception of the various processes and many of the involved but interesting details.

A few miscellaneous facts were jotted down as likely to prove of interest in the record. For instance, one of their ore boats loaded 10,000 tons of ore in fourteen minutes and took two and one-half hours unloading the same quantity. Ten to twelve million tons of ore are mined and used every year in the United States. The average capacity of a blast furnace is from 500 to 700 tons in twenty-four hours. Eight tons of material (including four tons of air) go to the making of one ton of iron. Bessemer converters carry from twelve to fifteen tons of steel, the manganese and silicon burn off with the low flame which is first seen and the later flame, thirty or forty feet in height, indicates the period when carbon is being consumed. All structural steel shapes and rails are now being made with the open hearth process, the furnaces of which carry from 100 to 250 tons each. The U. S. Steel plant at Coatsville manufactures a grade of charcoal iron which has many special uses. The maximum width of plates obtainable is now 152 inches.

After Mr. Richardson there were two other speakers, Mr. A. F. Kenyon and Mr. L. A. Umansky, but the St. Catharines members had a forty-mile drive ahead of them and therefore were forced to forego the latter part of a most enjoyable session.

VISIT TO WESTINGHOUSE AND STEEL COMPANY'S PLANTS

The branch is developing a delightful faculty of availing itself of neighbouring goodwill and kindliness. A faint hint is more than sufficient, in fact, if there is some particular plant we wish to visit our well trained executive sometimes has been known to hint for a hint. Be that as it may, the fact remains that we called upon the Buffalo society to entertain us last month, and on November 14th we invaded Hamilton in the other direction, and they both responded so nobly that they can count upon remaining permanently on our lists.

The East End works of the Westinghouse Electric Company and the adjacent plant of the Steel Company of Canada were our double-barrelled aim, and for good measure the Hamilton Branch were somehow able to convince Brigadier-General C. H. Mitchell, M.E.I.C., that he should journey all the way from Toronto to tell us about, and show pictures of, the latest engineering achievements in Europe.

Due to accidental misunderstanding some of the members who wished to visit the steel plant were beguiled into following an electric leader and once inside the Westinghouse plant they were lost and had to follow along.

The work, however, was absorbing, motors, generators, transformers, circuit breakers and even radios in all stages of the making and the afternoon was well spent. A few, nevertheless, did break away and get to the Steel Company, and the report of their reception and consequent inspection has started a movement to make another trip some afternoon for the purpose of visiting that one plant alone.

BRIG.-GEN. C. H. MITCHELL, M.E.I.C., ADDRESSES BRANCH

Dinner was held at the Royal Connaught hotel with Chairman W. L. McFaul, M.E.I.C., presiding, and after the tables were cleared General Mitchell held the complete attention of his audience while he described some of the engineering triumphs which he noticed whilst on a recent trip to Europe.

General Mitchell reviewed some of the outstanding activities in four distinct fields: railways, road transportation, aerial transportation and hydro-electrics.

"Canadian conditions are different from those in Europe," said the General, "and Canadian engineers do not lack in initiation or resourcefulness, but in quite a few things the Europeans are advancing with great strides and we might do worse than to study their methods and adopt those which may be deemed suitable."

Firstly, the railways have not been paying for some years. Three things have contributed to this condition (a) strikes, (b) increased taxes and (c) motor competition. They are meeting the difficulties and surmounting them by means of amalgamation—most of the railroads are now combined into four groups. Then they are improving the accommodations and adding fleets of their own motors to draw traffic to the railways from the surrounding districts. They are also electrifying largely; nearly all the main railway lines in the London area are electrified and all of the eighteen tracks running into Liverpool Street station. France also is going in largely for electrification, particularly that district south of Bordeaux and west of Toulouse, which can obtain easy hydro power from the Pyrenees.

General Mitchell was also particularly interested in some of the experiments which are being made at Greenwich on the liquefaction of coal under some 3,000 lbs. per square inch pressure. It is not yet at a commercial stage, but some of the results are startling enough—30 gals. Naptha oil, 60 gals. heavy oils and 30 gals. fuel oil at a cost of about 45 cents a gallon from a ton of coal carrying 13,500 B.t.u.

Most of the notable docks are being or have been recently enlarged. Pictures of the Gladstone dock at Liverpool, the Tilbury and West India docks at London were shown and attention was particularly drawn to some of the peculiar details necessitated by a very yielding foundation subsoil. These docks will now have 110 feet width or more and a least draft of 37 feet 6 inches over the sills, while the new French dry-dock at Toulon will be 1,460 feet long and 165 feet in width and 40 feet in depth.

Motor traffic in England has grown tremendously, the old Roman roads are coming back to their own again. Day and night trips can be arranged to almost any part of the island and the accommodation, consisting sometimes of a reclining chair-couch, are excellent. Timetables similar to those in use on the railway systems are printed and given out.

Aerial navigation is an everyday occurrence and practically part of European life now. It is accepted and has come to stay. The record of commercial accidents is negligible and is comparable with that of railways or other means of transport.

General Mitchell showed some very good views of the new airships R-100 and R-101 and described a most interesting afternoon spent in the control room at the Croydon airport. Wireless communication is kept up incessantly with every airplane, either going or coming, within range. One French plane lost its bearings in a fog that afternoon and got nearly to Southampton, which was many miles off its course. By means of direction-finders they were able to locate its exact position and give directions which enabled it to land safely at the airport. A new Goliath-Farman was at the field that day—a plane having 500 h.p., capable of 125 m.p.h., and carrying twenty-four passengers.

Most of the electric power in England is steam-generated, but in the Pyrenees and the French Alps advantage is taken of nearly every little stream. High heads predominate as needs be in countries where the volume of water is limited, but 400- to 700-foot heads are common, while one plant operated under 3,100 feet. The Romanche river, near Grenoble in the French Alps, is a beautiful example of conservation of power. There are about twenty hydro-electric plants generating some 50,000 h.p. located on this one little stream of about 1,500 c.f.s., and not an ounce of energy is wasted.

General Mitchell finished by showing some beautiful examples of bridge design, both ancient and modern, the famous Carcaconne bridge, some 2,000 years of age, and the old bridge at Avignon, both in an excellent state of preservation. The French are still past masters in the use of reinforced concrete and the boldness of design and audacity of construction may in a very great part be attributed to the care with which they inspect every bit of steel and every yard of concrete while erection is in progress. A 600-foot reinforced concrete arch span is now under construction in France and a rather remarkable lattice truss bridge, with 250-foot spans and trusses 33 feet deep, has just been completed. In England they have just opened their longest steel arch bridge, 540-foot span, with a parabolic arch, at Newcastle-on-Tyne.

Our chairman, E. G. Cameron, A.M.E.I.C., expressed the very great appreciation of the members to General Mitchell for the pleasure experienced and knowledge gained through his valuable address, and then tendered the thanks of the Niagara Branch to Chairman McFaul of Hamilton for having arranged so successful a day.

Ottawa Branch

F. C. C. Lynch, A.M.E.I.C., Secretary-Treasurer.

Addressing the members of the Ottawa Branch at a luncheon held at the Chateau Laurier, Mr. Frank P. McKibben, consulting engineer to the General Electric Company of Schenectady, N.Y., outlined the progress being made in electric welding as applied to the erection of buildings, bridges and other structures.

Electric Welding of Buildings and Bridges

Introduced by Dr. Charles Camsell, M.E.I.C., chairman of the Ottawa Branch, Mr. McKibben said that it was incumbent on the engineer to make haste slowly in the adoption of new ideas. He did not advocate electric welding to replace entirely the pin joint and the rivetted joint for every purpose. As the pin joint had given way many years ago to the rivetted joint for many purposes, so was the rivetted joint now being replaced in building construction and to a considerable extent in bridge building by the electrically welded joint.

Some sixty or sixty-five buildings, the speaker said, have now been erected with all or the major part of the steel work electrically welded. Electric welding has also been used on some fifteen bridges and on fifteen barges or ships, as well as on innumerable pipe lines.

The highest welded steel building to date is one of twelve storeys, Mr. McKibben said, and at Atlantic City there is a power house six storeys in height in which electric welding was used.

Revision of the building codes is necessary before electric welding can come into general use, the speaker stated, though it is now permitted in New York, Buffalo and many other large cities in the United States. Specifications for electric welding, he stated, are now available as the result of five or six years experience, and the strength of the welded joints is now well established as the result of many tests.

The General Electric Company, Mr. McKibben stated, is now using electric welding on 30,000,000 to 40,000,000 pounds of steel per annum and instructions have been issued that there were to be no more rivetted buildings. Engineers should go slow, however, he said, in adapting electric welding to structures where the impact stresses were very great. In bridges where the floor structure was such as to absorb impact shocks, electric welding would be all right, and he pointed out that there had been only one failure of an electrically welded joint that he knew of,—this in a tension member in a bridge joint.

Dealing with the advantages of electric welding, Mr. McKibben pointed out the saving in steel which results, particularly from the elimination of gusset plates and other parts which are necessary in rivetted joint construction. In electric welding the members of trusses are welded directly to one another. Trusses with electrically welded joints used in a General Electric building weighed 5,000 pounds, against 6,800 for similar trusses in our older building with rivetted joints. There was a 10 per cent reduction in the tender for electric welding from that for a rivetted steel job. Part of the saving in electric welding was due to an economy in labour, as two men took the place of nine to twelve men on a rivetted job. In shop practice, automatic electric welding machines were coming into use and trusses were largely built in jigs, with the welding machines quickly completing the work of permanently joining the various members.

Through the screening of a series of slides, Mr. McKibben illustrated the work of electric welding and how the various joints are made, also the results of testing the fillet joints which are made with the electric arc. Shearing tests establish the strength of the electrically welded joint at 11,000 pounds per lineal inch of the fillet, according to the tests sheets, but the speaker stated that this represented the minimum and there is a variation of about 25 per cent in the strength of the welding as performed by good or indifferent workmen.

In conclusion, Mr. McKibben stated that the General Electric Company recommends electric welding where adaptable and hopes it will not be used where not adaptable.

Meeting of November 15th

Speaking under the auspices of the Ottawa Branch at a luncheon which took place at the Chateau Laurier on November 15th, J. Ivon Graham, M.A., M.SC., F.R.C.SC.I., A.I.C., M.I.M.E., assistant director of the mining research laboratory of the University of Birmingham, outlined in a general way the work going on in fuel research in Great Britain.

The distinguished speaker, introduced by Dr. Charles Camsell, M.E.I.C., in the chair, was on his way to the International Fuel Congress at Pittsburgh.

Fuel Research in Great Britain

There were three separate organizations in Great Britain dealing with fuel research, stated Mr. Graham, namely, the Department of Scientific and Industrial Research, formed during the Great War and financed jointly by individual industries and the British government; the Safety in Mines Research Board, financed from the $25,000,000 mines welfare fund representing a five-year levy on coal output by tonnage; and the British Collieries Association Research Board, also financed by levy. This last-mentioned, which was purely a coal owners' association, Mr. Graham pointed out, largely financed the Birmingham research laboratory, where extensive research work was being carried out on hydrogenation of coal.

The fact was stressed by the speaker that the Fuel Research Board, formed as a section of the Department of Scientific and Industrial Research, was doing very good work on low temperature carbonization of coal. Experiments in this respect, said Mr. Graham, had indicated that low temperature carbonization not only yields smokeless fuel but more oil than high temperature carbonization. Another phase of research being carried out, he added, was a physical and chemical survey of structures of coal seams.

Alluding to the investigations being carried out by the University of Birmingham in connection with the hydrogenation of coal, Mr. Graham pointed out that he first became interested in this phase of research following a visit to Mannheim, Germany, where Dr. Bergius had made important tests. Five years of research in England, stated Mr. Graham, had substantiated Dr. Bergius' claims. Certain coals, said Mr. Graham, are much more amenable to hydrogen treatment than others. This was the case, he pointed out, with brown coals, owing to their high oxygen content. Some bituminous coals, he stated, are very readily hydrogenated and yield large oil content.

Mr. Graham spoke at some length of the use of catalysts in the hydrogenation process. By the use of a catalyst, he said, much higher percentages of oil were obtained. In one test at Birmingham using a catalyst there was a production of 25 gallons of petrol and 150 gallons of crude oil per ton of coal. The German Chemical Trust, the I.G., had recognized the importance of using a catalyst and had covered the process by patents. With a catalyst there was a very much greater yield of oil than by any low temperature process.

The general opinion, said Mr. Graham, was that 10,000,000 tons of coal could be utilized annually in Great Britain if hydrogenation of coal could be made a commercial success. This, he added, would be a wonderful help to the British coal industry. Imperial Chemical Industries, continued the speaker, are taking an active interest in hydrogenation, and if anybody can solve this problem on the commercial side, he thought they were the people to do so.

At the present price of gasoline in Canada, Mr. Graham thought that hydrogenation of coal as a method of producing motor fuel would not be commercially feasible. He pointed out, however, that cheap hydrogen is one of the things necessary for this method in liquefaction of coal, and Canada, with its cheap water power, is in an enviable position in this respect for the synthetic production of hydrogen.

The speaker also referred to experiments going on in partial hydrogenation. Certain coals which are non-coking in the ordinary way can be converted into coking coals by partial hydrogenation. Even with anthracite, the Fuel Research Board has obtained a strongly coking coal. The only satisfactory return, however, in Mr. Graham's view, was to carry out the complete conversion into oil.

At the conclusion of the address, Dr. Camsell expressed the hope that Great Britain and Canada would eventually co-operate in fuel research. This might take the form, he thought, of the interchange of technologists, as at present is being done between London and Washington.

Referring to Canada's new fuel research laboratory now nearing completion in Ottawa, Dr. Camsell stated that it was already attracting attention outside, and its sphere of usefulness was to be seen from the fact that he had already received an inquiry from the Portuguese Consul-General asking if the Canadian laboratory could undertake investigations on Portuguese lignites.

Peterborough Branch

S. O. Shields, Jr.E.I.C., Secretary.

A meeting of the Peterborough Branch was held on October 25th, 1928, at which W. Gore, M.E.I.C., of Gore, Nasmith and Storrie, consulting engineers, Toronto, gave an address entitled "Astronomy in an Engineer's Life." The talk was of a popular nature and covered a very wide range of subjects in the history and science of the universe.

Pointing out that while it had been said that engineering was the most useful of the sciences, whereas astronomy was the most useless, the speaker emphasized the interdependence of the two in many ways. Both dealt with such fundamental concepts as time, distance and speed, and progress in engineering enabled the astronomers to make new discoveries.

The great Pyramid was built by the association of engineering and astronomical knowledge. The purpose of the Pyramid has long been the cause of discussion, said the speaker. There were seven million tons of rock used in the construction, and all indications point to the fact that there was formerly a limestone covering which reflected the sun's rays and made it act in some form of a sun dial.

The Egyptians had great difficulty with their seasons and calendar, explained the speaker, but the Pyramid gave them a means of correcting their calendar. The age of the Pyramid can be definitely set at about five thousand years, by calculating the movement of Alpho Draco, a star at which one of the passages formerly pointed. The speaker went on to mention many ancient methods of measuring time, and the importance of the knowledge of telling the time and season to mankind.

Tides form another means of telling the time and the speaker explained the interesting phenomenon of the tidal bore, where the incoming rush of water makes a stream flow uphill. The bore or crest is formed because the water coming up behind travels faster than the water in front.

On the subject of tides, the speaker said, many would be surprised to learn that Lake Ontario had a tidal rise and fall, although difficult to find. The neap tide at Toronto is three-eighths of an inch and the spring tide about an inch.

Going on to the movements of the universe, the speaker spoke of the meteorites, those small pieces of metal which reach the earth and are called shooting stars by many people, and he explained that because the Romans discovered the meteorites contained a good deal of iron, they had a theory that the heavens was a roof of iron.

Dealing with the sun and its radiant energy, the speaker said it has been a question of how and where did the sun get all the radiant energy. The earth receives two thousand million horsepower per second from the sun, and yet we receive only a small particle of the energy the sun sends off. Many geologists claimed that the sun would burn itself out in ten million years (a comparatively short time in speaking of time in relation to the universe).

But now, according to the Einstein theory and greater knowledge gained, astronomers believe that the sun is getting hotter and not colder. This theory explains that the mass of the sun is breaking up into radiant energy in the form of electrons. The mass of the sun is getting smaller, but it is sending out as great or greater heat than it did formerly. Some scientists further advance the theory that the radiant energy forms back again somewhere else into mass and therefore is not lost. This disproves the old idea that the universe was slowly running down and we are in a fair way to believe that the universe will go on forever, said Mr. Gore.

The interesting feature of the moon is its craters, said the speaker, and went on to deal with some of the theories in regard to their formation.

The planet Mars is interesting because the lines seen on its surface are claimed to be canals, said Mr. Gore. These seemed to have been made by intelligent beings because of their straightness and their intersections, not haphazard but purposeful.

Mr. Gore then discussed at some length the theories regarding conditions on Mars.

Following an active discussion Mr. Gore was accorded a hearty vote of thanks for his interesting address.

Annual Banquet

The Divine Insanity of noble minds
That never falters nor abates,
But labours and endures and waits
Till all that it foresees, it finds,
Or what it cannot find, creates.

Thus, one of the speakers lauded the spirit of the engineering profession during the annual dinner of the Peterborough Branch, held in the Empress hotel on November 20th. Graced by the presence of prominent officials of The Institute from Montreal and Toronto, and featured by an impressive programme of toasts and addresses by members of the engineering as well as representatives of sister professions, the annual dinner crowned with success the labours of an energetic executive and afforded fresh impetus to the season's activities of the local branch.

Among the guest speakers were Julian C. Smith, M.E.I.C., president of The Engineering Institute of Canada and vice-president and general manager of the Shawinigan Water and Power Company; R. J. Durley, M.E.I.C., general secretary of The Institute; Fraser S. Keith, M.E.I.C., member of the Council of the E.I.C., of Montreal; Professor P. Gillespie, M.E.I.C., representative of the Toronto Branch and a past vice-president of the E.I.C.; V. J. McElderry, K.C., president of the Peterborough Law Association; Dr. F. P. McNulty, president of the Medical Association; Rev. J. L. Hughes, president of the Peterborough Ministerial Association; G. S. Mattice, of the Teachers' Association; and F. H. Dobbin.

Presiding over the dinner meeting, Chairman W. M. Cruthers, A.M.E.I.C., proved a capable master of ceremonies. Following the banquet, he introduced the programme by a short address, in which he reviewed the aims of The Engineering Institute, and the possibilities that the future holds for the profession.

"In agriculture, lumbering, mining, and the manufacturing industries, mechanically inclined men are destined to play a great part," he declared.

Toast to The Institute

"The Engineering Institute of Canada is unique among other national organizations, in that it includes in its membership, engineers practising all branches of the profession," said R. L. Dobbin, M.E.I.C., in proposing the toast to The Engineering Institute. "It was formed in 1887 as the Canadian Society of Civil Engineers, and in 1918 the name was changed to its present form. We have now 4,700 members of all classes, located in every part of the Dominion," he continued.

"The Institute has been fortunate in having many distinguished engineers as its presidents. Notable among them have been the late Walter J. Francis, Dr. R. A. Ross, M.E.I.C., and Dr. J. M. R. Fairbairn, M.E.I.C., all of whom we claim to have been Peterborough men; yet not the least of the engineers who have occupied that high office is the present incumbent, Julian C. Smith, M.E.I.C., who has honoured us by his presence tonight. This is not his first visit to the Peterborough Branch, for he came to us at our banquet in 1920. Gentlemen, is not The Institute in good hands? Let us drink to The Engineering Institute!"

President Julian C. Smith

Mr. Smith, responding, complimented the local branch on the evening's gathering. "As you know, The Institute has grown from a small beginning until now it boasts thousands of members," said he.

"One might speak of the past, present, or future of The Institute, but I do not choose to speak of the past. While in England last summer I met Rudyard Kipling, the first man to use the term 'cold iron.' Mr. Kipling was very much interested in The Engineering Institute, particularly in Canada.

"The future of The Institute is that thing in which we are most interested, for we must maintain the influence of it to keep the members of the profession joined together. This will be difficult because of geographic conditions, and the branch must necessarily play a great part.

"No man can get out more than he puts into The Institute, which has been organized for the mutual benefits to be derived—one member from the other."

The speaker dealt with membership fees as applied to Students of The Institute and regular members, as well as with proposed changes in the method of accepting members into The Institute.

Greater Work Ahead

"As regards the future, it is obvious that the work to be done by engineers will be greater than in the past in the development of electrical power with all branches of work incidental thereto," he continued. "With the development of Canada agriculturally and industrially, the work to be demanded of the engineering profession will be greater and more important. Therefore, engineers will have to be better prepared, and the co-operation and confidence that the Institute develops will be necessary."

The General Secretary

The general secretary of The Engineering Institute, R. J. Durley, M.E.I.C., expressed a desire to speak of the general affairs of The Institute. He, too, touched briefly on the changes in membership fees. Running over a few suggestions for further expenditures by the council in case a surplus is realized, in the future, he mentioned the Employment Service Bureau and urged co-operation in this work. He felt that more money could be spent on The Institute publications. The branch activities, he intimated, could sometimes be assisted by further assistance from the council, while the importance of the branch secretaries' work was stressed.

Entertainment

W. E. Ross, A.M.E.I.C., was called upon to show "what it means to look backward" to what The Institute was, particularly the Peterborough Branch. He then had thrown on the screen slides of members and conducted a "who-is-it" contest that provoked much merriment. The presentation of a silk hat prize by E. R. Shirley, M.E.I.C., to the winner, A. L. Killaly, A.M.E.I.C., followed.

The branch orchestra of three violins, piano and banjo was heard on several occasions, rendering popular numbers in commendable manner. In addition, there was community singing that added to the enjoyment of the evening.

Toast to the Branches

A. L. Killaly, A.M.E.I.C., proposed the toast to "The Branches." In so doing he referred to the mission and benefits of the branch as a unit in promoting the interests of The Engineering Institute of Canada as well as of individual members.

He went back in The Institute's history to the time when it began under its present name, and touched on the increase in the number of branches. "To those branches the Peterborough body now extends its good will," he concluded.

The representative of the Montreal Branch, Fraser S. Keith, M.E.I.C., responded to what he termed "one of the most important toasts of the evening."

"Today the branches of The Institute are the shining lights of the engineering profession," declared Mr. Keith, "for your mission is to interpret the engineer to the public and make it appreciate him and what he has done."

Declaring that engineers have built for posterity; that all the Titans of engineering do not live at the present time, and that engineering is a progressive science standing for the removal of materialism from human life and human affairs, Professor Peter Gillespie, M.E.I.C., was the second speaker responding to the toast to The Institute.

Professor Gillespie arose to speak as many of those present burst into the old School of Science yell. He thanked them for the enthusiastic reception and extended the best wishes of the Toronto Branch. Then, going back to the days of early history, he spoke of the Hadrian aqueduct, built to supply the city of Athens with water. Though without the more recently conceived engineer's transits, the methods used were necessarily crude, the job was a marvel of engineering, as was the Menai bridge, built hundreds of years later, with its 600-foot suspension. The third example quoted was the Stevenson creek experimental dam, built in California, and from which very valuable theories had been evolved.

"It has been heard from many quarters," said Professor Gillespie, "that we live in a materialistic age, but it seems to me that we are not nearly so materialistic when we worship in comfortable churches as the native who sat in filth and poverty, contemplating the problems of the universe. The profession of engineering has lifted us above that," he concluded.

A skit, depicting a meeting of the local branch, was put on by a group of Canadian General Electric Company students, who cleverly imitated well-known local members. It proved decidedly entertaining and laughter-provoking.

Toast to the Sister Professions

Recalling college days when rivalry between students of the various courses is keen, only to decrease as graduation brings common problems, W. T. Fanjoy, S.E.I.C., proposed the toast to the sister professions. Replying were four representatives of the four other professions, ministerial, law, teaching and medical, all of whom indicated in brief but well ordered addresses, the relations of their respective professions to the others. The Rev. Mr. Hughes, Mr. McElderry, Mr. Mattice and Dr. McNulty represented the sister professions.

Previous to the close of the meeting, Chairman Cruthers spoke of the Old Boys' Re-union to be held in Peterborough next year. Since next year will be the tenth anniversary of the branch and the dates of the re-union and of the annual dinner do not coincide, he urged the local branch, and thought that the members should catch the spirit of the re-union and co-operate in bringing back many of the old members to the annual dinner.

Saguenay Branch

J. F. Plow, Jr.E.I.C., Secretary-Treasurer.

Town and Hexagonal Planning

On October 23rd, at Arvida, the Saguenay Branch was favoured with a lecture from J. E. Nolan Cauchon, A.M.E.I.C., the government expert on town planning.

Mr. Cauchon's subject was "Town Planning and Hexagonal Planning," which he placed before his audience in a very clear and interesting manner, admirably illustrated by a series of diagrams. The lecturer covered the subject in a general way and gave the numerous advantages under which the inhabitants lived when their town was laid out according to town planning ideas. He laid stress, however, on the engineering viewpoint and its application to new and existing towns and cities.

The lecture was attended by nearly one hundred members and friends, Arvida, Chicoutimi, Kenogami, Isle Maligne and Riverbend being represented.

In introducing the speaker the chairman, G. F. Layne, A.M.E.I.C., said that though the branch had been very inactive of late, in future he hoped to be able to have a number of lecturers address the members: Mr. Cauchon being the first; and O. O. Lefevre, M.E.I.C., had consented to give an address on the St. Lawrence waterways, in the near future.

R. E. Parks, A.M.E.I.C., proposed a vote of thanks to Mr. Cauchon for his very interesting lecture, which he knew was heartily appreciated by all.

Sault Ste. Marie Branch

A. H. Russell, A.M.E.I.C., Secretary-Treasurer.

A regular meeting was held in the Y.W.C.A. rooms, at which W. S. Wilson, A.M.E.I.C., chairman, introduced Mr. Chas. A. Price, of the Precise Water Level Division, Canadian Hydrographic Service Department of Marine, Ottawa, the speaker for the evening.

He gave an illustrated talk on "Recording Water Levels of the Great Lakes and the St. Lawrence River." The Great Lakes were more fully dealt with, as they were in our own district. "The centralization of this work, for such a large territory, eliminates duplication, reduces overhead expenditure, and, most important of all, from an engineering point of view, the resulting data are reduced to a common basis of reference, to a precise standard in compilation. The reference datum now in general use is the U.S. Lake Survey levels of 1903 adjustment," he said.

The subject was considered by Mr. Price under the following nine main points:—

(1) *Territory involved.*—a general chart of the Great Lakes from Port Arthur to Kingston was shown giving the gauge locations.

(*a*) Lake Superior—seven gauges being operated.
(*b*) Lake Huron—five gauges being operated.
(*c*) Lake Erie—four gauges being operated.
(*d*) Lake Ontario—three gauges being operated.

In all, nineteen gauges are being maintained on the Great Lakes, while on the St. Lawrence river twenty-five gauges are being maintained, as follows:—

(*e*) The International section,—from lake Ontario to lake St. Francis, where the fall is approximately 94 feet in 105 miles, there are eight gauges in operation.

(*f*) The purely Canadian section,—from lake St. Francis to Montreal harbour, where the fall is approximately 132 feet in 68 miles, there are seven gauges being operated.

(*g*) The Montreal-Quebec section,—which is related to true deep sea navigation and which in the lower portion comes under tidal influence, and where the fall is approximately 19 feet at low water in 176 miles.

(2) *Types of gauges.*

(*a*) The Haskell self-registering graphic; thirty-six being used in 1928.

(*b*) The Gourley printing register No. 630; eight being used in 1928.

(*c*) Standard staff gauges.

(*d*) Levels used,—the Zeiss level, model 111, being used for all precise levelling in setting gauges and tieing in with other surveys, etc.

(3) *Installations of gauges for operation,*—slides were shown giving the location, type and general characteristics of the different gauges in use.

(4) *Types of records obtained.*
(*a*) Printed records.
(*b*) Graphic records.

(5) *Methods of compilation,*—the compilation of the July 1928 chart from the Upper Soo gauge resulted in 818 sets of figures, which gives a very fair idea of the amount of work to be done in handling all the charts.

(6) *Uses and requests for data.*—Mr. Price emphasized the remarkable increase in the demands for the data that his department is able to furnish. He estimates that they will issue over 30,000 sheets of data in 1928. Requests come in from all over the world.

The 1928 compilations will include approximately 500,000 sets of water surface elevations and will entail handling approximately 1,500,000 sets of figures.

(7) *Seiches and storms,*—the word seiche is given in the encyclopædia as being "An irregular fluctuation of the water level of lakes, first observed and so named in Switzerland. First noted in 1730." The first reference to seiches in the Great Lakes was made by Sir Alexander MacKenzie in regards to water action at Grand Portage in lake Superior about 1790.

On August 27th, 1917, at Michipicoten harbour, according to Mr. Price, seiches in five hours gradually increased until the first large change was:—

a fall of 1.00 feet in 10 minutes
rise " 2.56 " " 9 "
fall " 1.84 " " 8 "

The seiches continued for fourteen hours before action of water level again became normal. There were heavy south west winds during the seiche period.

Several charts and slides were shown giving comparisons at different stations during a seiche period or a storm period. Mr. Price pointed out how they could pick out a storm period on a chart. He said that a storm showed a steady banking up of the water in the direction of the wind, and the level will remain banked up until the velocity of the wind lessens, and then it recedes gradually. The progress of a storm can be followed down the lakes by the water levels registered on the different gauges.

(8) *General data relating to each of the Great Lakes,*—comparison charts were given showing general data of the Great Lakes.

(9) *Results derived by the use of data.*—A general discussion followed Mr. Price's address, and a hearty vote of thanks was tendered to him by the chairman.

Toronto Branch

J. J. Spence, A.M.E.I.C., Secretary-Treasurer.
(Reported by H. Neville Mason, A.M.E.I.C.)

New Engineering Projects in England and France

The first meeting of the season 1928-1929 of the Toronto Branch of The Engineering Institute of Canada was held in the Mining building, University of Toronto, on Thursday evening, October 18th, at 8.15 p.m. The speaker of the evening was Brigadier-General C. H. Mitchell, M.E.I.C., Dean of the Faculty of Engineering, University of Toronto.

Previous to the meeting dinner was served at Hart House. The meeting was well attended, ninety-one people being present, including Mrs. Mitchell and Mrs. Wynne-Roberts. The substance of the speaker's address was based upon a tour of Europe, which he had made during the previous summer.

The effect of motor coach transport on steam railway operation was indicated in terms of reduced revenue, which, combined with higher wages and heavy taxes, had caused the railway companies to seek relief in electrification of the roads, and in some cases the organization of motor coach services of their own. A complete guide giving all the motor coach routes, times and fares is obtainable, some of these routes traversing the same roads and passing through the same towns and villages as was the custom a hundred years ago.

The speaker described some of the most modern achievements in automobile construction in Great Britain, including a 25,000-mile test of a car without either clutch or gear-shift.

A further highly interesting topic was introduced by the description of the liquefaction of coal, which, if successful on a commercial scale, would create a use for our great deposits of low grade coal in the north and west.

Several very interesting slides were shown indicating the remarkable increase in shipping facilities at Liverpool and London; and peculiar features of construction in the latter area, due to the soft nature of the ground, were emphasized. At Toulon, in France, the largest dock in the world, now nearing completion, will be 1,460 feet long, 165 feet wide and 40 feet deep.

In aerial navigation, contrary to the general idea, Great Britain still leads the way. The Croydon aerodrome, with its visual synchronous control, reporting and despatching facilities, was romantic evidence of the great strides which had been made in recent years. The speaker described the facility by which a new pilot on a French air liner had been directed to the aerodrome after losing his way on the British coast. The total area covered by the air port is 360 acres, and the equipment includes control rooms, customs and immigration halls, express and freight rooms, police and hospital quarters, as well as a residential hotel and restaurant.

The speaker paid a visit to the government works at Cardington, near Bedford, where the new British air ship R101 is being built. This ship, when completed, will be about one and one half times the size of the "Graf Zeppelin," which but recently crossed over to America and back.

Hydro-electric power is making substantial progress, especially in the Pyrenees. One plant recently installed operates under a head of 3,100 feet. Reinforced concrete structures, sometimes as high as 60 feet, are used to carry the transmission wires. The development of the Romanche river was described as being of peculiar intensity. Fifteen plants are operated successively over a distance of 20 miles, the tail-water of one becoming the head-water of the next below it. When the development works are completed, the river will yield a total of 150,000 h.p.

One of the most interesting slides shown was of the new high level bridge at Newcastle-on-Tyne, recently opened by His Majesty the King. It has a clear span of 540 feet and permits a clearance for vessels of 100 feet. It is of an arch type, very high in the centre, and cost approximately $6,250,000 to build.

France continues to lead the world in boldness of design, ingenuity and care in workmanship where reinforced concrete is concerned, two notable examples being a reinforced concrete highway bridge in Paris, consisting of two 250-foot truss spans, continuous over the centre support, the trusses being 33 feet high and providing for a 66-foot roadway; and a 600-foot arch span, carrying a railway, now nearing completion at Brest.

In conclusion, the speaker displayed a number of beautifully coloured slides showing types of old bridges in the south of France, built centuries ago but still in a wonderful state of preservation. Some of the bridges shown dated back as far as 1180 A.D. The inclusion of these photographs made one appreciate to the full the privilege of accompanying the speaker on his wonderful holiday.

Wm. Gore, M.E.I.C., moved a hearty vote of thanks, seconded by Peter Gillespie, M.E.I.C., in which the gathering heartily concurred.

Vancouver Branch

F. P. V. Cowley, A.M.E.I.C., Secretary-Treasurer.

Executive Meetings

Since August 15th, three meetings of the Branch Executive have been held, on September 5th, October 12th and October 25th. The main item of business at the September 4th meeting was to discuss with Mr. Powell, Branch Councillor, the feeling of the branch on various matters which were to arise at the Plenary Meeting of Council in Montreal on October 15th to 17th. The October 12th meeting was in the nature of a "send-off" to the Branch Chairman, W. B. Young, M.E.I.C., who left the following day on a two-months trip via the Panama canal to the West Indies. The strain on Mr. Young occasioned by the death of Mrs. Young, following a long severe illness, had told on his health, and it was the hearty wish of the members that the change might be of benefit to him, restoring him to his usual good health and spirits.

At the meeting on October 25th, Mr. Powell reported to the executive the result of his trip to Montreal, explaining the attitude of Council on the various matters brought before it, together with the recommendations which will be put by it before the annual meeting early next year.

Aerial Surveying

At the first regular meeting of the branch this winter, on November 7th, a very interesting paper was given by C. H. Taggart, A.M.E.I.C., on "Aerial Surveying." Mr. Taggart outlined the development of aerial surveying in Canada, making particular reference to the experimental operations carried out during the past season in British Columbia. His address was illustrated by lantern slides, and the attendance of fifty members and friends attested the interest aroused in his subject.

Following a short introduction by the vice-chairman, W. B. Greig, A.M.E.I.C., Mr. Taggart sketched the development by the Dominion government of aerial surveying, supplying, through the Royal Canadian Air Force, the planes, equipment and personnel; and, through the Department of Interior, Topographical Surveys Branch, the photographers and surveyors. The inception of this work in Canada was some seven or eight years ago, the first flights being made over The Pas mineral area in northern Manitoba.

The two methods of photography were then described, the "oblique" method, the first used, and one suitable for work in the flat country with a definite even horizon, and later the "vertical" method, suitable for work in a hilly or mountainous country like British Columbia. In the first method, cameras were mounted in the nose of the machine and photographs taken obliquely to the horizon and through a horizontal angle of 180°. In the second method, photographs were taken through a hole in the floor of the machine, using the plumb bob as a base line.

Already by the photographic method 300,000 square miles of Canada have been photographed, reproduced and the finished maps issued.

Until the delivery this spring from New York of two Fairchild monoplanes, the Royal Canadian Air Force had no plane capable of being used in British Columbia, as a seaplane of high power is necessary for work there.

The general outline of the work done this year in British Columbia was then given, consisting of the Fraser valley, Vancouver to Lytton; the Thompson valley, Lytton to Kamloops, 3,200 square miles in the Shuswap lake area; the Fraser valley, Lytton to Prince George; and, finally, some 2,000 square miles in the Ootsa and Babine lake areas.

The Fairchild monoplanes used in this work were fitted with a nine-cylinder Wasp engine of 420 h.p., capable of flying at an altitude of 19,000 feet. With the 12-inch focal lens Fairchild camera, the first photos were taken at an altitude of 17,000 feet. Working at this altitude was difficult, and, as good results could be obtained at 15,000 feet, this altitude was later adopted, the latter part of the season's work all being done at an altitude of 15,140 feet, or, roughly, three miles. Even at this altitude, owing to "bumps" it was difficult to keep the planes on an even keel, only 2° out of plumb being allowed in taking photographs.

In all, 15,000 photographs had been taken, and of this number only 25 were classed as other than excellent. The photos were taken in strips one mile apart, allowing an overlap, and this required skilled pilots. From the flying standpoint, the season's work had been a success, and from the scientific standpoint as yet a trial, but success was expected.

Mr. Taggart showed forty-one slides during his address, and at the conclusion exhibited plotted flight lines, views of machines used, oblique views, views with grid used for plotting, the members viewing photographs through stereoscopes.

T. A. McElhanney, A.M.E.I.C., moved and A. S. Wootton, M.E.I.C., seconded a very hearty vote of thanks to the speaker.

STUDENT SECTION

The opening of the University of British Columbia on September 25th marked the beginning of the second year of the Students' Section of the Vancouver Branch. During the summer months, the executive carried on a correspondence among themselves, the object of which was to plan a programme of activities for the winter session at the university. A tentative constitution for the section was prepared, to be placed before the members when they met in the fall. The secretary also made numerous enquiries for a hall and caterers, with the intention of arranging for a dinner immediately the university opened.

The first executive meeting for the session was held on Friday, September 29th. The activities for the coming months were discussed and tentative plans for a programme were prepared. Due to the resignation of J. H. Legg as vice-president, it was decided that a new vice-president would be elected at the first meeting of the members. A drive for new members was planned and a circular letter to Applied Science students was prepared and sent to the branch for printing. The letter follows:—

Circular Letter to Applied Science Students

> The U.B.C. Students' Chapter of The Engineering Institute of Canada is commencing its second year at the university. An extensive programme is planned for the session. Plans include lectures by prominent men of various professions, trips to engineering and industrial works in the vicinity of Vancouver and a students' night, when members will have an opportunity to present papers before students and visiting engineers. A get-together dinner will be held in the fall term. Students are invited to join the section and take advantage of the benefits derived from membership. Students in 2nd, 3rd and 4th years of Applied Science are eligible.
>
> A. Peebles, *President.*
> R. Morrison, S.E.I.C., *Secretary-Treasurer.*

It was then decided to hold a dinner as soon as possible. This dinner was for the purpose of introducing new members to members of the branch and to create a keener interest in The Institute among the students. A postcard with suitable blanks was devised for circulation amongst the members, announcing meetings and trips.

Address by Prof. W. E. Duckering

The first meeting of the members was held at noon, October 10th. The president, A. Peebles, was in the chair. The first business brought before the meeting was the election of a new vice-president. W. W. Blankenback, S.E.I.C., and J. Hadgkiss were nominated; Mr. Blankenback being elected. Professor Duckering, honorary president, gave a short address. He first pointed out the numerous reasons for the origin of societies and reasons why the members of the various professions should band themselves together. The speaker then gave numerous concrete examples of how the societies protected the engineers from incompetent competition. Coming closer to home, he went on to point out the difference between The Institute and the Association of Professional Engineers. In closing, he pointed out many reasons for students becoming members; the benefits to be obtained by association with engineers in practice; the information to be obtained and broadening of the student outlook on life by listening to outside speakers and the insight to industrial methods obtained by visits to the various centres of industry. Professor Duckering's remarks were enthusiastically received by those present.

Ancient Irrigation and Some Modern Aspects

The second meeting of the year was held at noon on Wednesday, October 23rd, with A. Peebles in the chair. The speaker for the meeting was H. B. Muckleston, M.E.I.C., consulting engineer. He chose as his subject, "Ancient Irrigation and Some Modern Aspects." The speaker pointed out how man had always preferred the arid, desert lands, where irrigation was necessary. He went on to show how the water was put on the land; how it was first carried in gourds. Later they learned by experience that by flooding the land at high water a limited amount of moisture may be put into the ground. As time went on, men learned to make improvements and canals were built. Mr. Muckleston showed that irrigation was the beginning of modern civilization. Canals were built, then cities grew up on their banks. Man was progressing from the stage of nomads and seasonal habitations to permanent dwellings, all very largely as the result of irrigation becoming possible. The speaker then gave a brief history of various irrigation projects of ancient Egypt and in the vicinity of the Euphrates and Tigris rivers. He paid tribute to the engineers of ancient times in their design of large canals, some of which were several hundred miles long. In closing, he pointed out some of the modern problems of irrigation, how there were many details of irrigation as yet unsolved, but all of which were capable of solution.

Mr. Muckleston gave an exceptionally interesting and instructive talk and one which was very much appreciated. Mr. Blankenback moved the vote of thanks.

Visit to Creosoting Works

On Saturday, October 20th, the members took a trip to the Vancouver Creosoting Works. The plant handles ties, piles and timbers for small trestles and bridges.

Ties to be creosoted first enter the tie mill on the tie machine, where ¾-inch slits are incised in them. This gives a uniform penetration of the creosote into the wood. A conveyor then takes them to another machine, where they are adzed and holes bored into them, so that the railway spikes may be driven in without splitting the wood. They are then loaded on to a retort carrier and taken into the retort cylinder, where they are creosoted. Large timbers, for structures, etc., are cut to the required length in the framing mill before entering the retort.

Piles to be creosoted are seasoned for about two months before being treated, as this shortens the time required for treatment in the retort. Seasoned piles require 16 hours treatment, whereas the wet ones take from 35 to 40 hours.

The carrier, with its charge, is run into the retort, which is simply a long cylinder, and the end is sealed. The retort is then filled all but about 6 inches from the top with creosote; the valves are closed and a vacuum produced in it. The oil is now heated by means of steam coils underneath the retort; the temperature to which it is heated depending on the moisture content and the timber itself. This is known as the "boiling under vacuum" process.

The moisture which is thus taken out of the wood is drawn off into another tank.

A pressure of 150 pounds is then applied, forcing the oil into the wood. What oil is left in the cylinder is drawn off and the vacuum pump started again to take some of the oil out of the wood. The idea of this is to give a deeper penetration into the wood. If 6 pounds of oil per cubic foot of wood is to be used, then 9 pounds is pressed into it and 3 pounds drawn off; 6 pounds of oil giving a ⅝-inch penetration.

First Annual Dinner

On Friday evening, October 19th, the Section held its first annual dinner. Forty-three students and members of the branch gathered to enjoy a most excellent dinner. Due to the unavoidable absence of Mr. Young, chairman of the branch, W. B. Greig, A.M.E.I.C., vice-chairman of the branch, was called on as the principal speaker of the meeting.

Mr. Greig expressed the interest that the branch was taking in the students, the wonderful opportunity that the movement was giving to both members and Students to become better acquainted and have a better understanding of one another.

Mr. Greig was followed by Ted Hay, who gave the gathering two splendid piano solos. The meeting was fortunate in having two prominent engineers from Montreal, J. M. R. Fairbairn, M.E.I.C., chief engineer of the C.P.R., and P. B. Motley, M.E.I.C., engineer of bridges for the C.P.R. Both gentlemen had an interesting message for the students. Mr. Fairbairn encouraged the students to study the problems of government, to interest themselves in others and to make the most of their opportunities as students.

The chairman introduced the other members of the branch present. Those present were H. B. Muckleston, M.E.I.C., A. E. Foreman, M.E.I.C., H. P. Archibald, A.M.E.I.C., W. B. Greig, F. P. V. Cowley, E. A. Wheatley, F. W. Alexander, S. F. Ricketts and Professor Duckering.

The Science Men's quartette entertained the gathering for a few minutes. Then Professor Duckering, honorary president of the Section, had a few words to say to the students. He stressed the difference between a professional man and a technician. In conclusion, he advised the student to stick with whatever he has to do and make a good job of it.

The remainder of the evening was spent in playing bridge. An orchestra added the necessary melody. The evening was declared by all as an entire success. The menu was excellent and the entertainment, which was provided entirely by Students, was the crowning success of the evening.

The executive for the session of 1928-29 is as follows:—

Honorary President	Professor W. E. Duckering.
President	A. Peebles, S.E.I.C.
Vice-President	W. Blankenback, B.A., S.E.I.C.
Secretary-Treasurer	R. L. Morrison, B.A., S.E.I.C.
Assistant Secretary	W. R. Workman, S.E.I.C.

Victoria Branch

K. M. Chadwick, M.E.I.C., Secretary-Treasurer.

The Design and Construction of the Victoria Grain Elevator

A. L. H. Sommerville, resident engineer on the new Victoria grain elevator, addressed the members of the Victoria Branch at a meeting on October 30th.

Mr. Sommerville described in detail the construction of the plant and expressed a very high opinion of the way in which it was done. Considerable interest attached to his description of the method of constructing the cement tanks, where the system was employed of raising the moulds as the work proceeded so that the cement was kept pouring continuously for the full twenty-four hours of the day for each succeeding day.

The process was described in handling the grain from the time that the cars arrived and were dumped into the hoppers until it was carried along continuous belts and through the dryers into the various compartments, and eventually carried into the ships for transport across the sea.

The drying is accomplished by dropping the grain through compartments where, by means of fans, hot air is kept circulating. The grain in its descent is made to follow a broken course, so that it is being constantly subjected to the air currents. The dryer is capable of handling some 5,000 bushels an hour.

The piling was described, and Mr. Somerville said that nothing was left to chance. Every pile placed in position was definitely recorded, and it was known exactly the position of it and full particulars, together with the estimated load which it would carry. In order that the piers might not suffer any damage from the driving of the piles, the jets of water were used under pressure, so that the way for the pile was made easy. Some of the piles were put down fifty feet.

Following the address a general discussion took place.

Aids to Navigation

"Although trans-Pacific travellers feel comparatively safe out on the ocean with plenty of water under them, they breathe sighs of relief when they sight land," said Col. W. R. Wilby, C.B.E., agent for the Department of Marine, in a paper on "Aids to Navigation," delivered before the Victoria Branch of The Engineering Institute of Canada, on November 12th.

"You can imagine what navigators of ships think of obscuring fog and snow," he continued, showing views of the rocky formation of the west coast of Vancouver island, including Pachena point.

"The first requirement of safety for vessels is location of danger points, which must be marked. In this connection the Hydrographic Survey vessel Lillooet is kept busy charting the British Columbia coast.

"Lighthouse construction requires patience, tenacity and obstinacy beyond description," said Col. Wilby, showing views of C.G.S. Lillooet and foam-covered rocks on the coast of Vancouver island.

"In the old days we had beacon fires to guide vessels on their courses; now we have fog alarm signals, radio beacons and powerful lights. I can remember the days when C.P.R. steamers were guided out of Victoria harbour during foggy weather by persons on shore beating tin pans," he continued, showing views of modern whistling buoys and the Pachena lighthouse.

At this point a view of the old wireless station and lighthouse at Triangle island was thrown on the screen. Col. Wilby explained that the wind on the barren rock was so fierce that ropes had to be laid to enable persons stationed there to move from one part to another. The station was moved to Bull harbour, at the north end of Vancouver island, several years ago. Other views shown included Portlock point, Quatsino sound light and Ivory island light.

"Navigation aids include unwatched lights and watched lights," said the colonel, "the earliest form of light was a wood fire on top of a tall tower, its visibility depending upon the direction of the wind. If there was an off-shore wind the light would show brilliantly, but not otherwise.

"Metal reflectors, candles, fish oil, coal oil and gasoline were later used for lights. In 331 B.C. a light was established in Greece on top of a 400-foot tower and it burned for 1,600 years. On the coast of Spain, off Finisterre and on the Bay of Biscay, two of the world's oldest lights are still burning," he said.

"The Biscay light was built by a tax levied upon all ships passing in and out, and included a chapel and royal residence on a 134-foot circular base. Wrecked during the French Revolution, the lighthouse was reconstructed.

"Started in 1695 and finished in 1698, the Eddystone lighthouse in England is another famous navigation aid. After it was swept away in a tremendous gale in 1706 another was started and survived until 1755, when it was destroyed by fire. It was replaced in 1756 by Smeaton's tower, built of stones weighing a ton each. In 1877 the foundation became insecure and the site of the light was moved.

"The fourth light was built 133 feet high and with walls from two feet three inches to eight feet six inches in thickness," said the speaker.

"The first lighthouse on the British Columbia coast was at Race Rocks. It was constructed in England and sent out in pieces in 1861 by the Imperial government. The son of the first keeper is still in the service, being stationed at Pachena. Cape Beale, one of the worst spots on the west coast, was the first station constructed by the Canadian government."

Following a description of the action of a radio compass, fog signals and automatic flashing buoys, Colonel Wilby said that the Department of Marine now maintained 24 lighted buoys, 124 beacons and 203 unlighted buoys, a large increase over the number in 1921.

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

Recent graduate required by a large electrical manufacturing concern for work on factory methods and manufacturing problems. Please state in first instance, education, full qualifications, references, salary required, age, and when available. Apply Box No. 69-V.

Civil or Mechanical Engineer

Civil or mechanical engineer for office and field work on hydro-electric power plant. At least three years experience desirable. Apply to Box No. 125-V.

Mechanical Superintendent

First class mechanical superintendent with experience and capable of taking complete charge of machine shop employing approximately 300 men, manufacturing brass and iron valves, plumbing goods, locomotive specialties, also large steel and bronze fittings and specialties for pulp mills. Apply giving full particulars as to qualifications, past experience and salary expected to Box No. 137-V.

Electrical Salesman

A company in the province of Quebec, has an opening for an electrical engineer to take charge of their merchandise sales department. The applicant must speak French and English, and must have had previous experience in salesmanship, and be able to conduct sales campaigns and supervise sales staff. He must also be able to direct the advertising and must have a personality necessary for such a position. Apply giving full particulars regarding qualifications to Box No. 138-V.

Traffic Superintendent

Traffic superintendent wanted on South American tramway property. Require man with experience in actual operation of street cars and buses on modern city property. Preference given to young man and to technical graduate if with necessary practical experience. Applicants please state full details of education, experience, present salary and give references. To right man this opening presents great opportunities. Apply to Box No. 139-V.

Mechanical Designer and Estimator

A company in Montreal has an opening for a mechanical engineer with experience in the design of digester and acid plants for sulphite pulp mills. The work will be designing and estimating special equipment, and the position offers excellent opportunities for advancement. Apply giving full details to Box No. 140-V.

Mechanical Draughtsman

A manufacturing company in central Ontario has an opening for a mechanical draughtsman with several years experience. The work is in connection with the extension and alteration of the company's manufacturing plant. Apply giving full details of experience to Box No. 141-V.

Mechanical Draughtsmen

Several good mechanical draughtsmen with paper machine experience preferred. Apply giving age, past experience, salary expected and when services are available, to Box No. 142-V.

Transitmen

A pulp and paper company in Quebec have openings for several transitmen for general surveying work. Apply to Box No. 144-V.

Civil Engineer

A large utility company in Ontario require a civil engineering graduate, about 30 years of age, having practical experience covering building construction to a large degree, with some experience in the installation of electrical apparatus, heating, plumbing, fire protection systems, and the layout and construction of sewers, water mains, roads and railways. This position will eventually lead to position of plant engineer. Apply giving full particulars to Box No. 145-V.

Chemical or Metallurgical Engineer

Wanted a recent chemical or metallurgical engineering graduate, with Italian background. Must be able to read and write Italian fluently. Position open contemplates an indefinite training period at a metallurgical plant in Canada for possible future transfer to plant located in Italy. Apply to Box 150-V.

Structural Draughtsman

Structural steel detailer for small firm, with at least five years experience making and checking shop details on bridge and building work. Knowledge of design desirable but not essential. Position permanent to man who can fill the position satisfactorily, with splendid opportunity for advancement. Apply to Box 151-V.

Architectural Draughtsman

Young architectural draughtsman with a knowledge of strength of materials for a young and growing company in Montreal, engaged in the chemical industry. Permanent position. Apply to Box No. 153-V.

Situations Vacant

Chemical Engineer

Recent graduate in chemical engineering for general chemical laboratory and test work. Apply to Box No. 155-V.

Mechanical Engineer

Mechanical engineer, age about 30, technical graduate with six to seven years' experience, including hydro-electric power plant design and construction. Prefer applicant with knowledge of French and German. Ultimate location South America. Please give full details age, education, experience and references. Apply Box No. 157-V.

Power Sales Engineer

Power sales engineer required by a large electric light and power utility in South America. Must be capable of investigating and encouraging development of new business of wide variety utilizing electric power. Should be a technical graduate with five to ten years' sales experience and possess ability to learn foreign languages. Applicants please give details of age, education, experience and references. Excellent opportunities for right man. Apply to Box No. 158-V.

Manager for Cold Storage Terminal

Wanted, a man with engineering and sales experience to take charge of the management and operation of a large modern cold and general storage terminal in New Brunswick. Must be able to sell storage to a wide clientele and have mechanical, organizing and operating ability. Apply giving full particulars regarding qualifications to Box No. 159-V.

Designing Draughtsman

Designing draughtsman for newsprint mill. Must be neat and accurate, capable of designing structural steel and reinforced concrete structures and handling mechanical details for plant equipment installations. Industrial plant experience necessary, preferably paper mill. State age, education, experience, salary expected, if married or single, and notice required. Send samples of design calculations and draughting work, also photograph. Apply to Box No. 160-V.

Structural Draughtsmen

Two structural draughtsmen required who have had experience in steel plate and tank work, if possible. Apply stating past experience, education, whether married or single, salary expected and when services available. Apply to Box No. 161-V.

Recent Graduate

Recent graduate in chemical or mechanical engineering for process work in large newsprint mill. Reply giving full details of experience, education, salary expected and nationality to Box No. 163-V.

Mechanical Engineer

Young graduate Canadian engineer experienced in air moistening and conditioning for the Canadian plant of an American blower concern. Business also comprises artificial heating and ventilation. Position, which is with large bona fide concern, calls for an investment of $1,000 to $2,000 as evidence of good faith. State salary and full particulars of experience to Box No. 164-V.

Chemist

Wanted, experienced chemist for high-grade bleached sulphite mill. In reply, state age, past experience whether on control or research work. Apply to Box No. 165-V.

Mechanical Draughtsman

Competent draughtsman, preferably a graduate in mechanical engineering, with experience in paper mill maintenance and alteration work. Apply to Box No. 166-V.

Situations Vacant

Sales Engineer

An engineering company manufacturing power plant and materials handling equipment requires a graduate engineer with experience in the power plant field and interested in sales engineering work for assistant in sales department. Sales experience desirable but not essential. Excellent opportunity for qualified man. Apply to Box No. 167-V.

Mechanical Engineer

A recent graduate in mechanical engineering interested in sales work to start in erection or draughting office of engineering company manufacturing power plant and materials handling equipment, to fit him for sales department. Apply to Box No. 168-V.

Assistant Engineer

Wanted immediately, assistant engineer experienced in the design of structural steel work and reinforced concrete, stating age, salary expected, experience and earliest date on which service available. Apply to Box No. 169-V.

Sales Engineer

A graduate engineer with wide experience in sales work, for a company manufacturing power plant and materials handling equipment. Apply to Box No. 170-V.

Mechanical Engineer

Young mechanical engineer about 25 to 30 years of age, with technical training and several years shop experience, for draughting and designing department of a company in western Ontario, where there is ample opportunity for advancement. Position permanent. Apply to Box No. 171-V.

Electrical or Mechanical Engineers

Vacancies exist for commissioned officers in the Royal Canadian Signals, Permanent Forces of Canada. Applicants must be British subjects, be under 25 years of age, physically fit and unmarried, and hold degree of electrical or mechanical engineering from a recognized university. Apply Box No. 172-V.

Production Engineer

A manufacturing company near Toronto has an opening for a young graduate engineer with experience in estimating and also preferably with experience in actual machine shop work. Apply Box 173-V.

Chemical or Metallurgical Engineer

A company with headquarters in the state of West Virginia requires the services of an experienced chemical or mechanical engineer for work in connection with the development of sodium sulphate deposits. The work in the first instance will be in West Virginia and later in western Canada. Apply Box 174-V.

Construction Engineer

A graduate engineer with five or six years experience on concrete and steel construction, required by a firm in Montreal. Apply with full particulars to Box 175-V.

Draughtsman

Wanted, a structural draughtsman with some experience in power plant and machinery layout. Location Montreal. Apply to Box No. 176-V.

Assistant Engineer

Wanted, an assistant engineer, preferably with some experience in connection with pulp and paper mills. Apply, stating age, experience, salary expected, and when available to Box No. 178-V.

Situations Vacant

Chemical Research Engineer

A young chemical graduate with a good academic record required by the research department of a large pulp and paper company in the province of Quebec. Apply to Box No. 179-V.

Recent Graduate

A paper company in Quebec has an opening for a recent graduate in mechanical, civil or electrical engineering. This position offers an opportunity for experience in the manufacture of pulp and paper. Apply to Box No. 180-V.

Salesman

An established, rapidly growing manufacturing business with branch offices in principal Canadian cities, distributing roofing and allied building materials, has an opening for a salesman in the Toronto office for promotion work with architects. This position requires a young ambitious man of irreproachable character, preferably with experience in engineering and building construction. Apply, stating age, education, experience, and give references to Box No. 181-V.

Draughtsman

Draughtsman wanted for general engineering in industrial plant in Montreal. Must be graduate engineer with at least five years experience, and with initiative and some ability to design. Permanent position. Apply to Box No. 182-V.

Situations Wanted

Designing Engineer

Electrical engineer, five years' experience in design and construction of hydro-electric plants and H.T. sub-station work, seeks position in or around Montreal. Experienced in all phases of electrical power house and sub-station design. B.Sc. '24, M.Sc. '28, age 30 years. A.M.E.I.C. Apply Box No. 7-W.

Construction Engineer

Electrical engineer, B.Sc., M.Sc., wishes to locate in Montreal on electrical construction or installation work involving power and distribution equipment. Experience covers design, testing, operation, maintenance and installation of power equipment. Can handle men successfully and show results. Now employed in Quebec. Apply Box No. 40-W.

Mechanical Engineer

Graduate mechanical engineer, aged 30 years, of good standing and integrity, with several years experience in paper mill design, construction, operation and records department, also good knowledge of cost accounting, desires responsible position. Apply to Box No. 45-W.

Civil and Mechanical Engineer

Civil and mechanical engineer with long and varied experience on design, construction, and operation of pulp and paper mills, desires position of responsibility. Specialty is reduction of conversion costs. Apply to Box No. 53-W.

Civil Engineer

Young graduate civil engineer with experience as field draughtsman and instrumentman on hydro-electric power developments, making plans, estimates on excavation and concrete, would like to secure a position. Apply to Box No. 54-W.

(Continued on next page)

Situations Wanted

Civil Engineer

A graduate of McGill Univ. '24, with some knowledge of French, wishes to return to Canada from the U.S.A. His experience includes instrumentman on railway construction, resident engineer on railway construction, instrumentman on general maintenance, and transitman on preliminary surveys. Apply to Box No. 103-W.

Civil Engineer

McGill graduate with eleven years experience on the construction of hydro-electric developments and industrial buildings desires a position as resident engineer. Open for engagement at very short notice. Apply to Box No. 117-W.

Civil Engineer

Toronto Univ. graduate '25 desires permanent position, preferably but not necessarily on hydro-electric development. Most recent experience, design of bridges, culverts, etc., two years; river control studies and open channel hydraulics for hydro developments, two years; draughtsman and detailer on hydro development, three years; mechanical draughtsman on steam power plant work, two years; at present in Southern California, but available on short notice. Apply to Box No. 119-W.

Sales Engineer

A graduate mechanical engineer resident in Toronto, experienced in the design and construction of industrial plants and smaller work, would like to represent manufacturing concerns in this territory. Remuneration could be adjusted after a reasonable trial. Apply to Box No. 123-W.

Structural Designer and Draughtsman

Structural designer and draughtsman, graduate engineer with 16 years experience in Canada and in the city of New York, on all types of structures, including tall buildings, apartments, hotels, warehouses, factories and industrial buildings. At present in Montreal, desires spare time employment, evening, Saturday afternoons, etc., at home or office, designing, laying out, figuring, checking or estimating. Apply to Box No. 127-W.

Electrical Engineer

Graduate of McGill Univ. '27 in electrical engineering, age 24, single, desires a position which will give him experience in construction or design along this line. Employed since graduation by a large public utility on pole line work. Has also had considerable experience in surveying. Apply to Box No. 129-W.

Recent Graduate

Electrical engineer, graduate '27, with experience in electrical construction, Diesel engines operation and eighteen months tests course, wishes to secure position with promise of advancement. Location immaterial. Apply to Box No. 132-W.

Civil Engineer

Graduate R.M.C., eighteen years' experience on hydraulic construction, building construction and design, dredging, manufacturing, steel fabrication, and plant maintenance, desires position as resident engineer, maintenance engineer, or dredging manager. Apply to Box 136-W.

Mechanical Engineer

Graduate mechanical engineer with 8 years experience, including 2 years on hydro-electric power construction and 6 years design and installation of equipment with a pulp and paper company and a large industrial manufacturing plant, desires a position as mechanical engineer in an industrial plant or pulp and paper mill, or as representative on the sale of heavy machinery. Apply to Box No. 142-W.

Mechanical Engineer

M.E.I.C., with exceptional experience in the design, manufacture and sale of cranes of all types. Can organize economical production throughout, accustomed for many years to full responsibility. Apply to Box No. 148-W.

The Training of Young Engineers

Each year at this season, a certain number of engineers have claim to a good deal of sympathy from their fellows. The call to the high office of president of our leading technical institutions carries with it, among other responsibilities, that of delivering an address, which everybody, author, secretary and audience included, devoutly hopes and prays may be found to be not without interest. Each year a number of such addresses are delivered, and as the number of our important institutions is not small, the rate at which topics are thus dismissed is considerable. There is indeed little hope of anyone nowadays striking one that is really novel. The circle, in spite of the wider fields into which engineering is ever extending, tends to become relatively narrower. The philosophical type of address will remain the exception. There are few engineers in these days with leisure during their working lifetime sufficient to devote to erudite scholarship, much as many would like to crowd it in, and addresses on the more abstract side of what the profession stands for are better left to the gifted few than attempted by many. More often the best address, as Mr. Richard W. Allen suggested on Friday last, is made out of a man's own experience.

On the occasion to which we have alluded, Mr. Allen delivered his presidential address to the Institution of Mechanical Engineers, and in more than one respect was fortunate above his fellows. Both he and his firm have been closely connected with a special branch of engineering work not previously dealt with so far as memory serves, in addresses before the Institution. In any case the review given by Mr. Allen of the development of marine auxiliaries was not only permissible but welcome, covering as it did stages on which he is qualified to speak better than most engineers. Secondly, his remarks on training, in view of the attitude for so long adopted by his firm, cannot fail to carry the conviction that they are the outcome of a very practical experiment. And, we may add, thirdly, Mr. Allen's address was delivered in a manner which, without exaggeration, made listening a delight.

We have already referred to the place which the training of young men occupies in the economy and organization of the Queen's Engineering Works, Bedford. The stress laid upon the importance of this has been brought before engineers, on occasions, since the system was first adopted under the late Mr. W. H. Allen, who, it will be remembered, signified his interest in the younger men in the Institution by presenting to it not many years ago two valuable scholarships. In respectively proposing and seconding a vote of thanks to the president for his address, both Sir John Aspinall and Dr. H. S. Hele-Shaw referred to this matter of training. Sir John asserted that much of the success which Messrs. Allen had achieved was undoubtedly due to the care taken with regard to training. The company has never allowed itself to be exercised by the fear, so often expressed, that if a firm educates lads they will leave it as soon as possible for jobs at more attractive pay with its competitors. While this may be sometimes the case, taken by and large the care bestowed upon them is worth while. In many cases it results in a sincere attachment between the members of the staff and the firm, while we may be sure the latter has few regrets if, of the multitudes passing through its hands, some must inevitably ultimately become detached to follow the profession in the Dominion overseas, or elsewhere, provided that, as will most certainly be the case with the majority, the Allen traditions are maintained. With such a training coupled with the development of healthy social spirit, the Empire will certainly gain if at times men leave Bedford for more distant spheres.—*Extract from Engineering, October 26th, 1928.*

Preliminary Notice

of Applications for Admission and for Transfer

November 20th, 1928.

The By-laws now 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 1928.

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 or 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

BROWN—HILTON ORLAND, of Iroquois Falls, Ont., Born at Port Sydney, N.S., July 28th, 1890; Educ., B.A.Sc., Univ. of Toronto, 1912; 1911 (summer), asst. on stream measurements, Dept. Interior, Calgary; 1912-14, engr. on hydrographic surveys and irrigation inspections, Dept. Interior, Calgary; 1914-15, supervising house constrn. work (personal); 1915-17, dftsman. and asst. engr. on constrn. at McIntyre Mines, Ontario; 1917-19, overseas, Can. Engrs.; 1919-20, field engr. on constrn., E. A. James Co., Toronto; 1920-21 (5 mos.), designing dftsman., Riordon Paper Co.; 1921-25, designing dftsman., and 1925 to date, engr. in charge of dfting., Abitibi Power & Paper Co., Iroquois Falls, Ont.

References: H. J. Buncke, C. B. Shaw, E. M. Proctor, W. B. Redfern, P. M. Sauder, F. H. Peters.

CALDWELL—FREDERICK WILLIAM, of 17 Marlowe Ave., Montreal, Que., Born at Lawrence, Mass., Nov. 12th, 1875; Educ., S.B., Mass. Inst. Tech., 1899; 1897-1902, periods of six mos. to two years, with United Shoe Machy. Co., American Soda Fountain Co., Mass. Highway Commn. (res. engr. i/c of constrn. of Reading & Woburn Rd.), Penn. Steel Co. (designed special milling machine and machy. for wall cranes in bridge shop); 1902-27, with General Electric Company, Schenectady, N.Y., engr. in office of vice-president, i/c of engineering and manufacturing, duties of a general engineering and executive nature; at present consltg. engr., Montreal, Que.

References: H. O. Keay, L. DeW. Magie, F. Newell, G. Kearney, W. M. Cruthers, V. S. Foster.

GRAVEL—ARTHUR L., of 451 Clarke Ave., Westmount, Que., Born at Montreal, July 4th, 1904; Educ., B.Sc., McGill Univ., 1924; 1922-23 (summers), elect'l mtce. work, Hollinger Cons. Gold Mines, Ltd.; 1924-25, student course, and part of 1925, switchboard engrg. dept., Westinghouse Elec. & Mfg. Co., East Pittsburgh; 1925, elect'l engr., Quebec Development Co., Isle Maligne, Que., power plant mtce. and transmission line design and field location; 1926-27, educational work under H. M. Morris, Bell Telephone Co. of Canada; 1928, paper mill design and layout, Canada Power & Paper Corpn., Montreal, Que.

References: C. V. Christie, P. S. Gregory, H. M. MacKay, J. B. Porter, F. H. Cothran, W. S. Lee.

HAWTHORNE—DONALD J., of Peterborough, Ont., Born at La Salle, Ill., U.S.A., March 31st, 1901; Educ., commissioned and lieut., U.S. Marine Corps., U.S. Naval Academy, June 1923; 1923-24, U.S. Marine Corps., Officers' School, Quantico, Va.; 1924-25, 2nd lieut., U.S.M.C. Signal Battn., U.S. Marine Corps. Exped. Force, i/c of radio communications; 1925 to date, supt., Western Clock Co., Ltd., i/c of all mfg., machine mtce., power supply, boilers.

References: R. L. Dobbin, W. M. Cruthers, R. H. Parsons, E. R. Shirley, A. L. Killaly.

JARAND—WILLIAM HENRY, of 56 Willowdale Ave., Outremont, Que., Born at Emden, Germany (born British subject), Dec. 27th, 1900; 1916-19, elect'l course (silver medal), Montreal Technical School; 1919-20, engr. student course, Northern Electric Co.; 1917-18 (summers), elect'l repair work, Fred Thompson Co., Ltd.; 1920 to date, with the Northern Electric Co., Ltd., as follows: 1920-21, telephone equipment engrg.; 1921-23, inspection engrg. laboratory; 1923 to date, i/c inspection engrg. lab., testing and inspection of telephone circuits, repeater, carrier current equipment, etc.

References: W. C. Adams, W. C. M. Cropper, A. J. Lawrence, N. L. Dann, H. J. Vennes, N. L. Morgan, W. L. Dawson.

HUNT—JOHN, of Montreal, Que., Born at Dundee, Scotland, Sept. 20th, 1903; Educ., B.Sc. (Civil and Mech. Eng.), St. Andrews Univ., Scotland, 1927; 1918-21, marine engrg. ap'ticeship, Caledon Shipbldg. & Engrg. Co., Dundee; 1927 (Sept.-Dec.), struct'l steel design, Caledon Shipbldg. Co.; Feb. 1928 to date, asst. designer, Canadian Vickers, Ltd., Montreal, Que.

References: A. W. K. Massey, G. Agar, P. F. Stokes, A. Dawes, W. K. Scott.

LANGFORD—JOHN ALEXANDER, of 141 Brookdale Ave., Toronto, Ont., Born at Gravenhurst, Ont., June 9th, 1895; Educ., B.A.Sc., Univ. of Toronto, 1922; 1922-23, students' course, and 1923-24, gen. engrg. section as junior engr., specializing in application of rly. motors and equipment, Westinghouse Co., at East Pittsburgh; May 1924 to date, elect'l engr., Canadian and General Finance Co., Toronto, work including writing specifications and orders and carrying out inspections on all kinds of elect'l equipment for use on various properties in Mexico and Brazil of the companies with which the above named company is connected; also assisted with design of indoor and outdoor substations and carried out numerous special studies. (Overseas with Can. Engrs., final rank, Acting Capt.)

References: G. D. Maxwell, H. L. Dowling, A. Roberts, E. V. Deverall, H. G. Thompson.

MORRISON—CARSON F., of Toronto, Ont., Born at File Hills, Sask., Aug. 23rd, 1902; Educ., B.E., Univ. of Sask., 1925; M.Sc., McGill Univ., 1927; 1922-26 (summers), rodman and instr'man, Sask. Dept. of Highways; 1927, asst. Geodetic Survey of Canada, precise levelling; at present lecturer, dept. of civil engrg., University of Toronto, Toronto, Ont.

References: C. J. Mackenzie, H. M. MacKay, H. R. MacKenzie, R. S. L. Wilson, E. Stansfield, C. R. Young, T. R. London, E. H. Phillips, G. M. Williams.

PARKER—WILLIAM ALEXANDER, of Three Rivers, Que., Born at Halifax, N.S., Feb. 28th, 1900; Educ., I.C.S.; 1916-19, chainman, Halifax Ocean Terminals; 1919 (Apr.-Dec.), leveller on cross sectioning, Halifax Shipyards, Ltd.; 1919-20, instr'man on location surveys, N.S. Highway Board; 1921 (Jan.-May), transitman, N.S. Power Commn.; 1921 (July-Oct.), checker on concrete work, Halifax Shipyards, with C. A. Fowler, M.E.I.C.; 1922 (Jan.-July), tester, McArthur Irwin, Ltd., Montreal; 1922 (Aug.-Dec.), inspr., N.S. Highway Board; 1923-25, chief of party on flowage and topog'l surveys, N.S. Power Commn.; 1925 (Mar.-May), chief of party on topog'l surveys, A.P.W. Co., Sheet Hbr.; bal. 1925, instr'man on constrn., International Paper Co., Three Rivers; Jan. 1926 to date, dftsman., transitman and asst. engr., Wayagamack Pulp & Paper Co., Three Rivers, Que.

References: A. A. Wickenden, C. A. Fowler, A. M. James, J. F. Lumsden, H. S. Johnston, R. P. Freeman, J. G. Dryden, D. E. O'Brien, L. H. Robinson.

RORVIK—OLE JOHAN, of 1233 Dorchester St. West, Montreal, Que., Born at Vigra, Norway, July 31st, 1873; Educ., Examen Artium (B.A.), Univ. of Oslo, 1896; studied at Univ. of Oslo, 1896-97; studied civil engrg., Univ. Berlin, Germany, 1897-1900; post-graduate course in reinforced concrete, Columbia Univ., New York, 1908-09; 1900 (May-Nov.), instr'man and dftsman., Prog, Austria; 1900-03, locating engr., Govt. Rlys. of Saxony; 1903-04, instr'man and dftsman., P.R.R. and B. & O.R.R., U.S.A.; 1904-09, detailer and checker of struct'l steel drawings with bridge and steel companies in U.S.A. and Canada; 1909-12, designer, bridge dept., N.Y. Central R.R., New York; 1912-16, designer and checker of struct'l steel in San Francisco; 1916-18, designer, bridge dept., N.Y. Central R.R., Cleveland, Ohio; 1918-19, designer and constrn. engr., American Gas & Electric Co., New York; 1919-24, asst. engr. on location and constrn. of govt. rlys. in Norway; 1925-26, supervising engr. in Tyssedal, Norway, for constrn. of transformer stn. 15,000 h.p., pier-area 2,500 sq. yds., four factory bldgs. and a retaining wall, in reinforced concrete, and a storage house, furnace house, three travelling cranes (cap. 35 tons ea.), in steel; Feb. 1927 to date, designer of reinforced concrete for grain elevators, with J. S. Metcalf Co., Montreal.

References: H. Rolph, L. Coke-Hill, L. N. Jenssen, H. L. Steenbuch, E. Eriksen.

STEEVES—BEVERLY HALL, of Montreal, Que., Born at Moncton, N.B., April 7th, 1897; Educ., B.Sc., McGill Univ., 1923; 1923-27, engrg. inspection dept., and May 1927 to Oct. 1928, engrg. vacuum dept., Northern Electric Co., Ltd., Montreal, responsible for the production and inspection of broadcast and repeater vacuum tubes and for design and development of radio tubes; at present engr. in charge of engrg. vacuum tube shops.

References: W. C. Adams, H. J. Vennes, A. J. Lawrence, N. L. Dann, N. L. Morgan, C. M. McKergow.

THOMPSON—FREDERIC GERARD, of 4328 Sherbrooke St. West, Montreal, Que., Born at Hillsboro, N.B., Sept. 4th, 1901; Educ., B.Sc. (C.E.), Univ. of N.B., 1925; Aug. 1918 to Aug. 1919, and Aug. 1920 to Aug. 1921, rodman, dftsman., etc., C.N.R.; 1923 (summer), asst. engr., sewer constrn., St. Andrews, N.B.; 1924 (summer), field dftsman., storage survey, Grand Falls, N.B.; Nov. 1925 to Nov. 1926, dfting., field engrg., exploration, United Fruit Co., Guatemala, C.A.; 1927 (Jan.-May), owner's engr., concrete silo constrn., slip-form work, Albert Mfg. Co.; May 1927 to May 1928, town planning and designing, Aluminum Co. of Canada, and from May to Oct. 1928, chief field engr.; not employed at present.

References: E. G. Evans, H. R. Wake, R. E. Parks, C. J. Mackenzie, A. W. McMaster.

FOR TRANSFER FROM THE CLASS OF JUNIOR TO A HIGHER GRADE

DICKSON—THOMAS HAVELOCK, of Moncton, N.B., Born at Pictou, N.S., Sept. 16th, 1895; Educ., B.Sc. (E.E.), N.S. Tech. Coll., 1922; 1915-19, overseas, bldg. constrn. and operation of small engine generator plant (3 unit), France, 1917; 1922-23, switchboard operator, meter tester, etc., N.B. Power Co., Saint John, N.B.; 1924 (Apr.-June), installing equipment, Malay Falls power plant, and June to Oct. 1924, senior operator of same plant, N.S. Power Commn.; Apr. 1924 and Jan.-Apr. 1925, instructor, elect. machy., short course, N.S. Tech. Coll.; 1925-26, signal dftsman. and inspr., C.N.R., Atlantic region; Sept. 1926 to date, supervisor of unit cars, Atlantic region, C.N.R., i/c of all gasoline-mech'l storage battery and oil electric cars in service in this region.

References: G. L. Dickson, F. O. Condon, M. J. Murphy, F. Williams, H. B. Titus, J. R. Freeman, V. C. Blackett, F. R. Faulkner, W. F. McKnight, J. H. Reid, A. A. Turnbull, B. E. Bayne.

FOX—EDWARD CECIL EVANS, of 94 Duplex Ave., Toronto, Ont., Born at Coaticooke, Que., Nov. 29th, 1899; Educ., diploma, mech'l engr., I.C.S., 1922; qualified as Capt. in Military Engrg., R.M.C., 1924; 1918-20, app. engr., Canadian Ingersoll-Rand, Sherbrooke, Que.; 1920-21, app. instr'man and civil engrg. dftsman., Q.C. Rly.; 1921-24, instr'man and app. struct'l engr., McGregor & McIntyre; 1924-27, instr'man and app. struct'l dftsman., Bethlehem Steel Co.; 1927, asst. res. engr., T. & N.O. Rly., constrn. on James Bay Extension; 1928, asst. res. engr., Dominion Bridge Co., on erection of steel of Royal York Hotel; at present on leave of absence.

References: C. S. L. Hertzberg, E. T. Bridges, J. Robertson, S. B. Clement, A. W. Robinson.

GATES—GRANT GORDON, of 198 Fairleigh Ave. South, Hamilton, Ont., Born at Fairground, Ont., July 18th, 1894; Educ., 1916-17, first year, applied science, McGill Univ.; 1915, 1918-19, rodman and instr'man with J. W. Tyrrell & Co., and 1920-22, municipal, survey and subdivision work for same company; 1923-24, partner with O. R. Blandy, gen. engrg. and survey work, design of coal handling plant for Barton Coal Co.; 1926, res. engr. on constrn. of sheet mill and galvanizing plant; 1927, constrn. of new power house, and at present constrn. engr. for Steel Co. of Canada, Ltd., Hamilton, Ont.

References: J. W. Tyrrell, E. G. MacKay, J. E. Jackson, J. E. Grady, W. F. McLaren, J. J. MacKay, F. W. Paulin.

McCURDY—LYALL RADCLIFFE, of 227 Milton St., Montreal, Que., Born at New Glasgow, N.S., July 16th, 1897; Educ., B.Sc. (Mech.), 1921, M.Sc., 1927, McGill Univ.; 1918-20-22 (summers), dfting, freighting-car layout, estimating, etc., engrg. dept., Eastern Car Co., Ltd., New Glasgow, N.S.; 1922-27, sessional lecturer and demonstrator, dept. mech'l engrg., McGill University, and from 1927 to date, full time lecturer in same dept.; 1924-25 (summers), lab. experimentation on artificial stone, with Prof. R. DeL. French, M.E.I.C.; 1926 (summer), prepared new manual for mech'l drawing course, 1st and 2nd years, McGill Univ.; 1927 (summer), conducted investigation into efficiency and operating costs of fleet of 25 tow-boats on Upper Ottawa River; 1928 (summer), assting. Prof. A. R. Roberts, A.M.E.I.C., in research on Journal Bearing Friction.

References: H. M. MacKay, C. M. McKergow, A. R. Roberts, R. DeL. French, J. A. Duchastel, A. S. Wall, R. B. Stewart.

MUELLER—VICTOR LEO AUGUST, 49 Radford Ave., Toronto 3, Ont., Born at Hamilton, Ont., Jan. 26th, 1895; Educ., 1916-18, Buffalo Tech. School; 1912-16, ap'tice, Hamilton Bridge Works; 1916 (6 mos.), checker, Ferguson Steel & Iron Works, Buffalo; 1917, designing, Essenwein & Johnston, Buffalo; 1918 (6 mos.), checking and designing, Peck Bros., Buffalo; 1918-28, checking and designing, Dominion Bridge Co., Ltd., Toronto; March 1928 to date, engr. for Canadian & General Finance Co., Toronto—work covers power, gas, rlys., tramways, transmission lines.

References: A. H. Harkness, W. W. Gunn, G. L. Wallace, D. C. Tennant, C. S. L. Hertzberg.

SCOTT—WILLIAM BEVERLY, of Grand'Mere, Que., Born at Dalhousie, N.B., Oct. 26th, 1895; Educ., B.Sc., McGill Univ., 1920; 1920 to date, with Laurentide Co., Ltd., as follows: 1920-21, erection foreman; 1921-22, asst. master mechanic; 1922-27, master mechanic; 1927 to date, master mechanic and steam plant supt.

References: A. R. Roberts, C. M. McKergow, E. Brown, H. O. Keay, E. Wilson, H. E. Bates.

SHAW—GERALD EDISON, of 772 Sherbrooke St. West, Montreal, Que., Born at Windsor, Ont., May 5th, 1901; Educ., B.Sc., 1924, M.Sc., 1925, McGill Univ.; Sept. 1919-Sept. 1920, dftsman.; 1921 (summer), finish shop, assembling, etc.; 1922-23-24 (summers), dftsman., detailing bridges and towers, Canadian Bridge Co., Ltd.; 1925 to date, engr. in bridge dept., C.P.R., Montreal; work mainly on Toronto grade separation, designing steel and concrete structures.

References: P. B. Motley, R. DeL. French, H. M. MacKay, A. R. Ketterson, F. H. Kester.

FOR TRANSFER FROM THE CLASS OF STUDENT TO A HIGHER GRADE

BAXTER—GORDON BRUCE, of 80 Ste. Angele St., Three Rivers, Que., Born at Quebec, Que., Sept. 29th, 1901; Educ., B.Sc. (E.E.), McGill Univ., 1926; 1920-22, mech'l and elect'l depts., Wayagamack Pulp & Paper Co.; 1923 (May-Sept.), elect'l testing, International Paper Co.; 1924-25 (summers), elect'l and struct'l dftsman., and from May 1926 to May 1927, elect'l dftsman., St. Lawrence Paper Mills; May 1927 to date, elect'l testing, research, dfting and gen. elect'l work, International Paper Company.

References: L. E. McCoy, C. V. Christie, G. A. Wallace, C. U. Vessot, H. M. MacKay.

GRUNDY—ERNEST, of Grand'Mere, Que., Born at Thief River Falls, Minn., U.S.A., Mar. 26th, 1905; Educ., B.A.Sc., Univ. of Toronto, 1927; 1927 (Aug.-Dec.), field dftsman. and instr'man, Alexander Power Development, Nipigon River, H.E.P.C. of Ont.; Jan. 1928 to date, instr'man and chief of survey party, Laurentide Company, Ltd., Grand'Mere, Que.

References: T. R. Loudon, C. R. Young, P. Gillespie, H. Horsfall, J. N. Stanley.

JUSTICE—CLAUDE WELLINGTON, of 363 Leslie Ave., Peterborough, Ont., Born at Dauphin, Man., Aug. 28th, 1901; Educ., B.Sc., Univ. of Man., 1926; 1920 (Apr.-Nov.), C.P.R. rld. constrn., Sask.; 1923 (May-Sept.), instr'man, Pan-American Oil Co., Calif.; 1924 (May-Sept.), C.P.R. rld. constrn., Alta.; 1925 (May-Sept.), cost clerk, L. E. Meyers Constrn. Co., Chicago; 1926-27, Can. Gen. Elec. Test Course, Peterborough; at present engrg. dept. of same company.

References: W. E. Ross, A. B. Gates, W. M. Cruthers, L. DeW. Magie, E. R. Shirley, B. Ottewell, E. P. Fetherstonhaugh.

LEMMON—CYRIL COOPER, of Fonthill, Ont., Born at Catford Kent, England, Oct. 23rd, 1901; Educ., B.Sc., E.M., Mich. Coll. of Mines, 1925; Aug. 1925 to Mar. 1926, dftsman. and instr'man, city engr.'s office, Windsor, Ont.; Mar. 1926 to Nov. 1926, field engr. for W. J. Lehner, Mt. Clemens, Mich., county engr. for Macomb Co.; 1927 (Mar.-Aug.), supt. and engr. on dock work and a filtered water reservoir for City of Detroit for Whitney Bros. Co., Detroit; Aug. 1927 to date, dftsman. on Welland Ship Canal, Welland, Ont.; work includes a considerable amount of designing.

References: M. E. Brian, E. G. Cameron, E. P. Johnson, O. Rolfson, J. C. Street, E. S. Turner.

MINTER—HARRY JOHN DUNCAN, of 1935 Bayle St., Montreal, Que., Born at Suffolk, England, Aug. 8th, 1901; Educ., B.Sc. (honors), Queen's Univ., 1925; 1924 (summer), recorder in charge of party; 1925 (summer), student engr., Bell Telephone Co. of Canada; 1927 (summer), elect'l dftsman., Power Engrg. Co., Montreal; winters 1925-26-27, demonstrator, dept. elect'l engrg., Queen's Univ.; at present methods engr., Northern Electric Co., Ltd., Montreal.

References: D. M. Jemmett, L. T. Rutledge, D. G. Geiger, J. A. McCrory, D. S. Ellis.

OLIVER—JOHN CRAIG, of 2716 42nd Ave. West, Vancouver, B.C., Born at Edinburgh, Scotland, Nov. 25th, 1904; Educ., B.A.Sc., Univ. of B.C., 1927; summer work with the municipality of Pointe Grey, B.C., as follows: 1923, rodman; 1924, instr'man; 1925, designing sewers; 1926 (summer), dftsman., forest survey party, Dept. of Lands, Prov. of B.C.; 1928 (summer), asst. designing engr., sewer dept., City Engr.'s Office, Vancouver, B.C.; at present instructor, civil engrg. dept., Univ. of British Columbia.

References: W. H. Powell, C. Brakenridge, J. M. Begg, W. B. Young, W. B. Greig.

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A

AIR COMPRESSORS

PORTABLE. Portable Air Compressors (Gleisfahrbare Untertage-Elektro-Kompressoren). Bergbau, vol. 40, no. 40, Oct. 6, 1927, pp. 553-556, 9 figs. Description of DEMAG air compressors travelling along narrow-gauge tracks, suitable for mining work; also compressed air locomotives.

AIR CONDITIONING

HIGH AIR TEMPERATURE. The Physiology of Work Under High Air Temperature Conditions, K. Neville Moss. Jr. Instn. Engrs.—Jl., vol. 37, part 11, Aug. 1927, pp. 541-547. Notes based on experimental work carried out for mining industry in mining department of University of Birmingham with view to obtaining information about work done by human body under varying conditions of air temperature and humidity; tests referred to have distinct practical value, apart altogether from their physiological interest.

AIRPLANE ENGINES

COMBUSTION IN. Combustion Time in the Engine Cylinder and Its Effect on Engine Performance, C. F. Marvin. Jr. Nat. Advisory Com. for Aeronautics—Report, no. 276, 1927, 16 pp., 16 figs.

AIRPLANES

PERFORMANCE. A Simple Theoretical Method of Analyzing and Predicting Airplane Performance, I. H. Driggs. Flight, vol. 19, nos. 34, 38 and 43, Aug. 25, Sept. 22 and Oct. 27, 1927, pp. 596a-596d, 668d-668f and 750a-750b. Gives formulas to show relation of certain fundamental variables to absolute ceiling and to rate of climb, and to allow estimate to be made for these quantities with but minimum of calculation.

STRUCTURAL DESIGN. Some Further Practical Points in the Structural Design of Aircraft. Inst. Aeronautical Engrs.—Jl., vol. 1, no. 9, Sept. 1927, pp. 5-14 and (discussion) 14-19, 9 figs.

WINGS. Pressure Distribution Tests on PW-9 Wing Models Showing Effects of Biplane Interference, A. J. Fairbanks. Nat. Advisory Com. for Aeronautics, no. 271, 1927, 13 pp., 14 figs.

ALLOY STEELS

MOLYBDENUM. Facts and Principles Concerning Steel and Heat Treatment, H. B. Knowlton. Am. Soc. Steel Treat.—Trans., vol. 12, no. 5, Nov. 1927, pp. 814-826, 3 figs.

ALLOYS

ALUMINUM. *See Aluminum Alloys.*

BRASS. *See Brass.*

COPPER. *See Copper Alloys.*

CORROSION-RESISTANT. Selection of Corrosion-Resistant Alloys, W. M. Mitchell. Blast Furnace & Steel Plant, vol. 15, no. 9, Sept. 1927, pp. 427-434. Causes of corrosion are explained; elements which increase resistance of steel are silicon, copper and chromium; non-ferrous alloys effective under certain conditions.

ALUMINUM

COMMERCIAL. Commercial Forms and Applications of Aluminum and Aluminum Alloys, P. V. Faragher. Am. Inst. Min. & Met. Engrs.—Tech. Publication, no. 33, 1927, 28 pp., 5 figs. Commercially pure metal containing from 99.0 to 99.4 per cent aluminum, remainder consisting largely of iron, silicon and copper, introduced in process of electrolytic reduction is called "pure aluminum" when it is desired to distinguish it from its alloys; effect of impurities in aluminum of high purity; uses for commercially pure aluminum; strong alloys; heat treatment; casting alloys; types of casting processes; sand-casting alloys; effect of heat treatment on strength; permanent-mould castings; die castings; aluminum-alloy forgings and aluminum cable.

MACHINING. Machining Aluminum, R. L. Templin. Am. Inst. Min. & Met. Engrs. —Tech. Publication, no 31, 1927, 15 pp., 10 figs. Comparison of tools more commonly used in machining brass and mild steel with tools most suitable for machining aluminum, and specific discussion of individual tools.

SAND CASTING. Some Notes on Sand Casting Aluminum. Mech. World, vol. 82, no. 2128, Oct. 14, 1927, pp. 290-291. Light weight of aluminum has always to be borne in mind, hence it must be fluid and poured quickly, and it must not meet much resistance from steam or air in mould; moulds should be as dry as possible while still remaining workable, and they must be well vented in places where gases of any kind would otherwise be able to form pockets.

ALUMINUM ALLOYS

ALUMINUM-COPPER. Industrial Utilization of Aluminum Alloys (A propos de l'utilisation industrielle des alliages d'aluminium), H. Pommerenke and P. Herman. Revue de Métallurgie, vol. 24, no. 6, June 1927, pp. 297-306, 8 figs.; and translated abstract in Metallurgist (Supp. to Engr.), Oct. 28, 1927, pp. 154-155, 2 figs.

ARCHES

STRESSES IN. A Graphic Method for Determining the Stresses in Circular Arches Under Normal Loads by the Cain Formulas, F. H. Fowler. Am. Soc. Civil Engrs.—Proc., part 1, Oct. 1927, pp. 1893-1917, 13 figs. Presents series of curves for determining stresses, in pounds, per square inch, at extrados and intrados of crown and abutments of circular arches under normal loads.

AUTOMOBILE ENGINES

CARBURETORS. The Function of Carburetors, with Special Reference to Automobile Engines (Le fonctionnement des carburateurs des moteurs à explosion, envisage principalement au point de vue de leur application à l'automobile), A. Coppens. Chaleur & Industrie, vol. 8, nos. 87 and 90, July and Oct. 1927, pp. 424-428 and 603-610, 17 figs. July: Deals with control of carburetors. Oct. Construction of curves and diagrams.

VARIABLE-COMPRESSION. A New Automobile Engine, Nau-Touron (Un nouveau moteur à courses inégales à faible obliquité de bielle et à compression variable), E. Marcotte. Arts & Metiers, no. 83, Aug. 1927, pp. 277-288, 23 figs. Theory and construction of engine of unequal stroke, slightly oblique, connecting rod and variable compression; points out its special economic value for France in permitting use of various fuels, and its significance for aviation by making possible a wider range of flight.

AUTOMOBILE MANUFACTURING PLANTS

HEAT PROCESSES. Heating Processes Synchronized in Straight Line Production, J. B. Nealey. Iron Trade Rev., vol. 81, no. 10, Sept. 8, 1927, pp. 584-587, 5 figs. Methods and equipment of Ford Motor Co.; heating steel ingots.

AUTOMOBILES

BRAKE-TESTING MACHINES. Brake-Testing Machine Simulates Road Operating Conditions. Automotive Industries, vol. 57, no. 19, Nov. 5, 1927, pp. 684-685, 4 figs. Synchrometer automatically makes record of decelerating characteristics of each wheel, plotting speed for each foot of travel from time brake is applied to complete rest.

PROGRESS. Progress in Design. Autocar, vol. 59, no. 1668, Oct. 21, 1927, pp. 816-870. Notes on development based upon characteristics of 312 different types of cars available on British market.

AUTOMOTIVE FUELS

DEVELOPMENT. Motor Fuels, J. B. Hill. Indus. & Eng. Chem., vol. 19, no. 10, Oct. 1927, pp. 1114-1115. Chemistry's contribution to quantitative production and quality of motor fuels; substitutes for gasoline.

B

BALANCING

PRINCIPLES. Balancing of Rotating Bodies, C. R. Soderberg. Tech. Eng. News, vol. 8, no. 5, Oct. 1927, pp. 212-216 and 246, 18 figs. Principles involved in mechanical balancing, with description of various types of balancing machines.

BEAMS

REINFORCED CONCRETE. Experiments on Shearing Strength of Reinforced Concrete Beams, J. Gilchrist. Engineering, vol. 124, no. 3224, Oct. 28, 1927, pp. 563-566, 8 figs. Experiments made to find out how shearing strength of beams varied with strength of concrete.

BEARING METALS

SELECTION. Choosing White Bearing Metals, E. R. Thews. Am. Mach., vol. 67, no. 20, Nov. 17, 1927, pp. 759-760. Great number of combinations possible in white bearing-metal alloys makes it desirable for designer and shop man to have clear understanding of effects of each element entering into alloy on final bearing qualities of metal to be selected for bearing.

BEARINGS, BALL

MANUFACTURE. The Manufacture of Ball and Roller Bearings, G. James. Eng. Jl., vol. 10, no. 11, Nov. 1927, pp. 487-493, 22 figs. Details of major manufacturing operations.

BOILER FEEDWATER

TREATMENT. Boiler Feed Water Treatment, E. Caldwell. Indus. Power, vol. 8, no. 4, Oct. 1927, pp. 54-58 and 94 and 96, 5 figs. Discusses necessity for treating boiler feed water and various methods of treating.

Boiler Feed Water Treatment from a Manufacturer's Viewpoint, J. B. Romer. Am. Ry. Eng. Assn.—Bul., vol. 29, no. 298, Aug. 1927, pp. 64-69. Deals with scale, corrosion, embrittlement and priming and foaming.

Treating Boiler Feed Waters, M. H. Watson. Power House, vol. 21, nos. 18 and 19, Sept. 20 and Oct. 5, 1927, pp. 17-20 and 117-121. Discussion of common impurities found in boiler feed water, chemical treatment to prevent corrosion and foaming and explanation of chemical reactions involved, with reference to external purification.

BOILER FURNACES

Combined Pulverized Coal and Stoker Firing. Pulverized Coal Takes Fluctuations in a Stoker Fired Plant. Power, vol. 66, no. 20, Nov. 15, 1927, pp. 733-735, 6 figs. Application of pulverized-coal burners in combination with existing stoker equipment.

Gas-Fired. Gas-Fired Steam Boilers, A. B. Greenleaf. Chem. & Met. Eng., vol. 34, no. 9, Sept. 1927, pp. 566-568, 8 figs. Study of economics involved; there are two principal types of gas-fired boilers in general use; cast iron type is limited to use for comparatively low pressures, while steel firetube type can be used over practically entire range of working pressures.

Water Walls. Boilers with Water Walls for Industrial and Isolated Power Plants, K. Toensfeldt. Combustion, vol. 17, no. 5, Nov. 1927, pp. 293-297, 4 figs. Shows how presence of water walls in furnace not only makes possible higher ratings than may be obtained with old firebrick-lined furnaces, but also how their presence betters relative performance of boiler at same steaming rates.

BOILER PLANTS

Instrument. Automatic Volume Control of Steam and Air, J. Wolfe. Chem. & Met. Eng., vol. 34, no. 9, Sept. 1927, pp. 562-565, 17 figs. Cites two examples: first is one in which continuous control of air for combustion in steam raising is used, while second is example of intermittent or cyclic control of air and steam for manufacture of blue gas or carburetted water gas.

BOILERS

Heat Transfer in. Large Boiler Units and Heat Transfer, A. Page. Power Engr., vol. 22, nos. 259 and 260, Oct. and Nov. 1927, pp. 377-380 and 425-427, 2 figs. Oct.: Thermal losses of modern boiler unit are analyzed. Nov.: Novel method of boiler construction by which chimney and radiation losses are claimed to be greatly reduced.

Marine. *See Marine Boilers.*

Selection. The Selection of Steam Boilers, W. A. Shoudy. Combustion, vol. 17, no. 5, Nov. 1927, pp. 285-288 and 302, 2 figs. Whether waste-heat or direct-fired boilers are to be installed, there is no rate which will completely govern their selection; author has attempted to point out certain paths of approach to problem and to offer few words of warning; there is not now, nor will there be, a universal type suitable for all needs.

Settings. Boiler Settings, G. E. Dignan. Engrs'. Soc. West. Pa.—Proc., vol. 43, no. 6, July 1927, pp. 279-302 and (discussion) 303-305, 12 figs. Points out how conditions can be met in practical and commonsense manner; deals more with larger installations, as conditions are more severe and lessons learned can be applied with profit and discrimination to smaller installations.

Increasnig Height of Boiler Settings, H. B. Singleton. Power House, vol. 21, no. 20, Oct. 20, 1927, pp. 20-21, 3 figs. View is expressed that when boilers are set higher than it is customary and careful firing methods adopted they can be run with practically clean surface if tubes are cleaned every 10 or 12 hours.

Waste-Heat. Raising Steam by Waste-Heat, F. J. Taylor. Colliery Guardian, vol. 135, no. 3485, Oct. 14, 1927, pp. 617-621, 9 figs. Deals with facilities available for producing steam by gas-fired or waste-heat boilers, and certain other means of turning waste-heat to good account.

The Production of Steam from Waste-Heat, A. J. Ebner. Chem. & Met. Eng., vol. 24, no. 9, Sept. 1927, pp. 572-574, 6 figs. Although waste-heat boilers of firetube type have been installed to operate at steam pressures up to 250 lb., greater number are in service at 150 lb. or less; combination of better heat recovery and low initial cost of equipment in an operation at moderate pressure usually outweighs benefits to be derived from high-pressure steam.

Waste-Heat Boilers, J. B. Crane. Combustion, vol. 17, no. 5, Nov. 1927, pp. 303-306 and 310, 6 figs. Boilers for waste-heat purposes are horizontal return-tubular, horizontal or vertical water-tube; settings should be made heavier and more substantial with waste-heat than with regular boilers.

BOLTS

Heat-Treating. Low-Carbon Bolts Show Uniformly High Strength, E. F. Ross. Iron Trade Rev., vol. 81, no. 17, Oct. 27, 1927, pp. 1025-1027, 2 figs. That tensile strengths of low-carbon steel, containing up to 0.15 per cent carbon, could be increased 30 per cent simply by making extremely rapid quench was discovery of Roy H. Smith, of Lamson & Sessions Co., at Kent, Ohio; numerous improvements which have been made during past two years are described.

BRASS

Hot Rolling. Problems of Hot Rolling Brass, L. Kroll. Brass World, vol. 23, no. 10, Oct. 1927, pp. 325-326. Larger heats in casting shop result in more accurate mixing and easier work with moulds; critical review of hot-rolling literature.

BRIDGES, HIGHWAY

Concrete. Concrete Arch Bridge Over the Mississippi, M. S. Grytrak. Eng. News-Rec., vol. 99, no. 19, Nov. 10, 1927, pp. 754-758, 7 figs. Design of bridge on Twin City highway; arch ribs with spandrel bents; foundation work; cableway for concreting; steel centering.

BRIDGES, MOVABLE

Specifications. Standard Specifications for Movable Bridges. Can. Eng. Standards Assn., Sept. 1927, 70 pp., 2 figs. Specification is intended to include technical provisions necessary for supply of article herein referred to, but does not purport to comprise all necessary provisions of a contract.

BRIDGES, STEEL

Highway. Victoria Bridge, Ridout Street, London, Ont., J. R. Rostron. Can. Engr., vol. 53, no. 17, Oct. 25, 1927, pp. 474-478. New steel pony-truss bridge erected over south branch of river Thames to replace old structure; two spans, each 126½ feet, accommodate 31-ft. asphalt roadway and two 6-ft. concrete sidewalks.

BUILDING CONSTRUCTION

Wind-Bracing Connection. Wind-Bracing Connection Combines Welding and Riveting, W. A. Hakin. Eng. News Rec., vol. 99, no. 19, Nov. 10, 1927, p. 752, 2 figs. Tests were completed by Detroit Structural Welding Committee on a combined arc-welded and riveted wind-bracing connection between floorbeam and column.

Winter Inclosure. Winter Construction Methods and Plant, C. S. Hill. Eng. News-Rec., vol. 99, no. 17, Oct. 27, 1927, pp. 674-679, 11 figs. Winter inclosure in building construction.

BUILDINGS

Wind Connections. Details for Wind Connections in Tier Buildings, W. H. Weiskopf. Eng. News-Rec., vol. 99, no. 10, Sept. 8, 1927, pp. 396-399, 7 figs. Connections using angles and I-beams; several types of bracket; connections for double girders.

C

CABLES, ELECTRIC

Conduits for. Determining the Size of Conduit Required for Cables. Elec. World, vol. 90, no. 16, Oct. 15, 1927, p. 787. Proper allowances for conductor placement to avoid expensive alterations and rearrangements may be made by preliminary survey and analysis of specifications.

CABLEWAYS

Aerial. Aerial Tramways, F. C. Carstarphen. Am. Soc. Civ. Engrs.—Proc., vol. 53, no. 9, Nov. 1927, pp. 2101-2182, 22 figs. Author aims at outline classification, together with such comments and formulas that may be of service to engineers in determining elements of aerial ropeway for their needs; these formulas have been derived, checked and used by author and are believed to be in correct and convenient form.

CANALS

Automatic Head Works. Side Spillways for Regulating Diversion Canals, W. H. R. Nimmo. Am. Soc. Civil Engrs.—Proc., part 1, Oct. 1927, pp. 1869-1892, 10 figs. Deals with design of automatic head works for Ouse-Great Lake canal in Tasmania; as head works are likely to become coated with ice for several weeks at a time, forces applied to move gate must be large, and for this reason gates operated by floats were found to be unsuitable; writer investigated theory of flow in side spilling channel with a view to devising a type of regulator without moving parts; paper presents theory developed, describes experiments carried out to test it, and adaptation of theory to design of automatic head works for Ouse-Great Lake canal.

Head Works. The Head Works of the Imperial Canal, C. E. Grunsky. Am. Soc. Civ. Engrs.—Proc., vol. 53, no. 9, Nov. 1927, pp. 2183-2187, 2 figs. In 1916 it became necessary to make considerable improvements, which included an upstream extension of canal for about 1 mile and building of intake structure which is known as Rockwood Gate; this gate was designed for erection on sand foundation; it has 75 openings between piers and extends for more than 600 ft. along bank of river; there has been no trouble with settling during eight years since its completion.

CARS FREIGHT

Braking Power. Proposed Revision of Braking Power for Freight Cars, F. K. Vial. Ry. Mech. Engr., vol. 101, no. 11, Nov. 1927, pp. 714-719, 5 figs. Irregularities are principal cause of wheel failures; simple remedy suggested.

CARS, PASSENGER

Aluminum. Aluminum Used Extensively in New C. & N. W. Suburban Cars. Ry. Mech. Engr., vol. 101, no. 10, Oct. 1927, pp. 665-667, 6 figs. Affords saving in weight of 5,700 lb. per car; 120 cars equipped with Melcher-Hyatt roller bearings.

CASE HARDENING

Practice. Practice in the Carburization of Steel, J. D. Gat. Forging—Stamping—Heat Treating, vol. 13, no. 10, Oct. 1927, pp. 393-396. Factors which exert an influence on final product such as manner of packing, carburizing agents, energizers, etc.

CAST IRON

Strength of. The Strength of Cast Iron, J. E. Fletcher. Foundry Trade Jl., vol. 36, no. 570 and 571, July 21 and 28, 1927, pp. 69-72 and 89-92, 5 figs. Presents deflection in transverse tests; dominating influence of silicon and total carbon together, and importance of carbon and silicon proportions in (T. C. + Si) factor must have first attention when attempting to interpret analysis of cast iron in terms of its mechanical strength.

CASTING

Centrifugal. Centrifugal Castings for Locomotive Piston-Valve Bushings. Engineering, vol. 124, no. 3225, Nov. 4, 1927, pp. 580-581, 4 figs. Importance attached by locomotive engineers to centrifugal castings for piston-valve liners is shown by fact that they are now frequently specified; process known as Spun-Sorbitic is new development of Hurst-Ball process; it enables casting, having relatively low silicon contents, ranging from 0.75 to 1.5 per cent to be produced without incurring danger of chilled surfaces or hard spots; important feature of process is that casting is cooled from temperature immediately below solidification point by means of special type of wet-air blast; immediate effect of this special cooling treatment is to convert pearlite into sorbite.

CEMENT

Proportioning Raw Materials. Proportioning Raw Cement Materials, E. S. Ernst, W. S. Ernst and W. A. Ernst. Rock Products, vol. 30, no. 21, Oct. 15, 1927, pp. 73-77, 4 figs. Use of system of triangular co-ordinates compared with algebraic methods.

CEMENT MILLS

Electric Drive. Application of Electricity in Cement Mills, W. E. North. Am. Inst. Elec. Engrs.—Jl., vol. 46, no. 9, Sept. 1927, pp. 881-884, 5 figs. Advantages of electric drive for cement mills are enumerated and general pointers on installing electrical equipment are given.

CHAINS

Manufacture. Heavy-Duty Chain Made by New Method. Iron Trade Rev., vol. 81, no. 15, Oct. 13, 1927, pp. 897-898 and 908, 3 figs. Drop-forging company in Worcester, Mass., has started production of weldless heavy-duty chain, patterned after design first worked out in connection with anchor chain for U.S. navy; this new weldless chain develops on testing machine strength considerably greater than usual type of forged welded chain.

CHIMNEYS

Flue Lining. A Study of Flue Lining, R. A. Hart and H. W. Clark. Am. Ceramic Soc.—Jl., vol. 10, no. 10, Oct. 1927, pp. 795-803, 4 figs. Investigations conducted on various types of flue lining following failure of several lengths in a chimney; standardization on a round tile lining with minimum area of 95 square inches, and having modified tongue and groove joint is recommended.

CIRCUIT BREAKERS

Control. The Use of High-Frequency Currents for Control, C. A. Boddie. Am. Inst. Elec. Engrs.—Jl., vol. 46, no. 8, Aug. 1927, pp. 763-769, 11 figs. Details of high-frequency system installed at Tipton, Indiana. See also discussion in no. 10, Oct. 1927, pp. 1128-1129.

High-Voltage. High-Voltage Oil-Circuit Breakers, R. Wilkins and E. A. Crellin. Elec. World, vol. 90, no. 17, Oct. 22, 1927, pp. 833-835, 3 figs. Functional requisites of equipment for high-tension transmission networks; contact designs and operating speeds bear close relation to improved performance.

COAL

CARBONIZATION. Coal Utilization. World Power, vol. 8, no. 46, Oct. 1927, pp. 185-187. Papers read before British Assn. urge importance of pretreatment and chemical additions before or during coking, and need for further research toward improved methods of heat transmission in carbonization.

Low Temperature Carbonization. Can. Engr., vol. 53, no. 15, Oct. 11, 1927, pp. 447-448. These processes described; appendix to report on proposed coke ovens for Toronto; estimate of cost.

PULVERIZED. *See Pulverized Coal.*

COAL MINING

ALBERTA. Operations of the Cadomin Coal Co., W. J. Dick. Can. Min. Jl., vol. 48, no. 43, Oct. 28, 1927, pp. 852-854. Mine is situated at Cadomin, Alberta; method of extracting pillars; rock-tunnel isolated-panel system of mining; ventilation and haulage.

COLD STORAGE

INSULATION. Insulation of Fruit Storage Houses, F. G. Hechler. Agric. Eng., vol. 8, no. 9, Sept. 1927, pp. 249-251, 1 fig. Insulating materials and methods of heat transfer; gives tabular data on thermal conductivity of materials and relative insulating value of some air storage constructions.

PERISHABLE-PRODUCTS TERMINAL. The New Philadelphia Perishable Products Terminal, H. D. Peltier. Ice & Refrigeration, vol. 73, no. 4, Oct. 1927, pp. 193-198, 13 figs. Description of modern plant erected at Philadelphia, Pa., by Baltimore & Ohio and Reading Railroad companies; equipped with latest improvements in cold-storage equipment; ample facilities provided for storage of perishable products of markets and general consumers.

COMBUSTION

CONTROL. Operating Principles of the Smoot System of Combustion Control, D. L. Fagnan. Nat. Engr., vol. 31, no. 11, Nov. 1927, pp. 523-527, 5 figs. Fundamental operating principles of centralized combustion control; functions of different parts of apparatus and construction details; applications and operation under various service conditions.

COMPRESSED AIR

LEAKAGE. New Method for Measuring Compressed Air Leakage (Sur une nouvelle méthode de mesure des fruites d'air comprimé), G. Levy. Revue de l'Industrie Minérale, no. 163, Oct. 1, 1927, pp. 401-407, 6 figs. Reviews common methods of determining leakage from centrifugal and displacement compressor systems and proposes new grapho-analytic method of parallel tangents.

MEASUREMENT. Measurement of Compressed Air by the Air Orifice Method, G. J. Heimel and W. Z. Lidicker. Wis. Engr., vol. 32, no. 1, Oct. 1927, pp. 10-11 and 32, 3 figs. In making a thesis investigation of an air-lift pump, writers found it necessary to measure compressed air used in operation of pump; standard orifice method was used with 6-in. drum.

CONDENSERS, STEAM

SURFACE. Final Devaporization of Steam in Surface Condensers, W. J. Dana. Power, vol. 66, no. 20, Nov. 15, 1927, pp. 747-749, 2 figs. Shows how to calculate surface necessary to condense remaining steam.

CONDUITS

PRESSURE. Steel Penstock Design by a Graphical Method, P. Bier. Eng. News-Rec., vol. 99, no. 16, Oct. 20, 1927, pp. 629-634. Charts used to determine proper thickness of steel plates, most efficient type of joint; weight and cost of pipe; both riveted and welded pipe included, also various working stresses.

CONSTRUCTION WORK

WINTER. Winter Construction Methods and Plant, C. S. Hill. Eng. News-Rec., vol. 99, nos. 9 and 10, Sept. 1 and 8, 1927, pp. 332-336 and 391-394, 7 figs. Planning and servicing winter construction. Sept. 8: Winter care and servicing equipment.

COOLING TOWERS

DESIGN AND OPERATIONS. Construction and Operation of Cooling Towers (Construction des refrigérants, et sur leur fonctionnement), T. J. Gueritte. Société des Ingénieurs Civils de France—Mémoires et Compe Rendu, vol. 80, nos. 3-4, Mar.-Apr. 1927, pp. 388-415, 13 figs. Covers elements of theory with use of psychometric charts, describing construction of hyperbolic and rectangular types and showing performance of a few installations.

COPPER ALLOYS

COPPER-ZINC. Physical Characteristics of Commercial Copper-Zinc Alloys, W. H. Bassett and C. H. Davis. Am. Inst. Min. & Met. Engrs.—Tech. Publication, no. 26, 1927, 16 pp., 12 figs. Data and plots are arranged to constitute summary, enabling one at glance to see physical properties of copper-zinc alloys to 62 per cent; characteristics shown are tensile properties, hardness and grain size, both in picture and in numerical values.

COPPER METALLURGY

CONCENTRATES, DEWATERING. Dewatering Concentrates at Chino, J. T. Shimmin. Eng. & Min. Jl., vol. 124, no. 19, Nov. 5, 1927, pp. 726-729, 2 figs. Describes filtration problem; steps taken to solve it by making changes in existing equipment and development at Chino of new type of filter which not only demonstrated its ability to handle flotation concentrates with ease, but also handled mixture of flotation and table concentrates.

CORROSION

THEORY OF. The Theory of Metallic Corrosion in the Light of Quantitiative Measurements, G. D. Bengough, J. M. Stuart and A. R. Lee. Roy. Soc.—Proc., vol. 116, no. 774, Oct. 1, 1927, pp. 425-467, 11 figs. Object of research is discovery of satisfactory way of measuring corrosion of metals in water and dilute salt solutions, and use of it to test adequacy of newer electrochemical theory of corrosion as applied to such media.

D

DAMS

ARCH. Semi-Circular Arch Dam Model Tested in Italy, C. Cuidi. Eng. News-Rec., vol. 99, no. 17, Oct. 27, 1927, pp. 668-669, 2 figs. Dam forming inner wall of ring-shiped tank tested under pressure; other tests on concrete structures.

CONSTRUCTION. Construction Features of Bull Run Dam, B. E. Torpen. Modern Irrigation, vol. 3, no. 9, Sept. 1927, pp. 40-41, 4 figs. New and unusual construction methods are being utilized by builder of Exchequer Dam in new project; manufacture of concrete aggregates, dam excavation and dam concrete operations will be continuous throughout period of construction.

MODEL EXPERIMENTS. Baffle-Pier Experiments on Models of Pit River Dams, I. C. Steel and R. A. Monroe. Am. Soc. Civ. Engrs.—Proc., vol. 53, no. 9, Nov. 1927, pp. 2189-2218, 27 figs. Results obtained from series of experiments made on one-twentieth scale models of diversion dams for Pit No. 3 and Pit No. 4 hydro-electric projects of Pacific Gas & Elec. Co.; object to determine most satisfactory means of controlling or destroying energy from overpour water at foot of dams in order to prevent erosion of downstream banks and bed of stream; several types of stilling devices were experimented with; most satisfactory results were obtained by use of two rows of baffle piers resting on concrete apron below bucket of dam, upper row of piers being truncated prisms serving as splitters and lower row having curved upstream faces to act as deflectors and baffles.

DIELECTRICS

ELECTRIC STRENGTH. Electric Strength of Solid and Liquid Dielectrics, W. A. Del Mar, W. F. Davidson and R. H. Marvin. Am. Inst. Elec. Engrs.—Jl., vol. 46, no. 10, Oct. 1927, pp. 1002-1006 and (discussion) 1127. Summary of existing literature; consideration of general subject of instability in electric circuits, and explanation of instability in case of dielectrics, in terms of stress and strain characteristic; distribution of stress and strain in non-uniform fields, and their relation to breakdown; reversible and non-reversible phenomena of dielectric failure; relation of breakdown voltage to various factors, such as insulation thickness, insulation area, electrode form, heterogeneity, temperature, rate of voltage, variation, pressure, etc. Bibliography.

DIESEL ENGINES

AIRLESS-INJECTION. A 1,500-Horse Power Diesel of the Solid-Injection Four-Stroke Cycle Type. Power, vol. 66, no. 19, Nov. 8, 1927, pp. 695-697, 5 figs. Among other unusual features is speed of 300 to 350 r.p.m.; eight cylinders are 18 in. diameter by 22-in. stroke, giving piston speed of 1,283 ft. at 350 r.p.m.

DESIGN. Modern Trend of the Diesel Engine with Respect to Low Weight Per Horse Power, High Revolutions Per Minute and High Mean Effective Pressure, O. D. Treiber. Soc. Naval Architects & Mar. Engrs.—Advance Paper, no. 13 for mtg., Nov. 10-11, 1927, 13 pp., 16 plates.

M.A.N. Test of a Two-Cycle Double-Acting Marine Diesel Engine, E. Nibbs and S. A. Gardner. Soc. Naval Architects & Mar. Engrs.—Advance Paper, no. 10, for mtg., Nov. 10-11, 1927, 12 pp., 14 figs. Tests carried out on M.A.N. type engine built for U.S. Shipping Board by New London Ship and Engine Co. to be installed in S.S. Wilscox, 9,500-deadweight ton vessel of Oscar Daniels type.

POWER COSTS. Diesel Oil Engine Power Costs. Elec. News, vol. 36, no. 19, Oct. 1, 1927, pp. 30-33. Collection of data over several years from 98 plants having combined annual output of over 223,000,000 kw.-hr. may be used to estimate cost per kw.-hr. of a proposed plant.

POWER PLANTS. How to Figure Diesel Plant Initial Costs, E. J. Kates. Power, vol. 66, no. 19, Nov. 8, 1927, pp. 697-698. Initial cost of 1,000-kw. Diesel generating plant for industrial use and of 1,000-kw. Diesel electric central station in dollars per kilowatt capacity.

U.S. SHIPPING BOARD. The Engines of the U.S. Shippnig Board Diesel Conversion Programme, R. D. Gatewood. Soc. Naval Architects & Mar. Engrs.—Advance Paper, no. 12 for mtg., Nov. 10-11, 1927, 6 pp. Diesel conversion programme includes engines of all variations and, in addition, special features of design which are described, together with shop-test results and operating results at sea on such engines as are in service at time of writing.

E

EDUCATION, ENGINEERING

CURRICULUM. The Engineering Curriculum, H. P. Hammond. Jl. Eng. Education, vol. 18, no. 1, Sept. 1927, pp. 57-84, 9 figs. Summarizes number of more significant facts and conclusions concerning curriculum which have been gathered in course of investigation.

GRADUATE STUDY. Graduate Study in the Engineering Schools, D C. Jackson. Jl. Eng. Education, vol. 18, no. 2, Oct. 1927, pp. 125-147 and (discussion) 148-158. See also contribution by G. M. Butler, pp. 136-143, giving account of experiment in engineering education that University of Arizona is making; and contribution by C. S. Coler, pp. 144-147, on method employed by University of Pittsburgh; and discussion, pp. 148-158.

TEACHERS. A Brief Report and Impressions of the Summer School for Engineering Teachers at Cornell University and University of Wisconsin, H. P. Hammond. Jl. Eng. Education, vol. 18, no. 1, Sept. 1927, pp. 11-36. Brief comments, supplemented by excerpts from some of statements received from those who attended; general impression of those who attended or observed schools seems to be that work may be pronounced successful.

ELECTRIC CIRCUITS

MECHANICAL FORCES. Experimental Measurement of Mechanical Forces in Electric Circuits, J. W. Roper. Am. Inst. Elec. Engrs.—Jl., vol. 46, no. 9, Sept. 1927, pp. 913-915, 6 figs. Simple laboratory method of measuring mechanical forces exerted on parts of complete circuit due to current flowing in circuit; tests, using method, show that "classic" methods of computing such forces are reliable.

Mechanical Forces Between Electric Currents and Saturated Magnetic Fields, V. Karapetoff. Am. Inst. Elec. Engrs.—Jl., vol. 46, no. 9, Sept. 1927, pp. 897-903, 2 figs. General case considered is that of N independent electric circuits placed in medium of variable permeability and subject to saturation, in parts or as whole; problem is to determine component (in given direction) of mechanical force acting upon one of electric circuits, upon group of circuits, or upon group of circuits with part of magnetic medium rigidly attached to them; it is believed that problem has not been solved in this general form heretofore.

ELECTRIC CONDUCTORS

PROXIMITY-EFFECT CALCULATIONS. Proximity-Effect in Groups of Round Wires, H. B. Dwight. Gen. Elec. Rev., vol. 30, no. 11, Nov. 1927, pp. 531-536, 7 figs. Formulas to determine division of current; impedance drop; watts loss; five types of conductor grouping with examples.

ELECTRIC CURRENTS, A.C.

NON-HARMONIC. Non-Harmonic Alternating Currents, F. Bedell. Am. Inst. Elec. Engrs.—Jl., vol. 46, no. 10, Oct. 1927, pp. 1057-1064. Certain principles are presented for solving non-harmonic a.c. problems. Bibliography.

ELECTRIC CURRENTS

SHORT CIRCUITS. Short Circuits Currents, R. C. R. Schulze. Elec. Light & Power, vol. 5, nos. 10 and 11, Oct. and Nov. 1927, pp. 21-25 and 27-30, 11 figs. Author shows that there are number of uses for knowledge of short circuit currents that may flow in various parts of system, and illustrates just what the calculations represent; shows ways by which calculations can be made and procedure when making study of the fault currents; sources of error are pointed out, with their approximate magnitude and possible effect.

ELECTRIC DISTRIBUTION SYSTEMS

EQUIPMENT. Equipment for 220-Kv. Systems, J. P. Jollyman. Am. Inst. Elec. Engrs.—Jl., vol. 46, no. 9, Sept. 1927, pp. 877-880. Characteristics of equipment which have been found most suitable for use on 220-kv. systems or on extensive lower-voltage systems; consideration is given to general system design, governors of prime movers, generators, excitation systems, transformers, high-voltage oil circuit breakers, transmission line and equipment of sub-stations.

ELECTRIC FURNACES

BRITISH PRACTICE. British Electric Furnace Practice, H. C. Dews. Elec. Times, vol. 72, no. 1876, Oct. 6, 1927, pp. 416-419, 5 figs. Operating costs; power supply; steel melting; melting mild steel; arc furnaces; electric pig iron; induction-type furnaces; Ajax Wyatt furnace; Ajax Northrup.

MELTING. High-Frequency Induction Melting, D. F. Campbell. Elec. Rev., vol. 101, no. 2602, Oct. 7, 1927, pp. 607-609. 5 figs. Details of Ajax-Northrup high-frequency furnace. Abstract of paper read at Iron and Steel Inst.

ELECTRIC GENERATORS, A.C.

SYNCHRONOUS. A Study of Transverse Armature Reaction in Synchronous Machines, R. A. Schaefer. Am. Inst. Elec. Engrs.—Jl., vol. 46, no. 8, Aug. 1927, pp. 811-814, 5 figs. Results of tests by means of second machine with adjustable stator.

ELECTRIC MEASURING INSTRUMENTS

SHORT-CIRCUIT TORQUE. An Instrument for Measuring Short-Circuit Torque, G. W. Penney. Am. Inst. Elec. Engrs.—Jl., vol. 46, no. 11, Nov. 1927, pp. 1151-1159, 10 figs. Small instrument which can be attached to end of shaft of machine to be tested; it records instantaneous acceleration of rotor, corresponding torque being calculated; acceleration is measured by two separate methods; first method gives points on acceleration time curve, and second gives continuous record of torque; acceleration is recorded on oscillogram, so that by using six-element oscillograph simultaneous record can be obtained showing both acceleration and short-circuit currents; it can also be used for measuring sudden shocks on motors and other rotating machinery.

ELECTRIC MOTORS, A.C.

INDUCTION. Recent Improvements in Large Induction Motors, D. F. Alexander. Am. Inst. Elec. Engrs.—Jl., vol. 46, no. 11, Nov. 1927, pp. 1167-1175, 6 figs. Deals with ventilation, insulating, coil design and bracing, collectors, bearings and manufacturing improvements.

SYNCHRONOUS. The Automatic Control of Synchronous Motors, J. H. Hall. Iron & Steel Engr., vol. 4, no. 10, Oc.t 1927, pp. 427-434 and (discussion) 434-435. Describes several of methods in use for closing field contactor automatically at proper moment; operation; protective devices; electrical interlocks; instruments; automatic power-factor regulation.

Starting Performance of Synchronous Motors, H. V. Putman. Am. Inst. Elec. Engrs.—Jl., vol. 46, no. 8, Aug. 1927, pp. 794-801 and (discussion) 830-832, 13 figs. Deals with theory underlying starting performance of salient pole synchronous motor equipped with damper windings; method for calculating speed torque curve from standstill to synchronous speed.

ELECTRIC MOTORS, D.C.

PARALLEL OPERATION. Operation of Series Motors in Parallel When Rigidly Coupled to the Same Load, J. A. Jackson. Iron & Steel Engr., vol. 4, no. 10, Oct. 1927, pp. 423-427, 11 figs. Occasionally economy in selecting control equipment leads to error of using common reversing contactors or drum switches with single reversing segments for motors mechanically connected to same load which frequently results in unsatisfactory operation; author analyzes this connection and shows why such control connection is dangerous.

ELECTRIC SWITCHES

AUTOMATIC. Development of Automatic Switching Equipments in the United States and Europe, A. H. de Goede. Am. Inst. Elec. Engrs.—Jl., vol. 46, no. 11, Nov. 1927, pp. 1209-1214, 8 figs. Outline of history and general development as applied to power equipment; comparison based on personal observation between conditions in United States and Europe, which accounts for less rapid development and less extensive applications of automatic equipments in Europe; mercury arc rectifiers and supervisory-control systems.

ELECTRIC TRANSMISSION LINES

CARRIER-CURRENT PILOT SYSTEM. A Carrier-Current Pilot System of Transmission Line Protection, A. S. Fitzgerald. Am. Inst. Elec. Engrs.—Jl., vol. 46, no. 10, Oct. 1927, pp. 1015-1021, 14 figs. Term carrier current is employed as descriptive of a.c. energy generated at frequencies which lie, roughly, between 10 and 200 kilocycles; at these frequencies, transmission of electrical energy exhibits special characteristics due to which it is possible to superpose carrier-current-control circuits on transmission lines or cables. See abstract in Elec. World, vol. 90, no. 18, Oct. 29, 1927, pp. 889-891, 2 figs.

COUPLING FOR CARRIER-CURRENT. Coupling Capacitors for Carrier-Current Applications, T. A. E. Belt. Am. Inst. Elec. Engrs.—Jl., vol. 46, no. 10, Oct. 1927, pp. 1051-1056, 8 figs. Approximate method for determining effectiveness of coupling wires and coupling capacitors.

ELECTRIC OSCILLATIONS. Electric Oscillations in the Double-Circuit Three-Phase Transmission Line, Y. Satoh. Am. Inst. Elec. Engrs.—Jl., vol. 46, no. 9, Sept. 1927, pp. 868-875 and (discussion) 875-876, 6 figs. Shows that there are three kinds of travelling waves, and describes nature of these waves, and some of important results of induced transients; in appendices, it is shown how these results were derived and how to calculate line constants from construction data of lines; numerical examples.

GROUND PROTECTION. Ground Relay Protection for Transmission Systems, B. M. Jones and G. B. Dodds. Am. Inst. Elec. Engrs.—Jl., vol. 46, no. 10, Oct. 1927, pp. 1089-1094, 5 figs. Discusses different schemes for ground protection.

HIGH-VOLTAGE FEEDERS. Serving Large Power Blocks with 24-Kv. Feeders, W. H. Colburn. Elec. World, vol. 90, no. 17, Oct. 22, 1927, pp. 845-847, 4 figs. Limitations of 13.8-kv. system dictate use of higher voltage feeders; simplification of substation design and improved testing arrangements are achieved.

OPERATION. Recent Investigation of Transmission Line Operation, J. G. Hemstreet. Am. Inst. Elec. Engrs.—Jl., vol. 46, no. 11, Nov. 1927, pp. 1221-1229, 8 figs. Operating experience on 140,000-volt isolated neutral system of Consumers Power Co., Michigan; tests to determine conditions existing relative to insulator flashover.

RELAY PROTECTION. Directional Ground Relay Protection of High-Tension Isolated Neutral Systems, J. V. Breisky, J. R. North and G. W. King. Am. Inst. Elec. Engrs.—Jl., vol. 46, no. 11, Nov. 1927, pp. 1184-1192, 14 figs. Problem of obtaining selective relay protection in case of accidental grounds; relay was developed whose overcurrent element operates on residual charging current which exists when ground occurs on such system, and whose directional element is operated by residual charging current and residual voltage.

TOWERS. Transmission Tower Diagonal Bracing, C. R. Young, W. B. Dunbar and E. B. Allan. Can. Engr., vol. 53, no. 15, Oct. 11, 1927, pp. 441-444, 7 figs. Effective length of diagonal bracing struts; tests made in laboratory of University of Toronto; average slenderness ratio for struts supported in one direction 81.6 per cent of that for unsupported struts.

TRANSIENTS DUE TO SHORT CIRCUITS. Transients Due to Short Circuits, R. J. C. Wood, L. F. Hunt and S. C. Griscom. Am. Inst. Elec. Engrs.—Jl., vol. 46, no. 10, Oct. 1927, pp. 985-994, 22 figs. Study of tests made on Southern California Edison 220-kv. system.

ELECTRIC WELDING, ARC

CRANE CONSTRUCTION. Arc Welding Applied to Crane Construction. Elec. World, vol. 90, no. 19, Nov. 5, 1927, pp. 934-935. 10-ton, 60-ft. span electric overhead travelling crane, fabricated entirely by means of arc welding, has been constructed by Cleveland Crane & Eng. Co., Wickliffe, Ohio.

RAILWAY STRUCTURES. Arc Welding for Railway Structures, G. D. Fish. Ry. Club of Pittsburgh—Official Proc., vol. 26, no. 8, Sept. 22, 1927, pp. 186-206 and (discussion) 206-208, 16 figs. Author claims that steady replacement of rivet by electric arc is a great economic movement which cannot be checked by skepticism as to dependability of process; results can be definitely controlled, and failures are as definitely preventable as they are in other engineering operations.

ROLLED-STEEL FABRICATION BY. Rolled-Steel Fabrication by Welding Displaces Castings in Machine Construction, R. H. Rogers. Universal Engr., vol. 46, no. 4, Oct. 1927, pp. 27-29. Rolled-steel is stronger pound for pound; readily fabricated by metallic arc welding; greater freedom in machine design; quicker production; final product superior.

ELECTRIC WELDING, RESISTANCE

PERCUSSION. On Electric Resistance and Percussion Welding, T. Okamoto. Inst. Elec. Engrs. of Japan—Jl., no. 469, Aug. 1927, pp. 874-894, 24 figs. Solution of a differential equation expressing temperature at any time and distance along bar in butt welding is obtained; theory of percussion welding is developed; percussive welded joints of various metallic wires are drawn through dies several times and tested to show how they behave under this operation. (In Japanese.)

ELECTRICAL APPARATUS

PROTECTIVE DEVICES. Protective Devices. Am. Inst. Elec. Engrs.—Jl., vol. 46, no. 8, Aug. 1927, pp. 779-785, 12 figs. Annual report of committee as follows: development of automatic switching equipments in United States and Europe, by A. H. de Goede; subcommittee on lightning arresters; subcommittee on oil circuit breakers; subcommittee on protective relays; report of subcommittee on current and potential transformer characteristics, by H. M. Rankin. See also discussion in No. 10, Oct. 1927, pp. 1123-1124.

SHORT-CIRCUIT TESTS. Removing Errors from Short-Circuit Tests, C. L. Kasson. Elec. World, vol. 90, no. 18, Oct. 29, 1927, pp. 883-884, 2 figs. Miscalculations of energy and power values in many computations; oscillographic methods provide correct data.

ELECTRICAL MACHINERY

PROGRESS AND PROBLEMS. Annual Report of Committee on Electric Machinery. Am. Inst. Elec. Engrs.—Jl., vol. 46, no. 11, Nov. 1927, pp. 1241-1262, 23 figs. Attempt has been made to include more important articles that have appeared in domestic and foreign journals in several bibliographies; deals with research, standards, ventilation, turbo-alternators, transformers, induction and synchronous motors; d.c. machines.

ELECTRICAL MEASUREMENT

HIGH-FREQUENCY. High-Frequency Measurements. Am. Inst. Elec. Engrs.—Jl., vol. 46, no. 10, Oct. 1927, pp. 1033-1040. Report of committee on instruments and measurements. Bibliography.

HIGH-VOLTAGE. High-Voltage Measurements on Cables and Insulators, C. L. Kasson. Am. Inst. Elec. Engrs.—Jl., vol. 46, no. 10, Oct. 1927, pp. 1065-1073, 31 figs. Results of series of high-voltage tests on cables and insulators, extending over period of eight years, determining electrical characteristics of insulation; leakage current, insulation resistance and watt input tests were made with direct and alternating current.

ELECTRICITY SUPPLY

DOMESTIC. The Use of Electricity in the Homes of Canada, S. L. Barnes. Elec. Rev., vol. 101, no. 2604, Oct. 21, 1927, pp. 665-666. Low charges accelerate rate of domestic development.

ONTARIO, RURAL. Canadian Electrical Development, F. A. Gaby. World Power, vol. 8, nos. 45 and 46, Sept. and Oct. 1927, pp. 145-152 and 203-210, 3 figs. Better legislation and government support during past five years has stimulated rural electrification in Ontario; present indications promise unprecedented development of service following extensions being made in main transmission and distribution lines; rural dwellers recognize electrification as blessing which is revolutionizing domestic and farm labour. Oct.: Methods used for rural electrification; tables illustrate estimated costs of power service in rural districts.

ELECTROPLATING

CHROMIUM. Electrodeposition of Chromium from Chromic Acid Baths, H. E. Haring and W. P. Barrows. U.S. Bur. Standards—Technologic Papers, no. 346, June 10, 1927, pp. 413-449, 9 figs. Study of chromic-acid plating solution and of conditions for its operation and control; three principal types of chromic-acid bath which have been developed during past 70 years are shown to be identical not only in initial behaviour, but also in ultimate composition; recent commercial success of chromium plating is attributed not to any changes effected in composition of bath, but to its more careful operation and control; it was found that minor improvements could be effected in throwing power of chromic-acid baths, but that there appears to be little possibility of improving this property which has hindered more general adoption of chromium plating.

ENERGY

THERMAL, FROM TROPICAL SEAS. The Utilization of Thermal Energy from Tropical Seas (L'utilisation de l'énergie thermique des mers tropicals). Génie Civil, vol. 91, no. 9, Aug. 27, 1927, pp. 215-216. Outline of new scheme by C. Boggia for subterranean power station utilizing thermal energy of tropical seas; project involves a 100,000-kw. plant capable of producing 800 million kw.-hr. per year; 70 boilers would be required.

F

FANS

CENTRIFUGAL. Characteristics of Centrifugal Fans, T. G. Estep and C. A. Carpenter. Engrs'. Soc. West Pa.—Proc., vol. 43, no. 6, July 1927, pp. 306-316 and (discussion) 317-332, 16 figs. Information based on tests and manufacturers' data to show existing relationships which limit performance of a fan or blower of any given design; effects of some simple variations in this design; different operating characteristics of more prevalent types of fan, and effects of incorrect applications of fans.

The Theory and Design of the Modern Centrifugal Fan, S. C. Martin. Nat. Engr., vol. 31, no. 11, Nov. 1927, pp. 513-519, 8 figs. Relations of velocity and pressure; volume and horse power; efficiencies; fan blades and casings; cut-off point; fan inlet; blast area; fans for mechanical draught.

FILTRATION PLANTS

Aerators. Effluent Aerators Control Mechanical Filters, M. Pirnie. Eng. News-Rec., vol. 99, no. 10, Sept. 8, 1927, pp. 376-380, 6 figs. Plants at Providence, West Palm Beach, Poughkeepsie and Rahway utilize head between filters and clear well.

FLIGHT

Test-Data Reduction Chart. The Reduction of Flight Test Data to Standard Atmosphere Conditions, J. D. Blyth. Flight, vol. 19, no. 43, Oct. 27, 1927, pp. 750b-750d, 2 figs. Presents reduction chart prepared with object of providing rapid and simple method of reducing data obtained on flight tests to conditions of standard atmosphere.

FLOOD CONTROL

Mississippi River. Civil Engineers Consider Mississippi Floods. Eng. News-Rec., vol. 99, no. 16, Oct. 20, 1927, pp. 636-640. Review of efforts to control Mississippi river; commission severely criticized; definite proposals for flood relief.

FLUE-GAS ANALYSIS

Combustion-Air and CO_2 Determination. Alignment Chart for Determining Minimum Combustion-Air and Maximum CO_2, C. A. Kulmann. Power, vol. 66, no 19, Nov. 8, 1927, pp. 710-711. Chart is based upon equation for amount of CO_2 in waste gases when minimum amount of air is supplied and composition of fuel is known.

FLUMES

Hydraulic Design. The Hydraulic Design of Flume and Siphon Transitions, J. Hinds. Am. Soc. Civil Engrs.—Proc., part 1, Oct. 1927, pp. 1805-1841, 23 figs. Summary of rules established by U.S. Bur. of Reclamation for proportioning of important structures; although discussion is generally confined to inlets and outlets to and from inverted siphons and flumes, principles established may be applied to any structure designed to change shape or cross-sectional area of open stream of water.

FORESTRY

Drainage. The Marginal Ditch and Swamp Drainage for Forestry, A. E. Wackerman. Jl. of Forestry, vol. 25, no. 7, Nov. 1927, pp. 848-851, 1 fig. " Marginal ditch " usually surrounds northern swamps where they come in contact with upland, mineral soil; this ditch is depression in peat from 10 to 20 ft. wide at edge of swamp in which free water frequently stands and which supports distinct type of vegetation which thus rings swamp and isolates it from upland; drainage of forest swamps to be practical must be as cheap as possible and minimum amount of ditching necessary to bring about desired benefits is what is sought in forest ditching.

FOUNDATIONS

Science of. The Science of Foundations—Its Present and Future, C. Terzahi. Am. Soc. Civil Engrs.—Proc., vol. 53, no. 9, Nov. 1927, pp. 2263-2294, 16 figs. Reviews present state of science of foundations, its principal shortcomings and possibilities for its improvement; effect of type of building on admissible settlement; relation between settlement, size of loaded area and depth of foundation; distribution of soil reactions over rigid, loaded slabs; bearing capacity of individual piles; bearing capacity of a pile foundation; effect of freezing on foundations; soil classification based on elastic constants of soils.

FOUNDRIES

Automobile Plants. Foundry Effects Substantial Savings, C. H. Vivian. Automotive Mfr., vol. 69, no. 7, Oct. 1927, pp. 5-9. At shop of Campbell, Wyant & Cannon Foundry Co., Muskegon, Mich., most modern methods are utilized to produce 400 tons of motor castings daily; details of procedure in casting room.

French Automobile Foundry Employs Continuous System, V. Delport. Foundry, vol. 55, no. 19, Oct. 1, 1927, pp. 748-750 and 752, 6 figs. Details of continuous system of Citreon foundries at Clichy, France.

Future Design. An Engineer Visualizes Foundries of the Future, E. A. Custer, Jr. Foundry, vol. 55, nos. 20 and 21, Oct. 15 and Nov. 1, 1927, pp. 791-792 and 815 and 844-846. Oct. 15: Account of imaginary tour of plant where castings are made in manner radically different to methods which prevailed up to 1927; melting apparatus and control mechanism based upon modern ingenious theory. Nov. 1: Methods and equipment connected with handling sand, moulds and cores, theory and practice of pouring iron and cleaning castings.

Westinghouse Manufacturing Co., Hamilton, Ont. Foundry Methods in Westinghouse Plant, E. G. Brock. Can. Foundryman, vol. 18, no. 10, Oct. 1927, pp. 7-11, 6 figs. Up-to-date foundry equipment and efficient methods enable Hamilton ferrous and non-ferrous foundries to economically turn out castings varying from an ounce to many tons.

FRICTION

Contact of Flat Surfaces. Contact of Flat Surfaces, F. H. Rolt and H. Barrell. Rol. Soc.—Proc., vol. 116, no. 774, Oct. 1, 1927, pp. 401-425, 10 figs. Measurement of film thickness has been made by two methods; first, called area method, depends upon measurement of area attained by known volume of liquid placed between two flat surfaces which are wrung together and therefore gives average thickness of a wringing film; second, called interferometer method, is based upon comparison of length of wrung combination of block gauges with sum of their individual lengths.

FUELS

Coal. *See Coal; Pulverized Coal.*
Oil. *See Oil Fuel.*

FURNACES, INDUSTRIAL

Gas-Fired. Furnaces Burning Manufactured Gas, A. J. Smith. Forging—Stamping—Heat Treating, vol. 13, no. 10, Oct. 1927, pp. 403-404, 2 figs. Experiments on application of reversible regeneration as employed on gas-fired furnaces, give results showing high efficiency.

FURNACES, MELTING

Air Furnaces. Air-Furnace Practice, C. Kluijtmans. Foundry Trade Jl., vol. 36, nos. 576 and 577, Sept. 1 and 8, 1927, pp. 197-198 and 213-219, 25 figs. Results of experience with 15-ton hand-fired air furnaces; air furnace design; composition of charge, and melting practice; oxidation of constituents; influence of constituents on iron as cast; and on annealing; melting practice; temperatures, fractures and procedure; accidents.

G

GAS TURBINES

Heat-Regenerative Cycles. Heat Regeneration and Regenerative Cycles, W. J. Walker. Lond., Edinburgh & Dublin Philosophical Mag. & Jl. of Science, vol. 4, no. 22, Sept. 1927, pp. 526-530, 2 figs. Investigates possibilities in heat-regenerative cycles, particularly in relation to internal-combustion turbine development; new type of regenerative cycle is proposed, analysis of which indicates independence of turbine thermal efficiency on compression ratio.

GEARS

Manufacture and Heat Treatment. The Manufacture and Heat Treatment of Gears, F. A. Brooks. West. Machy. World, vol. 18, no. 10, Oct. 1927, pp. 471-475, 3 figs. Gear-tooth stress; manufacture of case-hardened gears; characteristic failures due to overstrain; microstructure; fracture at root of tooth.

Progress and Problems. Standardization of Gear Hobs Next on A.G.M.A. Programme, P. M. Heldt. Automotive Industries, vol. 57, no. 18, Oct. 29, 1927, pp. 660-662, 2 figs. Project is inaugurated at meeting in Montreal; broadening of association's studies urged by President; review of technical paper presented.

Tooth-Rounding Machine. A New Automatic Gear Tooth Rounding Machine. Brit. Machine Tool Eng., vol. 4, no. 47, Sept.-Oct. 1927, pp. 653-655, 2 figs. Work is carried in special fixture on knee, and is indexed in front of cutter by means of special indexing arrangement, which provides for all sizes of gears having same pitch.

Worm. Worm Gear Inspection and Testing, G. H. Acker. Automotive Industries, vol. 57, no. 18, Oct. 29, 1927, pp. 662-663, 1 fig. Potential sources of error in worm gearing that must be guarded against by suitable inspection are: eccentricity and correct sizing of worm, index, head and profile of worm thread, angle of gear, eccentricity of gear and silence.

GRINDING

Cylindrical. Speeding Up the Grinding Operation, H. Rowland. Can. Machy., vol. 38, no. 17, Oct. 27, 1927, pp. 15-17, 4 figs. Presents illustrations dealing with cylindrical grinding and covering wide variety of grinding machines; standard machines are used in practically every instance, but in many cases these have been slightly changed in order to adapt them to particular operation on production basis.

H

HEAT

Ambient, Utilization of. Utilization of Ambient Heat as a Motive Force (L'utilisation de la chaleur ambiante comme force motrice au moyen de la machine frigorifique), E. Guarini. Houille Blanche, vol. 26, no. 206, May-June 1927, pp. 73-77. Report to Fifth International Refrigeration Congress, in which author proposes utilizing heat of atmosphere, oceans, etc., by means of refrigerating machines, in manner similar to the Dornig-Boggia and Romagnoli schemes.

Flow of. The Flow of Heat in a Body Generating Heat, J. H. Awberry. Lond., Edinburgh & Dublin Philosophical Mag. & Jl. of Science, vol. 4, no. 22, Sept. 1927, pp. 629-638. Problem of temperature of all points and times, in sphere generating heat, is solved in detail, when constant initial temperature is given, surface being held at definite temperature from time-zero onwards, and also for more elaborate case where initial temperature distribution is an equilibrium one, and boundary condition is Newton's law of cooling.

HEAT TRANSMISSION

Cylinder Walls. The Transfer of Heat in Cylinder Walls, A. Nägel. Engineer, vol. 144, nos. 3744, 3745, 3746 and 3747, Oct. 14, 21, 28 and Nov. 4, 1927, pp. 420-421, 459-460, 480-482 and 506-507, 13 figs.

Insulating Materials. Effect of Moisture on the Heat Transmission in Insulating Materials, L. F. Miller. Refrig. Eng., vol. 14, no. 5, Nov. 1927, pp. 141-144, 7 figs. Experimental results on insulating value of wood, cane, flax and rag felt as it is influenced by degree of moisture.

Prandtl Theory. Heat Transmission Between Fluid and Wall (La transmissione del calore tra fluidi e pareti secondo la teoria moderna), A. Bernini. Nuovo Cimento, vol. 4, no. 5, May 1927, pp. 201-213, 2 figs.

HEATING, STEAM

Over-Heating, Reduction of. Control Steam to Reduce Over-Heating, C. A. Thinn. Power House, vol. 21, no. 18, Sept. 20, 1927, pp. 30-34, 4 figs. Differential vacuum system proves solution of endeavour to reduce great loss of heat in buildings due to over-heating in mild weather, bringing tangible savings in fuel consumption.

HYDRAULIC TURBINES

Relief-Valve Operation. Operation of Relief-Valves in Hydro-Electric Plants. Power, vol. 66, no. 20, Nov. 15, 1927, pp. 761-762. Two general types are in use for relief-action turbines, governor-operated type and type which operates due to pressure rise in penstock; size of relief-valves; closing time.

HYDRAULICS

Formulas and Theories. Comparison of Hydraulic Formulas and Theories. Mech. Eng., vol. 49, no. 11, Nov. 1927, pp. 1219-1227, 3 figs. Discussion of specific characteristics for hydraulic turbines, and comparison and limitations of various water-hammer theories.

Law of Similitude. Application of the Law of Similitude to Hydraulic Laboratory Research, G. De Thierry. U.S. Nat. Academy of Sciences—Proc., vol. 13, no. 9, Sept. 1927, pp. 684-688. While Froude began by applying laws of similitude to problems of naval architecture, Engels, of Tech. Univ. of Dresden, developed methods of research of constructions by hydraulic engineering; Krey, of Prussian Nat. Experimental Instn. for Hydraulic Eng. and Shipbldg., has extended Engels' investigations in applying methods of laboratory to special problem on the river Elbe; most valuable results obtained are his finding out, for special case he examined, relations between water and débris discharge.

HYDRO-ELECTRIC DEVELOPMENTS

Ontario. Hydro-Electric Progress in Ontario. Can. Engr., vol. 53, no. 16, Oct. 18, 1927, pp. 465-469. Annual report of Ontario Hydro-Electric Power Commission deals with progress in electrical development in province; extensions and improvements in various systems; extension of rural distribution systems.

Quebec. Development of Coaticook River, Que., E. E. Akhurst. Elec. News, vol. 36, no. 19, Oct. 1, 1927, pp. 27-30, 5 figs. Concrete-lined tunnel, 1,550 feet long, driven through rock under town delivers water to two 1,000-h.p. units with head of 143 feet.

HYDRO-ELECTRIC PLANTS

Automatic. Automatic Hydro Holds Lake Level. Elec. World, vol. 90, no. 19, Nov. 5, 1927, pp. 948-949, 2 figs. Electricity generated to carry investment charges on dam; energy sold on dump-power basis to Blue Ridge utility; resort expected to consume output ultimately.

Small. Small Water Powers, F. J. Taylor. Elecn., vol. 99, no. 2575, Oct. 7, 1927, pp. 432-433. Suggestions for economical development; plant under 1,000 h.p.; preliminary surveys of sites; choice of turbines.

South Africa. The Sabie River Hydro-Electric Power Station, A. M. Jacobs. S. African Engr., vol. 17, no. 112, Aug. 1927, pp. 3-11, 5 figs. Works comprise the dam and intake works; system for conveying water to power station, including three tunnels; two aqueducts with outdoor high-tension switchgear; 22,000-volt transmission line and telephone line; substation with outdoor high-tension switchgear at Sabie township; 2½ miles of 3,300-volt distribution line at Sabie, etc.

I

ICE FORMATION

Control. How Can Ice Formation Be Controlled? H. T. Barnes. Contract Rec., vol. 41, no. 43, Oct. 26, 1927, pp. 1085-1087. Methods by which ice jams can be relieved; cognizance must be taken of underlying causes of ice formation; jams successfully removed.

ICE PLANTS

Oil-Engine Drive. Efficiency in the Oil-Engine Driven Ice Plant, E. J. Kates. So. Power Jl., vol. 45, no. 10, Oct. 1927, p. 45. Points out that there is no reason why ice plant to be driven by oil engine cannot be made just as economical in its power requirement as that equipped with motor drive.

INDICATORS

Electric. Electrical Indicators for High Speed Internal Combustion Engines, J. Obata. Imperial Academy—Proc., vol. 3, no. 7, July 1927, pp. 426-429, 3 figs. Devised for purpose of serving for general uses in laboratories, they contain no mechanical part which exhibits appreciable friction or inertia, and they are entirely free from influence of natural vibration of any part of system, so that they are especially suited for high-speed engines, in which ordinary indicators fail to give correct diagrams.

INSULATING MATERIALS, ELECTRIC

Electrical Resistance. The Electrical Resistivity of Insulating Materials, H. L. Curtis. Am. Inst. Elec. Engrs.—Jl., vol. 46, no. 10, Oct. 1927, pp. 1095-1103. Review of literature on conduction through insulators; every dielectric has definite resistivity when potential gradient is below certain value, different for each substance; if potential gradient is continually increased, a point is reached where increase in voltage does not affect current; this is called saturation current. Bibliography.

INSULATION, ELECTRIC

Puncture Voltage. A Precision Measurement of Puncture Voltage, V. Bush and P. H. Moon. Am. Inst. Elec. Engrs.—Jl., vol. 46, no. 10, Oct. 1927, pp. 1007-1014 and (discussion) 1124-1127, 16 figs. Describes apparatus for automatic determination of dielectric strength of thin sheet insulation; machine makes about 1,000 breakdown tests in day; almost no attention is required, thus reducing human element to minimum; results of over 1,000,000 punctures are given.

INSULATION, HEAT

Thermal Constants, Measurement of. A Method for the Measurement of Thermal Constants of Heat Insulating Material, K. Kumabe. Soc. Mech. Engrs. of Japan—Jl., vol. 30, no. 125, Sept. 1927, pp. 395-399, 2 figs. On applying a sine-wave heating method for measurement of thermal constants of heat-insulating material, authors point out that pure sine thermal wave form on plane surface of sample is not necessary condition for application of this method, and only periodic wave is sufficient; they propose simple method on this principle for industrial purpose, and experiment result is given. (In English.)

INTERNAL COMBUSTION ENGINES

Efficiency of. The Ideal Efficiency of Internal Combustion Engines, W. T. David. Gas Jl., vol. 179, no. 3357, Sept. 21, 1927, pp. 695-696. Two suggestions are put forward in this paper—first, that ideal efficiencies of internal-combustion engines calculated upon basis of generally accepted specific heat and dissociation data are too low; and second, that ideal efficiencies increase with compression ratio at rate not only greater than that indicated by air standard, but also greater than that indicated by ideal efficiency calculations based upon usual specific heat data.

IRON AND STEEL

Bend Test. A Critical Study of the Bend Test as Applied to Iron and Steel, A. B. Kinzel. Am. Soc. Steel Treat.—Trans., vol. 12, no. 5, Nov. 1927, pp. 778-791 and (discussion) 791-793, 10 figs. Theoretical study of strains produced on bending a rectangular bar; from theory there is deduced a method for quantitative evaluation of a bend test; phenomena of inside crack is investigated and relation between tensile and bend elongation is discussed; specifications for routine quantitative bend testing.

IRON CASTINGS

Direct Metal for. How Ford Uses Direct Metal for Motor Castings, P. Dwyer. Iron Trade Rev., vol. 81, no. 12, Sept. 22, 1927, pp. 711-714, 8 figs.

IRON, PIG

Specifications. Propose Specification for Foundry Iron. Foundry, vol. 55, no. 21, Nov. 1, 1927, p. 846. Specification for foundry pig iron proposed by Federal Specifications Board.

L

LATHES

Turret. Heavy-Duty Turret Lathes. Iron Age, vol. 120, no. 19, Nov. 10, 1927, p. 1314. Rugged construction, intended to assure continued accuracy of entire machine, is among features of new Libby lathe which has been added to line of Int. Machine Tool Co., Indianapolis.

LIGHTING

Production and Application. Production and Application of Light. Am. Inst. Elec. Engrs.—Jl., vol. 46, no. 10, Oct. 1927, pp. 1022-1029. Report of committee as follows: incandescent filament lamps; residence lighting equipment; ultra-violet radiation; street lighting; signal lights for traffic control; lighting of exteriors; electric signs for daylight use; illuminated bulletin boards; subterranean lighting; railway lighting; illumination of outdoor substations; related topics.

Progress. The Year's Progress in Illumination, 1926-1927. Illum. Eng. Soc.—Trans., vol. 22, no. 7, Sept. 1927, pp. 689-819. Review of developments, includes bibliography and index.

LOCOMOTIVES

Cylinder Losses. An Investigation Into the Cylinder Losses in a Compound Locomotive, E. L. Diamond. Instn. Mech. Engrs.—Proc., no. 2, 1927, pp. 465-479 and (discussion) 480-517, 10 figs. Investigation to ascertain what proportions of available energy of steam between boiler and atmospheric pressures are accounted for by various known sources of loss in engine, and to discover relationship between variation of these losses and conditions under which they occur.

4-8-4. New 4-8-4 Type Locomotives in Canada. Ry Engr., vol. 49, no. 573, Nov. 1927, pp. 422-424. Engines placed in service on Canadian National Railways system represent advance of 20 per cent in tractive power over those of "6000" class, which, at time of their introduction, were largest passenger locomotives in world.

High-Pressure. High-Pressure Steam Locomotives, J. M. Taggart. Boiler Maker, vol. 27, no. 10, Oct. 1927, pp. 278-281, 3 figs. Discusses type of power best suited economically to utilize pressures of 800 pounds and over; the boiler of the future locomotive.

Power Blow-Off. A Power Blow-Off for Locomotives. Ry. Age, vol. 83, no. 18, Oct. 29, 1927, pp. 838-839, 3 figs. Bird-Archer Co. introduces attachment for operating locomotive blow-off cocks by power; device has two parts: power attachment proper and cab-operating valves.

LUBRICATING OILS

Properties. Lubricating Oil from an Engineer's Point of View, with a Note on Fuel Oil, F. G. Martin. Liverpool Eng. Soc.—Trans., vol. 48, 1927, pp. 65-75 and (discussion) 76-81, 2 figs. Notes on properties of fuel and lubricating oils and results.

LUBRICATION

Surfaces Under High Loads. Lubrication. World Power, vol. 8, no. 46, Oct. 1927, pp. 184-185. Important outcome of investigations of National Physical Laboratory is fact that certain mineral oils will maintain themselves in film condition at temperatures in excess of limiting temperature of castor oil.

M

MALLEABLE CASTINGS

Cupola. Metal for Malleable Iron Fittings Melted in the Cupola, L. E. Gilmore. Foundry, vol. 55, no. 31, Nov. 1, 1927, pp. 840-843, 4 figs. Production of desired quality in cupola malleable requires careful control over details of cupola construction and daily preparation; blast used; quality and quantity of fuel; raw materials; mixtures; control of sands for moulds and cores; details of annealing operation and effect of temperatures, time and rate of cooling.

Properties. Malleable Cast Iron (La fonte malléable), M. Guedras. Fonderie Moderne, vol. 21, Mar. 25, Apr. 10, June 25 and July 10, 1927, pp. 30-32, 58-61, 185-190 and 210-213, 8 figs.

MARINE BOILERS

Pulverized Coal Fired. Pulverized Coal Tests of a Marine Water Tube Boiler, T. B. Stillman. Soc. Naval Architects & Mar. Engrs.—Advance Paper, no. 9 for mtg., Nov. 10-11, 1927, 12 pp., 12 plates. Babcock & Wilcox Co. has conducted series of experiments at its Bayonne plant using pulverized coal under marine boiler; gives results to date, and general statements of advantages and disadvantages of this method of firing coal as observed during these tests.

Test of Pulverized Coal as Applied to Scotch Marine Boilers, E. Jefferson and J. S. Evans. Soc. Naval Architects & Mar. Engrs.—Advance Paper, no. 8 for mtg., Nov. 10-11, 1927, 17 pp., 9 plates.

MATERIALS HANDLING

Brick Factories. Cutting Costs to Third by Improved Methods of Handling Materials, J. Stuber. Mfg. Industries, vol. 14, no. 5, Nov. 1927, pp. 357-360, 7 figs. Camp Bros'. modern brick and hollow-tile plant shows how big savings can be made.

Ford Organization. Organizing for Effective Transportation Within the Plant, H. J. Payne. Indus. Mgmt. (N.Y.), vol. 74, no. 4, Oct. 1927, pp. 212-217, 6 figs. Points out proper management is as essential in work of handling as in contact of other operations within plant; demand upon transportation equipment can only be made upon establishment of orderly, systematized flow of materials embracing needs of entire plant.

Tendencies. Tendencies in Material Handling, S. G. Koon. Iron Age, vol. 120, no. 19, Nov. 10, 1927, pp. 1293-1296, 2 figs. Combination of systems needed to fit most cases; increasing size of units; financial aspect.

METALS

Structure. Crystallization and the Structure of Metals and Alloys (La cristallisation et la structure des metaux et alliages), A. Portevin. Société Chimique de France—Bul., vol. 41, no. 8, Aug. 1927, pp. 961-987, 40 figs. Solidification structures of commercial and other alloys; number and size of crystals; structural effect of cold hammering and subsequent reheating.

METEOROLOGY

Weather Forecasting. Two Contrasting Examples Wherein Radio Reception Was Affected by a Meteorological Condition, E. H. Kincaid. Inst. Radio Engrs.—Proc., vol. 15, no. 10, Oct. 1927, pp. 843-868, 15 figs. Shows that static has sufficiently definite relationship to distribution of atmosphere as plotted on daily weather map to enable one by proper observations to make use of static in weather forecasting, and to make use of present knowledge of atmospheric distribution and movement in static forecasting; includes abstracts of papers on meteorological relations of atmospheres.

MINE TIMBERING

Preservation. How Should a Mine Preserve Its Timbers? H. B. Carpenter. Coal Mine Mgmt., vol. 6, no. 10, Oct. 1927, pp. 35-36, 1 fig. It has been well-established that creosote is unsuitable for mine work; use of pressure plants.

MOTOR BUSES

Maintenance and Desiggn. Bus Maintenance and Design, P. V. C. See. Ry. Age (Motor Transport Sec.), vol. 83, no. 17, Oct. 22, 1927, pp. 814-817. Unusual methods of large electric railway operator; improvements in construction proposed.

N

NICKEL

Annealing. Nickel and Monel Metal, with Especial Reference to Annealing, C. A. Crawford. Am. Inst. Min. & Met. Engrs.—Tech. Publication, no. 35, 1927, 21 pp., 4 figs. Chemical composition; physical and mechanical properties; working and fabricating of nickel and monel metal; annealing; includes appendix on details regarding different classes of commercial nickel and monel-metal products.

NUTS

Standard. Standard Bolt Heads and Nuts. Am. Mach., vol. 67, no. 19, Nov. 10, 1927, p. 747. Standards for bolt heads and nut sizes approved by Am. Eng. Standards Committee and intended to introduce national uniformity and to supersede all existing standards of bolt heads and nuts. Reference-book sheet.

O

OIL FUEL

Burners. Low Pressure Fuel Oil Burning Systems, H. L. Schultz. Indus. Mgmt. (N.Y.), vol. 74, no. 5, Nov. 1927, pp. 263-269, 6 figs. Practical suggestions for better efficiency; types of systems and their merits; fuel-oil specifications vs. system; location of pumps, blowers, etc.

OIL STORAGE

Lightning Protection. Lightning Protection for Oil Reservoirs, J. T. Lusignan, Jr. Elec. World, vol. 90, no. 16, Oct. 15, 1927, pp. 775-779, 3 figs. Views of leading authorities and experiments discussed to show existing theories of lightning and lightning protection: protective systems described.

OIL TANKS

LIGHTNING PROTECTION. Lightning Protection for Oil Storage Tanks and Reservoirs, R. W. Sorensen, J. H. Hamilton and C. Hayward. Am. Inst. Elec. Engrs.—Jl., vol. 46, no. 8, Aug. 1927, pp. 859-868, 15 figs. Work done in connection with planning protection scheme for oil-storage-tank farms of Gen. Petroleum Corp. of Cal. shows that average annual number of storms at given location is constant; dielectric property of oil has no influence in causing lightning or inducing it to strike oil in storage; tests show that excellent protection can be obtained by towers properly installed, but they do not indicate absolute immunity against hits. Bibliography.

OIL WELLS

DRILLING. Electricity in the Drilling of Oil Wells, L. J. Murphy. Am. Inst. Elec. Engrs.—Jl., vol. 46, no. 8, Aug. 1927, pp. 805-811, 10 figs. It is claimed that satisfied drillers, easy operation, low maintenance, low power bills, fewer shut downs, perfect motion, faster drilling, heavier pulling, no standby losses have contributed to make electricity the coming accepted standard by which all other forms of oil-well drilling will be judged.

OPEN-HEARTH FURNACES

MODERN TYPES. Modern Open-Hearth Furnaces (Les fours Martin modernes), J. Seigle. Technique Moderne, vol. 19, no. 20, Oct. 15, 1927, pp. 641-647, 12 figs. General review of recent practice in design and operation of open-hearth furnaces in France, Germany and America.

ORE DRESSING

GRINDING MEDIA. Theory and Practice in Selecting Grinding Media, H. Hardinge. Eng. & Min. Jl., vol. 124, no. 18, Oct. 29, 1927, pp. 695-698, 7 figs. Outlines factors that affect both theoretical and practical side of this question; weight per unit of volume.

OVERVOLTAGES

PROTECTION AGAINST. Protection from Overvoltage Due to Voltage Regulators, J. H. Ashbaugh. Elec. Jl., vol. 24, no. 11, Nov. 1927, pp. 551-553, 5 figs. Discusses methods available to prevent overvoltage; scheme is now available for protection of small stations whereby they can be assured of continuity of service without any hazard of overvoltage due to failure of regulator contacts.

OXY-ACETYLENE WELDING

AIRPLANE-FRAME MANUFACTURE. Fabricating Frames for Airplanes by Oxy-Acetylene Welding. Iron Trade Rev., vol. 81, no. 15, Oct. 13, 1927, pp. 903-904, 2 figs.

P

PIPE, CAST IRON

CENTRIFUGALLY CAST. Cast Iron Pipe Centrifugally Made Sand Moulds, J. T. MacKenzie. Am. Iron & Steel Inst.—Advance Paper for mtg., Oct. 28, 1927, 13 pp., 4 figs. Presents tabulation or results obtained by Professor Talbot on pit-cast and centrifugally sand-cast pipe. See also Iron Age, vol. 120, no. 19, Nov. 10, 1927, p. 1302.

PLATES

RECTANGULAR. An Optical Determination of Axial Stresses in Long Rectangular Plates Under Torsion, I. A. Balinkin. Phys. Rev., vol. 30, no. 4, Oct. 1927, pp. 520-526, 5 figs. New photometric method for measuring stress intensities was employed.

POLES, CONCRETE

TESTING. Testing Concrete Poles Under Load, F. G. Welsch. Can. Engr., vol. 53, no. 15, Oct. 11, 1927, pp. 451-453, 7 figs. Tests show that concrete poles can be designed for definite loads and with uniform results. Reprinted from Concrete Highways and Mun. Improvements.

POWER FACTOR

CORRECTION. Correcting Power Factor with Static Condensers Reduces Power Costs, J. E. Trostle. Power, vol. 66, no. 20, Nov. 15, 1927, pp. 736-739, 3 figs. By addition of static condenser to improve power factor, certain power companies and industrial plants have been able to carry their regular load with less equipment in operation, while others have made it possible to take on more load without purchasing additional generating equipment.

Power Factor Correction, Effective Power and Reactive Power, W. H. Feldmann. Iron & Steel Engr., vol. 4, no. 9, Sept. 1927, pp. 389-395, 3 figs. Disadvantages of poor power factor and savings to be effected when power is purchased and when it is generated; static and synchronous condensers, and synchronous motors.

DISTRIBUTION CIRCUITS. The Most Economical Power Factor, H. S. Litchfield. Am. Inst. Elec. Engrs.—Jl., vol. 46, no. 9, Sept. 1927, pp. 904-9.2, 4 figs. Practical design formula for distribution circuits.

POWER GENERATION

PROGRESS IN. Progress in Power Generation. Am. Inst. Elec. Engrs.—Jl., vol. 46, no. 9, Sept. 1927, pp. 916-933. Annual report of committee as follows: Steam turbine generator units; condensers; boilers, superheaters and economizers; stokers and furnaces; pulverized fuel; automatic combustion control; ultra-high-pressure steam turbine generator installations; mercury-vapour installation; hydro-electric development; power station auxiliaries; power production economies.

POWER TRANSMISSION

LUBRICATION. Lubrication of Power Transmission Equipment, A. F. Brewer. Indus. Engr., vol. 85, no. 10, Oct. 1927, pp. 471-476, 6 figs. Lubrication of anti-friction bearings, gears, chain drive, etc.

PULSATING LOADS. Methods of Handling Shock or Pulsating Loads. Indus. Engr., vol. 85, no. 10, Oct. 1927, pp. 477-480, 6 figs. Presents examples showing how interesting problems were solved in transmission of power when shock or pulsating loads were important factor to be considered.

PSYCHOLOGICAL TESTS

APTITUDE TESTS. Determination of Vocational Aptitudes, H. D. Kitson. Personnel Jl., vol. 6, no. 3, Oct. 1927, pp. 192-198. Author is critical of methods of validation which rely on correlations between test score and proficiency on job, without consideration of scores made by a comparable but vocationally unselected group.

PULVERIZED COAL

BOILER FIRING. Pulverized Fuel and Its Application to Boilers, R. B. Potter. Instn. Mech. Engrs.—Proc., no. 2, 1927, pp. 549-554. Summarizes advantages of pulverized fuel; discusses apparatus needed.

PUMPS, CENTRIFUGAL

AXIAL-FLOW. Low-Lift Axial-Flow and Centrifugal Pumps, H. R. Lupton and J. H. W. Gill. Engineering, vol. 124, nos. 3223 and 3224, Oct. 21 and 28, 1927, pp. 534-536 and 566-568, 13 figs. Investigation of relative incidence of losses in centrifugal and axial pumps are examined; determination of characteristics and losses in axial-flow and centrifugal pumps.

GUARANTEES. Determining Centrifugal Pump Guarantees, G. H. Gilson. Power House, vol. 21, no. 18, Sept. 20, 1927, pp. 23-24. Meaning of velocity head in centrifugal pump guarantees is explained and methods of making velocity head corrections outlined, where areas of suction and discharge nozzles differ.

THEORY. New Theory for the Centrifugal Pump, A. F. Sherzer. Am. Soc. Civil Engrs.—Proc., part 1, Oct. 1927, pp. 1775-1803, 18 figs; and abstract in Power, vol. 66, no. 17, Oct. 25, 1927, pp. 645-646. Outlines programme of research and experiment on centrifugal pumps conducted in hydraulic laboratory of Univ. of Mich.; this study has resulted in (1) discovery of number of errors in present accepted theories; (2) development of entirely new theory; and (3) successful application of new theory in increasing the efficiency of centrifugal pump.

PYROMETERS

OPTICAL. Optical Pyrometer and Distance Thermometers. Engineering, vol. 124, no. 3224, Oct. 28, 1927, p. 550, 2 figs. Instruments made by Siemens Bros. & Co., Woolwich, England; portable pyrometer is of disappearing-filament type.

R

RADIOTELEGRAPHY

AERIAL SYSTEMS. Calculation of the Polar Curves of Extended Aerial Systems, E. Green. Experimental Wireless, vol. 4, no. 49, Oct. 1927, pp. 587-594, 9 figs. Case considered is that of a line of aerials, the adjacent ones separated by small fraction of a wavelength, and whole system extending in straight line several wavelengths long.

RAILS

SURFACE CRACKING. Surface Cracking of Rails in Service (La fissuration superficielle des rails en service Technique d'étude des rails fissurés), A. Portevin. Revue Générale des Chemins de Fer, vol. 46, no. 9, Sept. 1927, pp. 263-275, 19 figs. Chemical and physical tests for determining character of temper and cold rolling of rails with view of correlating with surface cracking of rails in service.

RAILWAY REPAIR SHOPS

LOCOMOTIVE. Steel-Frame Repair Shop for Locomotives, C. I. & L. Ry. Eng. News-Rec., vol. 99, no. 19, Nov. 10, 1927, pp. 759-761, 4 figs. Pit tracks served by 200-ton travelling crane and transfer table; heavy column design; transverse monitors.

RAILWAY SIGNALLING

COLOURED-LIGHT SIGNALS. Denver & Rio Grande Western Installs Its First Automatic Signals, B. W. Molis. Ry. Signalling, vol. 20, no. 11, Nov. 1927, pp. 415-417. Signal department organization established and 104 miles of single-track colour-light signals completed during first year.

RAILWAY TRACK

CURVE RESISTANCE. Freight Train Curve Resistance on a One-Degree Curve and a Three-Degree Curve, E. C. Schmidt. Am. Ry. Eng. Assn.—Bul., vol. 29, no. 298, Aug. 1927, pp. 1-30, 14 figs. Tests made with five freight trains; results relate exclusively to resistance of cars composing train and apply only to freight trains with four-wheeled trucks.

RECTIFIERS

MERCURY-ARC. Mercury-Arc Rectifier Characteristics, E. B. Shand. Elec. Jl., vol. 24, no. 10, Oct. 1927, pp. 486-493, 12 figs. Describes number of features adopted in a large rectifier which has recently been developed.

Automatic Switching Control for Mercury-Arc Rectifier, M. E. Reagan. Elec. Jl., vol. 24, no. 10, Oct. 1927, pp. 496-499, 2 figs. Shows that use of automatic switching has not greatly complicated handling of a rectifier substation.

Mercury-Arc Power Rectifiers, O. K. Marti and H. Winograd. Am. Inst. Elec. Engrs.—Jl., vol. 46, no. 8, Aug. 1927, pp. 818-826, 13 figs. Their applications and characteristics.

Papers on Mercury-Arc Rectifiers. Am. Inst. Elec. Engrs.—Jl., vol. 46, no. 10, Oct. 1927, pp. 1104-1105, 3 figs. Discussion of papers published in previous issues of Journal.

REFRACTORIES

MAGNESIA. Magnesia Refractories for Steel Furnaces, G. M. Currie and C. F. Pascoe. Can. Min. & Met. Bul., no. 186, Oct. 1927, pp. 1186-1272. Outlines occurrence of raw materials and indicates conditions under which finished product operates; nomenclature; uses; refractories available; applications; bibliography.

REFRIGERANTS

METHYL CHLORIDE. Certain Physical and Chemical Properties of Methyl Chloride, H. J. Macintire, C. S. Marvel and S. G. Ford. Refrig. Eng., vol. 14, no. 4, Oct. 1927, pp. 115-120 and 138, 2 figs. Summarizes facts about this refrigerant pertinent to present uses; physical and chemical properties.

REFRIGERATING MACHINES

AUTOMATIC. Hazards of Automatic Refrigerators, W. R. Rilling. Contract Rec., vol. 41, no. 42, Oct. 19, 1927, pp. 1068-1069. Possibilities of danger that should be considered by every architect and contractor responsible for specifying or installing electric or gas cooling devices.

MANUFACTURING COST. Manufacturing Cost, E. S. Schenck. Refrig. Eng., vol. 14, no. 5, Nov. 1927, pp. 139-140. Fundamentals apply to any variety of product, but special reference is given to refrigerating machinery.

REFRIGERATION

COMPRESSION AND ABSORPTION. Compression and Absorption Cycles Combined, M. Pohlmann. Refrig. Eng., vol. 14, no. 5, Nov. 1927, p. 162, 2 figs. Presents theoretical card for combined process and diagrammatic arrangement of possible combined cycle. Translated from Kälte-Industrie, Aug. 1927.

DOMESTIC. Household Refrigeration, C. C. Spreen and L. A. Philipp. Refrig. Eng., vol. 14, no. 5, Nov. 1927, pp. 145-149, 4 figs. Effect of compressor speed upon refrigerating capacity and efficiency in the case of small compressor.

REGULATORS

INDUCTION. Induction Regulators, N. D. Seaton. Eng. Jl., vol. 10, no. 11, Nov. 1927, pp. 481-486, 4 figs. Theory of induction regulators, special features of their design and construction, with note on their selection, operation and application.

RELAYS

PROTECTIVE. Ratio-Differential Relay Protection, H. P. Sleeper. Elec. World, vol. 90, no. 17, Oct. 22, 1927, pp. 827-831, 8 figs. By using relays that automatically exert reverse torque and raise pick-up on through faults, drawbacks of ordinary differential protection are avoided; characteristics and performance.

RIVERS

MISSISSIPPI. Work of Mississippi River Commission Outlined, C. W. Kutz. Eng. News-Rec., vol. 99, no. 17, Oct. 27, 1927, pp. 670-673. Reviews its history and limitations; studies for extensive flood-control programme based upon effects of 1927 flood.

ROAD CONSTRUCTION

Contract Control. Road Construction Contract Control, L. R. Ames. Can. Engr., vol. 53, no. 14, Oct. 4, 1927, pp. 159-260. Verbatim report of proceedings, tract control elevates standard of performance in contracting industry.

ROADS

Asphaltic Oil Surfaces. Light Asphaltic Oil Road Surfaces, C. L. McKesson and W. N. Frickstad. Pub. Roads, vol. 8, no. 7, Sept. 1927, pp. 125-158, 30 figs. Investigation to determine service value that may be expected of fine crushed rock and gravel surfaces to ascertain what methods might be employed to conserve material and increase serviceability by use of bituminous material; fine crushed rock and gravel roads; surface oiling of California state highways; bituminous treatment of crushed rock and gravel roads by surface mixing process; selection of method and oil for treatment; treatment of earth roads with oil.

Problems and Developments. Road Convention at Niagara Falls, Ont. Can. Engr., vol. 53, no. 14, Oct. 4, 1927, pp. 159-206. Verbatim report of proceedings, papers and discussions at fourteenth annual convention of Canadian Good Roads Assn., Niagara Falls, Ont.

ROADS, CONCRETE

Design. Design of Concrete Roads—Curing of Concrete, H. F. Clemmer. Boston Soc. Civ. Engrs.—Jl., vol. 14, no. 7, Sept. 1927, pp. 398-419 and (discussion) 419-423, 12 figs. Deals with actual factors affecting life and load-bearing qualities of pavement slab; fatigue of concrete, resistance to repeated stresses; use of centre longitudinal joint; internal stresses due to temperature and moisture changes; expansion joints; formula for design of cross section; curing of concrete; calcium chloride used integrally.

Sand Gravel as Aggregate. Sand Gravel as Total Aggregate for Concrete Roads, W. V. Buck. Eng. News-Rec., vol. 99, no. 19, Nov. 10, 1927, pp. 749-751, 4 figs. In many localities of Kansas, sand and sand-gravel deposits occur in abundance, both in stream beds and in banks or pits; method of utilizing fine aggregate deposits in concrete-road construction.

ROADS, EARTH

Corrugations. What Causes Corrugations in Traffic-Bound Roads, J. P. McMarin. Eng. News-Rec., vol. 99, no. 10, Sept. 8, 1927, pp. 384-386, 2 figs. Rain water and wind action start chatter bumps which motor vehicle traffic develops into a nuisance.

Sand-Clay and. Sand-Clay and Earth Roads, H. R. Mackenzie. Contract Rec., vol. 41, no. 42, Oct. 19, 1927, pp. 1069-1070. Two types that comprise greater part of Saskatchewan's highway system; methods used in that province to build and maintain these roads; cost data.

Alberta's Sand-Clay and Earth Roads, C. A. Davidson. Contract Rec., vol. 41, no. 43, Oct. 26, 1927, pp. 1089-1090. Procedure followed in connection with building 2,500-mi. main highway system; features of design, quantities and cost; sand-clay specification.

ROADS, GRAVEL

Asphaltic-Oil. Surface-Mixed Oiled-Gravel Road on Wyoming Plains, C. H. Bowman. Eng. News-Rec., vol. 99, no. 18, Nov. 3, 1927, pp. 703-704. New type of asphaltic-oil road construction for fine crushed surfaces; working force, plant and cost itemized.

Nova Scotia. Nova Scotia's Experience with Gravel Roads, R. W. McColough. Contract Rec., vol. 41, no. 42, Oct. 19, 1927, pp. 1071-1073. 5,000 miles of highway system surfaced with gravel; methods which are used by Nova Scotia Department of Highways to maintain these roads in good condition.

ROLLING MILLS

Bar Mills. Bar Mill Designed Essentially for Alloy Steel Sections. Iron Trade Rev., vol. 81, no. 11, Sept. 15, 1927, pp. 662-666, 4 figs. Barpiling device at hot bed retards cooling of material and permits stack annealing.

Bearing Pressures. Measuring Pressures on Bearings of Rolling Machinery. P. H. Frank. Iron Trade Rev., vol. 81, no. 16, Oct. 20, 1927, pp. 965-967, 3 figs. Two methods have been developed to determine loads which anti-friction bearings must withstand.

Electric Drive. Electric Drive for the Reversing Mill at Margam Works. Iron & Coal Trades Rev., vol. 125, no. 3111, Oct. 14, 1927, pp. 563-564, 5 figs. Equipment consists essentially of 8,000 18,000-h.p. d.c. motor driving mill; Ward-Leonard motor-generator set for control of mill motor; exciter set; high- and low-tension switchboards; switchgear for operation platform, and automatic slip regulator for a.c. motor of Ward-Leonard set.

Recent Developments in Electric Drives for Rolling Mills, L. A. Umansky. Am. Inst. Elec. Engrs.—Jl., vol. 46, no. 9, Sept. 1927, pp. 885-892, 12 figs. Electric drives, of capacities larger than encountered elsewhere, are usually designed to fit individual cases; special machines or special combinations of them are frequently used; several representative cases are outlined and methods of solving encountered problems are analyzed.

Four-High. Developments in Four-High Rolling, F. C. Biggert, Jr. Iron Age, vol. 120, no. 20, Nov. 17, 1927, pp. 1367-1370. Mill and roll design matured rapidly; roller bearings large factor; high tonnage output. Paper read before Iron & Steel Division of Am. Soc. Mech. Engrs.

Refractories for. Refractories and Four-High Mills. Iron Age, vol. 120, no. 20, Nov. 17, 1927, pp. 1370-1371. Review of papers read before iron and steel division of Am. Soc. Mech. Engrs.

Soaking Pits. Soaking Pit Operates on Recuperative Principle. Iron Trade Rev., vol. 81, no. 9, Sept. 1, 1927, p. 501. Because of success of this type pit in France, trial installation was made at Donner Steel Co., Buffalo; it was designed and built by Chapman-Stein Furnace Co.

Wire and Rod. Study of Wire-Rod Rolling Mills (Etude sur les trains à fils), E. Richarme. Revue de Métallurgie, vol. 24, nos. 4, 5, 6 and 7, Apr., May, June and July, 1927, pp. 161-178, 255-277, 307-316 and 405-407, 3 figs.

S

SEWAGE DISPOSAL

Pumping Station. Wellpoint Method for Handling Excavation of Foundation Pit at New Sewage Pumping Station, Lynn, Massachusetts, C. Terzaghi. Boston Soc. Civ. Engrs.—Jl., vol. 14, no. 7, Sept. 1927, pp. 389-397, 3 figs. In spring of 1927 rather delicate piece of excavation work was performed for foundation of new pumping station; work included an open excavation, 30 ft. deep, through quicksand, at short distance from both seacoast and incinerator plant with shallow foundation; by using wellpoints for lowering ground-water level contractor succeeded in keeping quicksand almost perfectly undisturbed; description of work and brief review of difference between American and European method of handling similar construction problems.

SHEARS

Combined Punching and Shearing. Cleveland No. 2 Combination Punching and Shearing Machine. Am. Mach., vol. 67, no. 19, Nov. 10, 1927, p. 751, 2 figs. Punching, notching, shearing and splitting can be performed on this machine; attachment is also supplied for twisting bars.

Continuous Automatic. Machine Trim Sheets Automatically. Iron Trade Rev., vol. 81, no. 17, Oct. 27, 1927, p. 1031, 1 fig. Substantial reduction in labour cost and increased production are made possible in sheet and tin plate mills by means of continuous, automatic shearing machine placed on market by Streine Tool & Mfg. Co., New Bremen, Ohio. See also Iron Age, vol. 120, no. 117, Oct. 27, 1927, pp. 1160-1161, 3 figs.

SIGNALLING

Traffic Control Lights. Traffic Control by Electric Signal Lights, M. O. Eldridge. Am. Soc. Civil Engrs.—Proc., part 1, Oct. 1927, pp. 1989-1994, 3 figs. One of more difficult traffic centres of Washington, D.C., is Scott Circle; situation is complicated because it is intersection of six streets (three directions), the main traffic being north and south in Sixteenth street; there is a considerable rotary as well as through movement, but signal lights have fairly well succeeded in solving difficulties; essential features of this plan are division of circular street with inner zone for through north and south traffic and outer zone for rotary traffic; and treatment of both diagonal avenue simultaneously as cross streets.

SMOKE

Abatement. Organizing a Smoke-Abatement Campaign, E. Ormsby. Mech. Eng., vol. 49, no. 11, Nov. 1927, pp. 1216-1218. Technical division of city's engineers first essential in smoke-abatement campaign; major activities of technical division; research-publicity work; smoke surveys; educational work; conduct of campaign; appalling monetary loss caused by smoke.

Some Hints on Securing Smokeless Combustion with Bituminous Coal, T. E. Landvoigt. Am. Soc. Heat. & Vent. Engrs.—Jl., vol. 33, no. 10, Oct. 1927, pp. 607-611. If suitable equipment is used, and intelligently operated, smoke is unnecessary; if well-known principles of combustion are applied in practice, satisfactory results are readily obtainable with bituminous coal; three things necessary for complete combustion are air properly introduced and controlled, a suitable temperature, and a properly proportioned combustion chamber.

SPRINGS

Steel, Corrosion of. Protection of Steel Springs Against Corrosion. Mech. World, vol. 82, no. 2127, Oct. 7, 1927, p. 269. Discusses various methods for protecting springs, including: (1) painting; (2) oil finishing; (3) coating by molten metal, chiefly by tin; (4) electroplating; (5) non-metallic coating produced by boiling in special chemical solution often sold under trade name.

STEAM ACCUMULATORS

Application. Application of Steam Accumulators, G. Keeth. Chem. & Met. Eng., vol. 34, no. 9, Sept. 1927, pp. 560-561, 2 figs. Writer's impression and observations on application of accumulators to industrial power plants.

Ruths. Ruths Accumulator in the Paper Industry. Paper Trade Jl., vol. 85, no. 17, Oct. 27, 1927, pp. 74-76, 5 figs. Far-reaching effect of accumulator upon operation of pulp and paper mill shown to good advantage at new plant of Price Bros. & Co., Ltd., at River Bend; other installations in United States and Canada.

STEAM ENGINES

Extractions. Extraction Engines. Power Engr., vol. 22, no. 260, Nov. 1927, pp. 412-414, 5 figs. Describes control systems in use in connection with extraction engines, with references to economies obtainable by engines of this type.

Single-Cylinder Extraction Engine. Engineering, vol. 124, no. 3224, Oct. 28, 1927, p. 550, 6 figs. on p. 554. Engine designed to meet wide variation in conditions; made by Maschinenbau, A.G., Silesia.

STEAM GENERATION

Submerged Combustion. Steam Generation—Submerged Combustion, N. Swindin. World Power, vol. 8, nos. 45 and 46, Sept. and Oct. 1927, pp. 128-132 and 189-196, 14 figs. Submerged combustion is inversion of present-day practice in steam generation and evaporation; history and development of burners in which fuels can be consumed in contact with water and other liquid. Oct.: Brunler and Hammond systems; influence of law of partial pressure on temperature and pressure of mixture of steam and gas; behaviour of steam-gas mixture when expanding in steam-engine cylinder; thermodynamics; difficulties in adapting submerged combustion boiler to steam power.

STEAM METERS

Control. Steam Metering and Control, H. M. Hammond. Chem. & Met. Eng., vol. 24, no. 9, Sept. 1927, pp. 569-571, 5 figs. Meters recording steam flow and air flow should be installed on each boiler not only to show distribution of load on boiler, but to guide firemen in controlling rate of fuel feed, air supply, etc., to generate required amount of steam most efficiently.

STEAM PIPES

Developments. Modern Developments in the Steam Piping Field, A. B. Williams and C. W. Welch. Chem. & Met. Eng., vol. 34, no. 9, Sept. 1927, pp. 547-550, 4 figs. Design of high-pressure plants; flow diagram; standards for fittings and pipe flanges; materials.

STEAM POWER PLANTS

Combined Power and Process. Balancing Process Steam and Power in a Coated-Fabric Plant, L. C. Cooley. Chem. & Met. Eng., vol. 34, no. 9, Sept. 1927, pp. 551-553, 3 figs. Story of production and use of steam for process and power; unique arrangement developed and applied to control of steam and power generation.

Turbine Loading Schedules. Large Economies Result from Using Steam-Turbine Loading Schedules, A. R. Haynes. Power, vol. 66, no. 13, Sept. 27, 1927, pp. 462-465, 5 figs. Study of operating schedule built up from water rates of units; typical case of station with four units is assumed, and operating data plotted to show characteristics of units and most efficient combination of loads.

STEAM TURBINES

By-Product Power from. By-Product Power from Steam Turbines, C. B. Campbell. Chem. & Met. Eng., vol. 34, no. 9, Sept. 1927, pp. 554-559, 10 figs. Most of larger process industries can develop their own power at favorable unit cost by taking advantage of possibility of co-ordinating generation of steam for power and process.

Extraction. The Field and Limitations of Extraction Turbines, C. B. Campbell. Elec. Jl., vol. 24, no. 11, Nov. 1927, pp. 553-556, 2 figs.

Loading. Efficient Loading of Steam Turbines, A. R. Haynes. Power, vol. 66, no. 20, Nov. 15, 1927, pp. 730-732, 1 fig. Minimum water-rate curves; total steam and water rates for different combinations of units; when auxiliary valve may be opened.

Small. Small Steam Turbines, G. A. Orrok. Engrs'. Soc. of West Pa.—Proc., vol. 43, no. 6, July 1927, pp. 267-272 and (discussion) 273-278, 4 figs. Author claims that small turbine is most advantageous; it is light and occupies very small space; rugged in construction and automatic in operation; economical in use of steam in proportion to price paid for it; requires little attention, and uses little oil; maintains its economies over a series of years.

The Small Steam-Turbine Unit for Industrial Requirements, G. Arrowsmith. Instn. Mech. Engrs.—Proc., no. 2, 1927, pp. 555-566, 1 fig.

STEEL

ALLOYS. *See Alloy Steels.*

ETCH TESTS. Deep Etch Test for Iron and Steel, H. G. Keshian. Am. Soc. Steel Treat.—Trans., vol. 12, no. 5, Nov. 1927, pp. 689-727 and (discussion) 727-736, 30 figs. Describes types of structure revealed by method; factors influencing results, such as method of melting, chemical composition, reduction of area, heat treatment, direction of fibre in steel, etc.; points out value and limitations of method based on relation of various etch structures to performance of steel in service as observed by author.

HIGH TEMPERATURES, EFFECT OF. The Properties of Steel at High Super-Heat Temperatures, A. McCance. Liverpool Eng. Soc.—Trans., vol. 48, 1927, pp. 205-224 and (discussion) 225-240, 11 figs. Examination of temperature-strength curves for various steels; secondary effects of prolonged high temperature.

PROPERTIES. On the Properties of Steels, J. E. Howard. Am. Soc. Steel Treat.—Trans., vol. 12, no. 4, Oct. 1927, pp. 622-629 and 650. Discusses various physical properties of steel and their behaviour under different conditions; some of points discussed are Poisson's ratio, Hooke's law, elastic limit, elongation and contraction of area, modulus of elasticity, coefficients of expansion.

The Relations Between the Properties of Materials and Their Structure, A. Pomp. Eng. Progress, vol. 8, no. 10, Oct. 1927, pp. 263-264, 2 figs. Points out that nature of structure is of great moment as regards machining of steel with cutting tools; original structure of steel is also of decisive importance for results obtained in hardening; influence of cementite structure on result of hardening; favorable results achieved with tempering.

COMPRESSION AND BREAKING ENERGY. Influence of Compression Upon the Breaking Energy of Steel (Influence de la compression sur la fragilité de l'acier—existence d'une limite de fragilité), P. Dejean and H. Le Chatelier. Académie des Sciences—Comptes Rendus, vol. 184, no. 4, Jan. 24, 1927, pp. 188-189. See brief translated abstract in Mech. World, vol. 82, no. 2128, Oct. 14, 1927, p. 295.

STEEL, HEAT TREATMENT OF

AUTOMOBILE PARTS. Heat Treating 20,000 Hubs and Piston Pins Daily, S. Thompson. Iron Trade Rev., vol. 81, no. 19, Nov. 10, 1927, pp. 1160-1161, 3 figs. Details of heat treating department of Defiance Screw Machine Products Co.

DEFINITIONS AND FUNCTIONS. Some Facts About Heat Treatments, S. Dunn. Ry. Mech. Engr., vol. 101, no. 11, Nov. 1927, pp. 745-747. Definition; difference between iron and steel; function of heat treating; heat treating billets for forging, and in blacksmith shop; heating steel to critical temperatures; importance of accurate heat treatment.

DESIGN PROBLEMS. Design from the Heat Treating Standpoint, G. M. Eaton. Am. Soc. Steel Treat.—Trans., vol. 12, no. 5, Nov. 1927, pp. 794-811 and (discussion) 811-813, 7 figs. Author stresses need for closer co-operation between metallurgist and mechanical engineer; gives some typical problems still unsolved because of lack of union; freight car bolster spring is discussed, and suggestions offered for possible elimination of it.

ELECTRIC. Benefits Obtained from Electric Heat Treatment. Elec. World, vol. 90, no. 19, Nov. 5, 1927, pp. 927-934. Annealing, carburizing, hardening and drawing in automatic electric furnaces speed-up production in Detroit automobile plants; heat-treating costs reduced and quality improved.

RAILWAY-SHOP TOOLS. Heat Treating Methods and Equipment Recommended for Railroad Shops. Ry. Jl., vol. 33, no. 10, Oct. 1927, pp. 21-23. Report of Committee on Am. Ry. Tool Foremen's Assn. on handling of railway repair tools requiring heat treatment; manufacture of and repairs to chisels, caulking tools, etc., high-speed machine tools, and reamers, taps, rivet sets, etc.

RATE OF HEATING. Heat Treatment and Metallography of Steel, H. C. Knerr. Forging—Stamping—Heat Treating, vol. 13, no. 10, Oct. 1927, pp. 420-422, 5 figs. Rate of heating.

THEORY. The Constitution of Steel and Cast Iron, F. T. Sisco. Am. Soc. Steel Treat. Trans., vol. 12, no. 4, Oct. 1927, pp. 651-666, 10 figs. Study of theory of heat treatment; review of constitution of steel and cast iron from standpoint of stable equilibrium; solid solution of carbon in gamma iron, or austenite; discussion of grain growth of austenite above critical range.

STEEL, HIGH-SPEED

TESTS. Comparisons of Impact and Slow Bend Tests of High Speed Steel, R. K. Barry. Am. Soc. Steel Treat.—Trans., vol. 12, no. 4, Oct. 1927, pp. 630-634, 1 fig.

STEEL WORKS

ENGLAND. The Works of William Beardmore & Co., Limited, Mossend Steel Works. Foundry Trade Jl., vol. 37, no. 584, Oct. 27, 1927, pp. 61-62, 3 figs. Details of melting shop; section mills, cogging mill, bail-finishing plant; power station; plate mill; shearing plant, etc.

POWER APPLICATION. Power Application in Steel Plant. Elec. World, vol. 90, no. 18, Oct. 29, 1927, pp. 877-882, 9 figs. New merchant mills in Gary works of the Illinois Steel Co. exemplify modern practice; highly developed methods speed production and improve quality of product.

STREET RAILWAYS

CARS, ONE-MAN. London, Ont., Cars Converted to One-Man Safety Operation, L. Tait. Elec. Ry. Jl., vol. 70, no. 13, Sept. 24, 1927, pp. 557-559. Two-man, single-truck cars converted to safety type, with double doors in front and treadle exit door in rear.

STRESSES

FILLETS AND HOLES, PRODUCED BY. Stress Concentration Produced by Fillets and Holes, S. Timoshenko. Int. Congress for Applied Mechanics—Proc., 1926, pp. 13-20, 13 figs. Study can be carried out either by analysis, photoelasticity, Lüders' lines or by fatigue test; all these methods are discussed.

SUBSTATIONS

AUTOMATIC. A 21,000-Kva. Automatic Substation, D. W. Ellyson. Am. Inst. Elec. Engrs.—Jl., vol. 46, no. 8, Aug. 1927, pp. 802-804 and (discussion) 832-834, 4 figs. Summary of apparatus and control equipment, general scheme of operation, together with floor plans of building, one-line diagrams illustrating operation, and view of portion of single-phase regulator equipment; shows total kva. capacity of apparatus that is automatically controlled.

SUPERHEATED STEAM

INDUSTRIAL APPLICATIONS. Application of Superheated Steam in Industrial Processes, F. G. Page. Chem. & Met. Eng., vol. 24, no. 9, Sept. 1927, pp. 575-576, 2 figs. Specific results are cited which constitute example of how superheat may be important factor in process work.

SURVEYING

BOUNDARY. Boundary Surveys, C. T. Johnston. Am. Soc. Civil Engrs.—Proc., part 1, Oct. 1927, pp. 2013-2020. Cadastral surveys; political and riparian boundaries

SWITCHBOARD

PANEL MATERIAL FOR. Panel Material for Switchboards, E. G. Bern. Gen. Elec. Rev., vol. 30, no. 11, Nov. 1927, pp. 541-543, 3 figs. Marble used chiefly for architectural effect; slate is better adapted to service requirements; synthetic material for panels; metal panels; panel beveling.

T

TELEPHONY

AUTOMATIC. Automatic Telephony, G. W. Stubbings. World Power, vol. 8, no. 46, Oct. 1927, pp. 197-199, 2 figs. After brief account of rudimentary automatic exchange, author describes problems which arise in application of automatic principle to groups of exchanges in large cities; differences between "controller" and "director" systems; statistics regarding relative operation costs of manual and automatic exchanges.

TEXTILE MACHINERY

ELECTRIC DRIVE. Applying Electric Drives to Textile Finishing Machines Where Speed Adjustment is Required, W. H. Tate. Textile World, vol. 72, no. 16, Oct. 15, 1927, pp. 43-47, 4 figs. Machines may be operated as single units or in tandem; five driving systems available.

TEXTILES

RESEARCH. Résumé of the Year's Textile Research at the Bureau of Standards, C. W. Schoffstall. Textile World, vol. 72, no. 19, Nov. 5, 1927, pp. 103-107, 3 figs. Work extended into new fields. Publication approved by Directors of Bur. of Standards.

TRAFFIC

CONTROL. Traffic Control in New York, N.Y., P. D. Hoyt. Am. Soc. Civil Engrs. —Proc., part 1, Oct. 1927, pp. 1995-2001. Complexities of problem are increased not merely in proportion to its great population but also because of many other factors, some of them peculiar to city; widening of highways and elevated roadways have been recognized as essential to future needs of city.

TRANSFORMERS

BANKS, INSTABILITY. Instability in Transformer Banks, K. E. Gould. Am. Inst. Elec. Engrs.—Jl., vol. 46, no. 11, Nov. 1927, pp. 1160-1166, 15 figs. Considers instability which sometimes occurs in banks of transformers supplying capacity load when certain harmonics in primary current are suppressed, either by type of transformer connections or by resonant circuit in series with primary of transformer, and similarity between several unstable circuits is pointed out.

COOLING. Auxiliary Cooling for Transformer Units, W. R. Farley. Elec. World, vol. 90, no. 18, Oct. 29, 1927, p. 885, 1 fig. Temperature controllers operate apparatus for protection of one or more transformers subject to heavy overloads.

EXCITING CURRENT. Reduction of Transformer Exciting Current to Sine-Wave Basis, G. Camilli. Am. Inst. Elec. Engrs.—Jl., vol. 46, no. 9, Sept. 1927, pp. 892-896, 7 figs. Describes two methods developed for reduction of exciting current to sine-wave basis.

LOAD-RATIO CONTROL. Application and Design of Load Ratio-Control Equipment, A. Palme. Am. Inst. Elec. Engrs.—Jl., vol. 46, no. 11, Nov. 1927, pp. 1202-1206 and (discussion) 1269-1273, 9 figs. Gives various possible applications and details of electrical and mechanical design of apparatus.

RADIO-FREQUENCY. Radio-Frequency Transformers, N. W. McLachlan. Experimental Wireless, vol. 4, no. 49, Oct. 1927, pp. 597-600, 4 figs. Their application to screened valves.

REPAIR VS. REPLACEMENT. Repair vs. Replacement of Old Transformers, M. D. Smith. Power, vol. 66, no. 15, Oct. 11, 1927, pp. 552-554, 8 figs. Method for determining which is more economical, to repair an old transformer that has failed or replace it with new one.

TAP CHANGING. Transformer Tap Changing Under Load, L. H. Hill. Am. Inst. Elec. Engrs.—Jl., vol. 46, no. 11, Nov. 1927, pp. 1214-1221 and (discussion) 1269-1273, 12 figs. Methods of changing taps under load; equipment for obtaining smooth curve voltage control; combination voltage and phase-angle control.

MECHANICAL FORCES. Mechanical Forces in Transformers, J. E. Clem. Am. Inst. Elec. Engrs.—Jl., vol. 46, no. 8, Aug. 1927, pp. 814-817, 8 figs. Method of calculating mechanical forces based on mutual reactance between coils, formula for mutual inductance between coaxial solenoids is developed and from this expression formula for mechanical force between concentric cylindrical transformer coils is derived. See discussion in no. 9, Sept. 1927, pp. 961-963, 1 fig.

TUNNELING

STREET RAILWAY TUNNELS. Tunneling Under San Francisco's Hills, C. W. Geiger. Explosives Engr., vol. 5, no. 11, Nov. 1927, p. 429. Construction methods employed on 4,232-ft. street railway tunnel now being constructed.

TUNNELS

RAILWAY. Cascade Tunnel Commission Favours Route Near Great Northern, F. W. Harris. Eng. News-Rec., vol. 99, no. 18, Nov. 3, 1927, p. 715. Construction of twin railroad tunnels 29 miles long under Cascade mountains to provide low level route for both highway and railway traffic between eastern and western parts of state of Washington has been recommended by Cascade Tunnel Commission in its report to 1927 legislature.

V

VIADUCTS

CONCRETE AND STEEL. East York-Leaside Bridge, Toronto, W. Snaith. Can. Engr., vol. 53, no. 17, Oct. 25, 1927, pp. 483-486. Long concrete and steel viaduct crossing Don Valley; steel superstructure erected by cantilever method; tall concrete piers built during winter and protected against frost. See also Contract Rec., vol. 41, no. 43, Oct. 26, 1927, pp. 1080-1081, 4 figs.

W

WAREHOUSES

TERMINAL. New Terminal Warehouse at Montreal, J. J. Shea. Can. Engr., vol. 53, no. 16, Oct. 18, 1927, pp. 457-461. Large warehouse with facilities for dry and cold storage erected adjacent to Place Viger yards; entire building of reinforced-concrete construction with slab-type floors; bulk of concrete was poured in winter.

WATER POWER

APPRAISALS. Water Power Appraisals, W. H. Cushman. Am. Soc. Civil Engrs.—Proc., part 1, Oct. 1927, pp. 1843-1850. Calls attention to lack of uniformity in methods now used in appraising water power property; attempt is made to outline a logical method of procedure that will eliminate several factors which, under some of current methods, are difficult to determine, or which lead to erroneous conclusions.

WATER SUPPLY

SURFACE, CANADA. Surface Water Supply of Canada. Can. Dept. Interior—Water Resources Paper, no. 52, 1927, 91 pp. Atlantic drainage (south of St. Lawrence river), New Brunswick, Nova Scotia, Prince Edward Island, climatic years 1924-25 and 1925-26.

WATER TREATMENT

CARBON DIOXIDE. Carbon Dioxide Treatment at St. Louis Water Works, A. V. Graf. Eng. News-Rec., vol. 99, no. 16, Oct. 20, 1927, p. 643. Each carbon dioxide plant will consist of gas producer burning coke; combined washer, scrubber and drier; gas burner, compressor or blower, and necessary gauges for control of operation.

COLOUR REMOVAL. Notes on Colour Removal from Water, R. S. Weston. Can. Engr., vol. 53, no. 17, Oct. 25, 1927, pp. 479-482. Results of observations on treatment of soft coloured waters; various methods of colour removal employed. Paper presented at Am. Water Wks. Assn.

WATERWAYS

ENGINEERING PROGRESS. Advances in Waterways Engineering During a Half Century, W. M. Black. Am. Soc. Civil Engrs.—Proc., part 1, Oct. 1927, pp. 1937-1959, 8 figs. Shows some of progress made in waterways engineering in United States.

WATT-HOUR METERS

ARRESTER PROTECTION FOR. Arrester Protection for Watt-Hour Meters, C. J. Fuhrmann. Elec. World, vol. 90, no. 17, Oct. 22, 1927, pp. 831-832, 1 fig. Points out that watt-hour meter failures caused by electrical storms can be materially decreased by installation of secondary lightning arresters of proper voltage rating at properly chosen locations on 3-phase power secondary circuits.

WIND POWER

MOTORS. Wind Motors (Fonctionnement des roues coliennes), F. Verdeaux. Revue Générale des Sciences, vol. 38, no. 19, Oct. 15, 1927, pp. 541-548, 7 figs. Mathematical theory of air motors and windmills with horizontal axis, their maximum and average mechanical efficiency, methods of operation, energy losses, etc.

WIRE DRAWING

PROFILE AND SHAPED WIRE. The Drawing of Profile and Shaped Wire, J. D. Brunton. Wire, vol. 2, no. 11, Nov. 1927, pp. 379-382, 10 figs. It has been found that a straight carbon steel, when properly treated and subsequently cold worked to correct degree, compares very favorably in physical properties with a heat-treated alloy steel, and fulfills entirely requirements specified for a certain purpose; for mass production there is undoubted saving in getting profiles drawn.

WOOD PRESERVATION

PAINT TESTS. Some New Paint Tests on Wood in Florida and in Washington, H. A. Gardner. Am. Paint & Varnish Mfrs'. Assn.—Scientific Section, no. 315, Aug. 1927, pp. 439-446. Discussion of paints with raw linseed oil or small percentages of heavy bodied oils as bases; observations on exposure tests in Washington and Florida on varnish and bodied oil paints; lacquer tests; formulas used in tests, etc.

WOODWORKING PLANTS

DRY KILNS. Improving Conditions in Drykiln Equipment, E. F. Werner. Wood-Worker, vol. 46, no. 8, Oct. 1927, pp. 41-42. Heart of woodworking factory is the drykiln; life of lumber, percentage of cutting value, returns on money invested, all depend upon condition of lumber as it comes from the kiln.

MATERIALS HANDLING. Receiving and Handling Lumber at the Plant. Wood-Worker, vol. 46, no. 8, Oct. 1927, pp. 44-45, 4 figs. How costs of receiving, moving and storing factory lumber have been reduced through use of various types of mechanical equipment.

Z

ZINC

WROUGHT. Wrought Zinc, C. S. Trewin. Am. Inst. Min. & Met. Engrs.—Tech. Publication, no. 34, 1927, 4 pp. Zinc, in its wrought form, is produced commercially in rolled strip, sheet, wire, rod and tubing; wire has been made periodically, but, due to fact that slight draughts are necessary, cost of production is greater than for more common non-ferrous metals which are made into wire.

ZINC DEPOSITS

CANADA. Zinc and Lead in Canada, T. W. Bingay and F. J. Alcock. Am. Zinc Inst.—Bul., vol. 10, no. 9-10, Sept.-Oct. 1927, pp. 14-25 and 66-67. Production of both zinc and lead in Canada has steadily increased during recent years.

ZINC METALLURGY

ELECTROLYTIC PRODUCTION. Electrolytic Zinc Production. Elec. World, vol. 90, no. 17, Oct. 22, 1927, pp. 837-840, 7 figs. Anaconda copper mining company uses 50,000 kw. at Great Falls zinc plant; heavy currents constitute chief problems at present.

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.

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A

AIRPLANE ENGINES

Superchargers. Supercharged Engine Performance, Calculated and Actual, O. Chenoweth. Soc. Automotive Engrs.—Jl., vol. 21, no. 5, Nov. 1927, pp. 508-515, 11 figs.

AIRPLANES

Airfoils. Experiments on Airfoils with Aileron and Slot, A. Betz. Nat. Advisory Committee for Aeronautics—Tech. Memorandums, no. 437, Nov. 1927, 6 pp., 4 figs. Results of experiments on three airfoils to which rear portions, having chords respectively ¼, 1/3 and 2/5 or total chord, are hinged so as to form ailerons, especial attention being given to shape of slot between aileron and main portion of airfoil.

Alignment. Alignment and Checking of Components, R. C. Taylor. Roy. Aeronautical Soc.—Jl., vol. 31, no. 203, Nov. 1927, pp. 1037-1049, 13 figs.

Defects and Deterioration. Defects and Deterioration, W. G. Gibson. Roy. Aeronautical Soc.—Jl., vol. 31, no. 203, Nov. 1927, pp. 1050-1060. Deals with general defects and deterioration encountered during normal life of aircraft without reference to actual breakages caused by crash, together with more general methods of overcoming or repairing such defects and deterioration.

Design Control. Control of Aircraft Design, E. W. Stedman. Soc. Automotive Engrs.—Jl., vol. 21, no. 5, Nov. 1927, pp. 516-518. Difficulties experienced in regard to engineering features of control of civil aviation during period of 7 yr. are summarized; outline of formation of International Commission for Air Navigation subsequent to Great War; Canadian Air Board Act of 1919; I.C.A.N. minimum requirements of aircraft and engines for air-worthiness which are being worked to in Canada as closely as possible; suggestion is then made that regulations must make minimum requirements for strength and performance sufficiently great to allow for reasonable deterioration of structure and loss of engine power; effect of increasing load factors.

Metal. Metal Aircraft Co. Construction at Vickers. Flight, vol. 19, no. 37, Sept. 15, 1927, pp. 646-649. Vickers, Ltd., at their Weybridge works, have carried out long series of experiments, and evolved forms of duralumin construction; simplicity is keynote of design; forms of construction evolved are such that resulting structure is considerably lighter than corresponding wood structure for same strength; basis of system is novel form of spar web. See also Nat. Advisory Committee for Aeronautics—Tech. Memorandums, no. 440, Dec. 1927, 5 pp., 5 figs.

ALLOYS

Aluminum. *See Aluminum Alloys.*

Copper. *See Copper Alloys.*

Corrosion-Resisting. Control of Corrosion—New Alloys, W. M. Mitchell. Indus. & Eng. Chem., vol. 19, no. 11, Nov. 1927, pp. 1253-1256.

Nickel. *See Nickel Alloys.*

ALUMINUM ALLOYS

Aluminum Bronze. *See Aluminum Bronze.*

Casting. Observations on Casting Aluminum and Its Alloys, W. J. Clark. Foundry, vol. 55, nos. 21 and 22, Nov. 1 and 15, 1927, pp. 847-849 and 891-893, 9 figs. Views of practical moulder on his experience with aluminum and its alloys; importance of gating.

Heat Conductivity. Heat Conductivity of Light Alloys (Sur la conductibilité thermique des alliages légers), C. Grard and J. Villey. Académie des Sciences—Comptes Rendus, vol. 185, no. 17, Oct. 24, 1927, pp. 856-858, 2 figs. Experimental study of aluminum-copper and magnesium-copper-aluminum alloys which may be used in engine construction, at various temperatures; calls attention to magnesium alloys.

ALUMINUM BRONZE

Properties. Aluminum Bronze, R. C. Reader. Foundry Trade Jl., vol. 37, no. 588, Nov. 24, 1927, p. 143. Deals with general properties; its tensile strength and elongation and further useful properties; aluminum-bronze golf clubs.

ARCHES

Masonry. The Philosophy of Masonry Arches, E. O. Williams. Instn. Civil Engrs.—Eng. Paper, no. 56, 1927, 34 pp., 6 figs. Design formulæ for various types of arches for spans up to 300 ft.; treatment of filled and open arch construction and comparison of rules with various authorities; economics of masonry arches.

ASH DISPOSAL

Power Plants. Disposal of Ashes and Flue Dust in Power Houses. Indus. Mgmt. (Lond.), vol. 14, nos. 7 and 11, July and Nov. 1927, pp. 237-242 and 403-406 and 408, 14 figs. Collection and removal of furnace ashes and clinkers is carried out by well understood methods, while removal of finer flue ashes has only come to fore with use of small low-quality fuel and extensive employment of pulverized fuel.

AXLES

Fatigue Cracks in. A Study of Fatigue Cracks in Axles, H. F. Moore. Forging—Stamping—Heat Treating, vol. 13, no. 11, Nov. 1927, pp. 447-449. Axles which had been in service were subjected to special test devised to indicate presence of cracks before rupture was complete; method of testing. Abstracts from Bul. No. 165, Eng. Experiment Station, Univ. of Ill.

B

BEARINGS, BALL

Standard Specifications. Ball Bearings and Parallel-Roller Bearings. Brit. Eng. Standards Assn., no. 292, Sept. 1927, 53 pp., 36 figs. Tables of permissible errors due to eccentricity and wobble; tables of tolerances; dimension nomenclature for component parts of ball bearings and parallel-roller bearings; explanation of formation of code of reference symbols.

BEARINGS

Anti-Friction. Machine Tool Precision Improved by Anti-Friction Bearings, R. F. Runge. Automotive Industries, vol. 57, no. 21, Nov. 19, 1927, pp. 762-763, 5 figs. Their use reduces wear and thus makes for greater accuracy and efficiency in production; many new applications have been found in last few years.

BLAST FURNACES

Excess-Gas Generation. The Use of the Blast Furnace as a Gas Producer, R. Franchot. Fuels & Furnaces, vol. 5, no. 11, Nov. 1927, pp. 1451-1454. Discusses generation of excess gas in blast furnace; its use; provision for, and effect of, excess gas outlet on blast-furnace operation.

BLOWERS

Rotary. Characteristics and Operating Requirements of Positive Pressure Rotary Blowers, G. Fox. Fuels and Furnaces, vol. 5, no. 11, Nov. 1927, pp. 1481-1484 and 1501. Various types of rotary blowers; their characteristics; power required and motor drive.

BOILER FEEDWATER

Salinity Determination. Salinity or Impurity Determination of Boiler Feed Water, C. Huey. Am. Soc. Naval Engrs.—Jl., vol. 39, no. 4, Nov. 1927, pp. 658-692.

Treatment. Water and Its Importance in Modern Steam Power Stations. Brown Boveri Rev., vol. 14, no. 11, Nov. 1927, pp. 291-301, 8 figs. New points of view relating to action of feedwater on material used in constructing boiler and suitable treatment of water; research work carried out in Brown Boveri laboratories.

BOILER OPERATION

Control. Automatic Control Regulates Seventy-Two Boilers as a Single Unit, J. A. Ingalls. Power, vol. 66, no. 21, Nov. 22, 1927, pp. 770-774, 9 figs. 72 boilers in double-deck installation are divided into four groups, each under control of master regulator, and four group masters are controlled by station supermaster regulator.

BOILER PLANTS

Design. Rational Boiler Plant Design for Low Cost Steam, F. A. Combe. Power, vol. 66, no. 23, Dec. 6, 1927, pp. 875-878, 3 figs.

Maintenance Costs. Maintenance Costs of 54,000-Kw. Boiler Plant. Elec. World, vol. 90, no. 24, Dec. 10, 1927, pp. 1197-1198, 1 fig. From data sheets of New England central station, costs are given for 32 months ended Aug. 31, 1927.

BOILERS

Fusion Welding. Fusion Welding on Boilers and Pressure Vessels, S. W. Miller. Boiler Maker, vol. 22, no. 11, Nov. 1927, pp. 319-321. Tests developed to insure good welds; suggestions for inspectors to follow in acquiring knowledge of welding processes.

High-Pressure. The Strength of Extra High-Pressure Steam Drums. Power Engr., vol. 22, no. 261, Dec. 1927, pp. 461-463, 4 figs. Deals with strength of steam drum which has dimensions equal to those of boiler at Weymouth station, Mass. (Edison Illuminating Co.), working at 1,200 lb. per sq. in.; drum length, 34 ft.; internal diameter, 4 ft.; and thickness, 4½ in.

Return-Tubular. Film Evaporation Applied to Return-Tubular Boiler Increases Capacity 75 Per Cent. Power, vol. 66, no. 21, Nov. 22, 1927, p. 781, 2 figs.

Steam Purifiers. Steam Purifiers Solved the Problem, J. P. Freund. Indus. Power, vol. 8, no. 6, Dec. 1927, pp. 58-61, 2 figs. On account of long steam-distribution lines a large amount of condensation was encountered; problem was met by installation of steam purifiers in steam drums of boilers.

BRASS

Ingot Melting. Some Practical Notes on the Manufacture of Brass Ingots or Strip, N. F. Fletcher. Metal Industry (Lond.), vol. 31, no. 19, Nov. 11, 1927, pp. 441-442. Describes methods whereby metals which form brass are melted and cast into ingots for subsequent rolling into strips. Paper read before Midland Section of Junior Instn. of Engrs.

Practice. The Fundamentals of Brass Foundry Practice, R. R. Clarke. Metal Industry (N.Y.), vol. 24, nos. 7, 8, 9, 10 and 11, July, Aug., Sept., Oct. and Nov. 1926, pp. 283-284, 318-320, 365-366, 417-418 and 453-454, and vol. 25, nos. 1, 2, 3, 4, 5, 8, 9, 11 and 12, Jan., Feb., Mar., Apr., May, Aug., Sept., Nov. and Dec. 1927, pp. 6, 63-64, 105-106, 146-148, 194-195, 327, 369-370, 455-456 and 493-494, 51 figs. Description of basic laws which control melting and casting of metals and their application to practical foundry operations.

BRIDGE DESIGN

SELECTION. Suitability of the Various Types of Bridges for the Different Conditions Encountered at Crossings, J. A. L. Waddell. West. Soc. Engrs.—Jl., vol. 32, no. 9, Oct. 1927, pp. 313-329. Enumerates many factors that must be considered in selecting design; foundation conditions; methods of pier sinking; preliminary studies for proposed bridges; right-of-way.

BRIDGE ERECTION

ARCH CENTERING. Unusual Arch Centering, J. S. Crandall. Boston Soc. Civ. Engrs. —Jl., vol. 14, no. 9, Nov. 1927, pp. 505-506, 2 figs. Progress and completion of bridge and dam; solution proposed.

BRIDGE PIERS

CENTRE, ENLARGING. Foundation Problems in Enlarging Centre Pier of Swing Bridge at Providence, G. W. Maker. Eng. News-Rec., vol. 99, no. 23, Dec. 8, 1927, pp. 927-929, 3 figs. Plant to enclose old pier, Point street bridge, in steel cofferdam driven into quicksand, and to concrete in dry proves unsuccessful; experts' reports and recommendations; final adopted plan discontinued driving of steel sheeting enclosing old pier; provided for dredging 1,000 yd. material and for cutting off new wooden piles by divers; specified pouring of lower 12 ft. of reinforced concrete by tremie.

BRIDGES

HIGH LEVEL. High Level Fixed Bridges Over Navigable Waters, R. Modjeski. World Ports, vol. 16, no. 1, Nov. 1927, pp. 38-52. Tables showing clearances provided over more important waterways in United States and also in foreign countries.

BRIDGES, HIGHWAY

FLOOR SLABS. Tests of the Delaware River Bridge Floor Slabs. Pub. Roads, vol. 8, no. 8, Oct. 1927, pp. 159-178, 47 figs. Concrete floor slabs of special and unusual design have been subjected to complete set of tests by Bur. of Public Roads in co-operation with Delaware River Bridge Joint Commission; slabs were designed to reduce to minimum weight of floor of bridge.

WINTER CONSTRUCTION. Winter Construction of Road Bridges in Michigan. Eng. News-Rec., vol. 89, no. 23, Dec. 8, 1927, pp. 914-916, 3 figs. Standard field practices and engineering control followed in building some 50 structures during last four winters; it should be undertaken without hesitation whenever time gained in putting road into service equals or exceeds in value extra cost of doing work in winter; for concrete, this extra cost runs from $3 to $6 a cubic yard.

BRIDGES, MOVABLE

CONTROL. Santa Fe Installs Low-Voltage Plant on New Mississippi Bridge. Ry. Signalling, vol. 20, no. 12, Dec. 1927, pp. 457-461. Special locking circuits for controlling operation of bridge, indication lights on machine and submarine cable, features of job for operation of signal facilities at draw span and for operation of two cross-overs and three passing track switches located at point 1.2 miles from Mississippi river bridge tower.

BRIDGES, STEEL

CONCRETE VS. Steel vs. Reinforced Concrete for Bridges, R. Modjeski. Iron Age, vol. 20, no. 22, Dec. 1, 1927, p. 1511. Advantages of steel include known durability, rapid erection and use of materials tested beforehand.

BRIDGES, WOODEN

HIGHWAY. Creosoted Timber Highway Bridge at Minocqua, Wis., C. H. Kirch. Roads & Streets, vol. 67, no. 10, Oct. 1927, p. 457. Wisconsin Highway Commission has completed Federal Aid Project No. 431-B, which consists of bridge over lake Minocqua, Oneida county; structure is 831 feet long, and is made up of 54 spans with bents at 15-ft. centres and one 21-ft. span at centre of bridge to allow for passage of boats.

MACADAM DECKS. Successful Macadam Bridge Decks, W. W. Shelby. Roads & Streets, vol. 67, no. 10, Oct. 1927, pp. 425-426, 4 figs. Los Angeles County Road Dept. is paving wooden bridges with bituminous macadam.

C

CABLES, ELECTRIC

POWER PLANT CONTROL. Standard Specification for Control Cable for Electrical Power Plant Equipment. Can. Eng. Standards Assn., no. C21, Aug. 1927, 10 pp. Particular attention is drawn to provision for use of uniform design and only two colours at any one time in conductor braid of multiple conductor cable.

TESTING. Proof Testing High Voltage A.C. Cables. C. L. Dasson. Elec. Light & Power, vol. 5, no. 12, Dec. 1927, pp. 28-29 and 93, 5 figs. Results of proof tests on 13,200-volt a.c. cable system of Boston Elevated Street Railway Co.; cable to be tested is taken out of service and connected by suitable insulated jumper cables to test set parked outside of station in street or driveway.

33,000-Volt Cable Testing, M. Hochstadter and E. Bowden. Elec. Rev., vol. 101, no. 3609, Nov. 25, 1927, pp. 894-895. Review of present-day testing practice and suggested specification of factory and installation tests embodying combination of usual methods.

CAMS

SPECIAL, MACHINING. Milling Cams of Unusual Outline, C. O. Herb. Machy. (N.Y.), vol. 34, no. 4, Dec. 1927, pp. 273-277, 11 figs. Typical methods of machining special cams ordered in small lots.

CARS. REFRIGERATOR

PALESTINE RAILWAYS. New Perishable and Refrigerator Cars, Palestine Railways. Ry. Engr., vol. 48, no. 575, Dec. 1927, pp. 451-455. These vehicles incorporate special features of design, particularly in respect of method of insulation; ice tanks carrying 2 tons of ice are fitted in roof; doors perfectly air and watertight.

CASE-HARDENING

GAS CARBURIZATION. Gas Carburization of Steel, R. G. Guthrie and O. Wozasek. Am. Soc. Steel Treating—Trans., vol. 12, no. 6, Dec. 1927, pp. 853-868 and (discussion) 868-870, 10 figs. Deals with use of so-called city or manufactured gas for carburizing medium and considers certain inconsistencies heretofore encountered in its use: (1) variation in depth and concentration of case from day to day; (2) what constituent in gas is responsible for carburization of steel; (3) mechanism of carburization; (4) factors affecting this mechanism; results show advantages to be gained from treatment of carburizing gas at furnace, and catalyzing steel in furnace at beginning of run.

NITRATION-HARDENING. Surface Hardening by Nitrogen. Foundry Trade Jl., vol. 37, no. 588, Nov. 24 1927, pp. 135-136. New process of Dr. Fry, of Research Laboratories of F. Krupp of Essen, consists of subjecting parts to be hardened to action of ammonia gas at temperature of 500 deg. cent. for period of time varying from 40 to 120 hr.; ammonia is dissociated, and portion of nitrogen thus formed passes into solid solution in outer layers of parts; one of most valuable features of process is small amount of distortion which parts undergo during nitrogen treatment; electric furnaces essential.

SOFT STEEL. Case-Hardening of Soft Steel. G. A. Nelson. West. Machy. World, vol. 18, no. 11, Nov. 1927, pp. 532-533, 7 figs. Operations in heat-treatment department of Pacific Gear & Tool Works; results obtained with soft steel heat-treated in electric furnace.

CAST IRON

HIGH-STRENGTH. Makes High Test Cast Iron, M. E. Greenhow. Foundry, vol. 55, no. 23, Dec. 1, 1927, pp. 919-920. Castings with varying sections require close-grained, high-strength, wear-resisting iron which is obtained by nickel additions; gives results and data on method followed.

CENTRAL STATIONS

HIGH-PRESSURE. Operating Experiences with 1,300-Lb. Steam Pressure, J. Anderson. Engineer, vol. 144, no. 3750, Nov. 25, 1927, pp. 605-607, 2 figs. Lakeside station operation; desirability of 1,300-lb. pressure; tells of major troubles experienced.

NEW YORK CITY. Analysis of System Conditions, J. W. Lieb. Elec. World, vol. 90, no. 24, Dec. 10, 1927, pp. 1187-1191, 13 figs. Study of load durations, other utility load characteristics, seasonal and weather effects, output, demand, load and coal-consumption trends, load densities and system layout.

CHROMIUM STEEL

HIGH TEMPERATURE. Steel for High Heat and Loads. Iron Age, vol. 120, no. 24, Dec. 15, 1927, pp. 1662-1663, 3 figs. Chromium steel and chrome-nickel steels have best combination of properties; huge seamless drums now forged for petroleum stills, chemical cells and boilers; advanced construction of values. Address before N.Y. Chapter, Am. Soc. for Steel Treating.

CIRCUIT BREAKERS

OIL. High-Voltage Oil Circuit Breakers for Transmission Networks, R. Wilkins and E. A. Crellin. Am. Inst. Elec. Engrs.—Jl., vol. 46, no. 12, Dec. 1927, pp. 1340-1348, 14 figs. Oil circuit breaker as limiting feature to securing best operating results in electric transmission developments; essential fundamental requirements brought out by investigation.

CLUTCHES

MACHINING. Machining Friction Clutch Parts, R. Mawson. Can. Machy., vol. 38, no. 18, Nov. 3, 1927, pp. 17-18, 6 figs. Methods employed by clutch manufacturer in machining various components of particular type of friction clutch, on production basis, without recourse to expensive jigs and fixtures.

COAL

ANALYSES. Analyses of Solid Fuels, J. H. H. Nicolls. Can. Dept. Mines—Investigations of Fuels and Fuel Testing, no. 671, 1927, pp. 106-136. Deals with solid fuels occurring in Canada; coal samples submitted by Dept. of Soldiers' Civil Re-establishment; miscellaneous solid fuels.

CARBONIZATION. The K.S.G. Process of Low-Temperature Carbonization, W. Runge. Am. Soc. Mech. Engrs.—Advance Paper, for mtg. Dec. 5-8, 1927, 7 pp., 2 figs.

Low-Temperature Carbonization of Bituminous Coals, R. A. Strong. Can. Dept. Mines—Investigations of Fuels and Fuel Testing, no. 671, 1927, pp. 64-100, 12 figs. Altogether, 32 carbonization tests were carried out, duplicate runs being made on same coal at same temperature by same method of carbonization; results are given as series of tables.

FRIABILITY. Effects of Continued Weathering Upon the Friabilities of Various Fuels, J. H. H. Nicolls. Can. Dept. Mines—Investigations of Fuels and Fuel Testing, no. 671, 1927, pp. 101-105. Tables showing results of continuation of tests upon fuels which have been subjected to open shed exposure; summary of completed friability tests, particularly as regards effects of weathering.

PULVERIZED. *See Pulverized Coal.*

COKE

METALLURGICAL. Properties of Metallurgical Coke, R. P. Hudson. Blast Furnace & Steel Plant, vol. 15, no. 11, Nov. 1927, pp. 526-527. Recital of properties and characteristics coke should possess in order that it may serve most efficiently as a fuel in blast furnace.

CONCRETE

AGGREGATE MOISTURE. Determination of Moisture in Aggregate. Pub. Wks., vol. 58, no. 12, Dec. 1927, pp. 457-458, 1 fig. When accurate control of mixing water for concrete is to be maintained, quick, simple method of determining moisture content of aggregate is desirable; laboratory of Portland Cement Assn. has developed special apparatus for making test.

CALCIUM CHLORIDE TESTS. Tests Show Shrinkage Effect of Calcium Chloride in Concrete, A. S. Levens. Eng. News-Rec., vol. 99, no. 23, Dec. 8, 1927, p. 912, 2 figs. $CaCl$ up to 6 per cent increases shrinkage; relative shrinkage over plain concrete decreases with setting time; results of five series of tests conducted at experimental laboratory of Univ. of Minnesota.

VIBROLITHIC. Further Tests of Vibrolithic Concrete. Pub. Roads, vol. 8, no. 8, Oct. 1927, pp. 179-189, 7 figs. Comparative transverse bending tests on normal and vibrolithic concrete were carried on at Arlington Experimental Station; object of investigation was to obtain data on resistance to rupture by bending, of specimens of different mixes fabricated by each of two methods.

CONCRETE CONSTRUCTION

RIGID-FRAME DESIGN. The Essentials of Rigid-Frame Design, E. H. Harder. Concrete, vol. 31, nos. 4, 5 and 6, Oct., Nov. and Dec. 1927, pp. 13-15, 43-45 and 37-42, 10 figs. Rigid-frame construction, practically non-existent in America, is widely used in Europe; advantages of this type of structure; what it is and how it is used; examples of rigid-frame design.

CONCRETE CONSTRUCTION, REINFORCED

FUTURE. The Future of Reinforced Concrete, F. R. McMillan. Eng. & Contracting, vol. 66, no. 11, Nov. 1927, pp. 513-516. Records of past and possible developments of future; rationalization of design; more attention to durability; volume changes in concrete; inelastic deformation in concrete. Address before Concrete Reinforcing Steel Inst.

PLASTIC YIELD AND SHRINKAGE. Plastic Yield, Shrinkage and Other Problems of Concrete and Their Effect on Design, O. Faber. Engineering, vol. 37, no. 3227, Nov. 18, 1927, pp. 661-663. It is shown that structures of reinforced concrete with stresses inside those allowed in good practice continue to deflect without change of load of temperature, result due partly to shrinkage and partly to plastic yield; consequently, absence of permanent set or deflection must not be insisted on as necessary criterion of safety where test involves appreciable time element; this yield and shrinkage produce large, though gradual, redistribution of stress between steel and concrete in reinforced-concrete structure, of such nature generally as to relieve concrete and add to steel stress; present regulations, which take no account of these matters, leave much to be desired; modulus of elasticity of concrete is much greater than specified in most regulations, but yield and shrinkage, in some cases, produce results similar to those obtained with very low modulus. Abstract of paper read before Instn. Civil Engrs.

CONDENSERS, ELECTRIC

RESONANCE IN CIRCUITS. Resonance in Series and Parallel Circuits, H. J. Boyland. Experimental Wireless, vol. 4, no. 50, Nov. 1927, pp. 675-683. Analyzes certain combinations of inductance, capacity and resistance in order to derive relationship which must exist in certain quantities to satisfy various conditions.

SYNCHRONOUS. Synchronous Condensers, P. L. Alger. Am. Inst. Elec. Engrs.—Jl., vol. 46, no. 12, Dec. 1927, pp. 1330-1338, 8 figs. Characteristics of large synchronous condensers, greater standardization in condenser specifications; ratio of lagging to leading kv.a. capacity; advantages of reactors where extra lagging capacity is needed; starting and stability characteristics; recent improvements in design; asynchronous condensers.

CONDUITS

Low-Pressure. The Design of Large Low-Pressure Water Conduits, H. H. Burness. Engineering, vol. 124, no. 3226 Nov. 11, 1927, pp. 632-634, 5 figs. Since height of free water surface, and consequently pressure at various points in shell of conduit, is likely to vary between certain limits once structure has been erected, bending moments will be induced in shell due to its efforts to adjust its shape to altered conditions; method of calculating these moments has therefore been given which can also be applied to determine stress conditions due to earth pressure on outside of conduit when latter may have to be buried at various depths; special case of free water surface coinciding with crown of conduit is dealt with separately; economic justification for use of this type of conduit is shown by comparing estimated cost of actual design with cost of alternative open channel.

CONVEYORS

Belt. Handling Bulk Materials with Belt Conveyors, H. F. Geist. Chem. & Met. Eng., vol. 34, nos. 11 and 12, Nov. and Dec. 1927, pp. 664-667 and 744-748, 8 figs. Presents tables which enable engineer or initiated layman to select width and ply of belt required, effective pull required for haul, speed, horse power, maximum permissible haul, and size of drive pulley and its shaft for either plain grease-bearing type or anti-friction-bearing type belt carriers. Dec.: Practical design; tables which permit of ready solution to any conveyor problem.

Control. How a Complex Conveyor System Was Magnetically Controlled, P. T. Van Bibber. Indus. Eng., vol. 85, no. 11, Nov. 1927, pp. 507-508, 2 figs. Sets forth unusual method of making magnetic type of switch serve also as sort of automatic block-control system on conveyor installation.

Drives and Gearing. Conveyor Drives and Gearing, E. C. Hatcher. Chem. & Industry, vol. 46, no. 46, Nov. 18, 1927, pp. 1063-1064, 2 figs. Deals with belt, chain, open-gear and totally enclosed gear drive; open spur-gear drive is probably most generally used form of conveyor drive; H-R gear manufactured by J. Stone & Co., combines advantages of all types, being standard form of gear box in which any speed ratio from 6 to 1 to 100,000 to 1 can be provided; because of its special construction, only smallest number of teeth are necessary on final driving wheel.

Portable. Portable Loaders. L. I. Thomas. Indus. Power (Indus. Handling), vol. 13, no. 5, Nov. 1927, pp. 137-142. This type of equipment will load from 20 to 60 tons an hour; consists of section of belt or bucket conveyor supported at incline on wheels or on crawler type of mounting.

COPPER ALLOYS

Adnic. Physical Properties of Adnie, W. B. Price. Min. & Met., vol. 8, no. 251, Nov. 1927, pp. 474-475, 2 figs. New corrosion and heat-resisting white-metal alloy, having composition of copper, 70 per cent; nickel, 29 per cent; tin, 1 per cent.

Brass. *See Brass.*

Phosphor-Copper. Phosphor-Copper. Foundry Trade Jl., vol. 37, no. 585, Nov. 3, 1927, p. 86. Claim is made that by method described, no loss of phosphorus is sustained and that uniform phosphor-copper is produced with introduction of 15 per cent phosphorus.

CUPOLAS

Practice. Hints on Cupola Practice, A. Sutcliffe. Foundry Trade Jl., vol. 37, no. 588, Nov. 24, 1927, p. 146. Principal causes of bad melting are faulty quantity and faulty delivery of blast, associated with poor arrangement of charge in furnace; author is of opinion that where adjustments are required in quantity of iron which founder requires to be delivered to him at commencement of his casting operations, they cannot be made satisfactorily by alterations of blast or of weight and disposition of charges in one cupola except within inconsiderable limits; ascertaining blast requirements; numerous large tuyeres advocated.

COPPER METALLURGY

Leaching. Development of Some Fundamentals in the Ferric Sulphate-Sulphuric Acid Process, F. S. Wartman and H. E. Keyes. U.S. Bur. Mines—Reports of Investigation, no. 2839, Nov. 1927, 11 pp. This process, developed by staff of Bureau of Mines, is method of making mixed solutions of ferric sulphate and sulphuric acid suitable in quantity and composition for leaching certain types of low-grade oxide-sulphide copper ores.

CORONA

Formation and Loss. The Law of Corona and Dielectric Strength of Air, F. W. Peek. Am. Inst. Elec. Engrs.—Jl., vol. 46, no. 12, Dec. 1927, pp. 1390-1398, 19 figs. Mechanism of corona formation and loss; loss following quadratic law above visual critical voltage; loss on polished wires, cables and imperfect conductors; irregularity factor for weathered conductors important; visual critical corona voltage calculated with great accuracy; artificial corona readily produced.

Loss Investigation. Methods Used in Investigating Corona Loss by Means of the Cathode Ray Oscillograph, W. L. Lloyd, Jr., and E. C. Starr. Am. Inst. Elec. Engrs.—Jl., vol. 46, no. 12, Dec. 1927, pp. 1322-1329, 14 figs. Photographic records of figure representative of loss; calculating accurate values of power expended; formulas of "critical disruptive gradients" and "visual disruptive "gradients" checked; practical effect of condition of conductor surface.

Space Charge. The Space Charge That Surrounds a Conductor in Corona, J. S. Carroll and J. T. Lusignan. Am. Inst. Elec. Engrs.—Jl., vol. 46, no. 12, Dec. 1927, pp. 1350-1357, 15 figs. Qualitative analysis of nature of space charge created about conductor in corona, particularly with respect to relative magnitudes and polarities, rather than actual quantitative measurement.

D

DAMS

Arch. Experimental Work on Small-Scale Models of Arch Dams Begun by Reclamation Bureau, I. E. Houk. Hydraulic Eng., vol. 3, no. 10, Oct. 1927, pp. 16-17 and 30-31, 2 figs. Miniature models of arch dams, built to exact scale, loaded with mercury, provide data required in design of full-size structures; models of different materials. See also Eng. & Contracting, vol. 66, no. 11, Nov. 1927, pp. 521-523, 2 figs.

Concrete. Ambursen Dam at Junction Brook, Nfld., A. B. McEwen. Can. Engr., vol. 53, no. 21, Nov. 22, 1927, pp. 541-545, 7 figs. Hollow reinforced-concrete dam built by W. I. Bishop, Ltd., for Newfoundland Power & Paper Co.; dam carries Newfoundland Government railway; depth below water level, 68 ft.; Grand Lake area increased from 135 to 215 sq. mi.

Multiple Arch. Multiple Arch Dam Construction. Concrete, vol. 31, no. 6, Dec. 1927, pp. 43-45, 4 figs. Overall length 585 ft. and 104 ft. high; among interesting practices employed was use of excavated rock for coarse aggregate; 3 distinct types of dam construction are employed; multiple arch, gravity-type arch for spillway and hydraulic core beyond concrete wind built on one end of dam.

Sand Impounding. Sand Embankment Impounding Dam at Chicopee, Mass., M. G. Mansfield. New England Water Wks. Assn.—Jl., vol. 41, no. 3, Sept. 1927, pp. 244-260, 4 figs. Dam is of embankment construction forming reservoir with surface area, at normal water level, of approximately 30 acres and maximum depth of 42 ft.; it consists almost entirely of sand and very small percentage of silt and loam, 550 ft. long at top, with maximum height above bed of stream of 48 ft.

DIELECTRICS

Solid. A Theory of Imperfect Solid Dielectrics, M. G. Malti. Am. Inst. Elec. Engrs.—Jl., vol. 46, no. 12, Dec. 1927, pp. 1373-1380, 12 figs. Hypotheses for observed behaviour of solid dielectrics; definitions of resistivity, permittivity, electric charge and electric strength under both continuous and alternating potentials; energy losses traced to sources and subdivided into hysteresis, viscosity and resistance losses; methods devised for separating total dissipated energy into its three component parts.

DIESEL ENGINES

Air Cleaners. New Development in Air Intake Protection. Oil Engine Power, vol. 5, no. 11, Nov. 1927, p. 762, 2 figs. Well known type of centrifugal air cleaner adapted to Diesel requirements.

Cylinder Wear. The Probable Causes of Cylinder Wear in Marine Oil Engines. Mar. Engr. & Motorship Bldr., vol. 50, no. 603, Nov. 1927, pp. 412-414, 1 fig. Considers possible principal causes of cylinder wear in Diesel engines and remedies.

Heat Transmission. Transmission and Removal of Heat by the Cooling System of Diesel Engines, W. Wakefield. Am. Soc. Naval Engrs.—Jl., vol. 39, no. 3, Aug. 1927, pp. 514-532, 5 figs. Transfer of heat from time of combustion until it reaches cooling medium is biggest problem that confronts designer of large Diesel engines; question has two phases: (1) transfer of heat of combustion to metal walls of combustion chamber; (2) transfer of heat through combustion chamber walls to cooling medium.

Lubrication. Cylinder Lubrication of Diesel Engines, C. G. A. Rosen. Pac. Mar. Rev., vol. 24, no. 12, Dec. 1927, pp. 568-569 and 41, 3 figs. Kinds of oil used, methods of application and distribution and combustion processes.

DROP FORGING

Die Rolling vs. Drop-Forging and Die-Rolling. Iron & Steel World, vol. 1, no. 2, Mar. 1927, pp. 145-146, 3 figs. Discussion of various factors which determine whether particular shape can best be made by drop-forging or die-rolling.

Fin Formation. Influence of Fin Formation on the Internal Structure of Drop Forgings, E. Decherf. Iron & Steel World, vol. 1, no. 7, Aug. 1927, pp. 489-492, 8 figs. Factors influencing position and formation of fins in drop forging; value of macroscopic tests in determining flow and internal tension of metal. Translated from Revue Universelle des Mines.

DYNAMICS

Newton's Law of Motion. A Suggested Method of Presenting Newton's Second Law of Motion, N. P. Bailey. Jl. Eng. Education, vol. 18, no. 3, Nov. 1927, pp. 176-177. Failure to grasp completely Newton's Second Law of Motion is one of worst stumbling blocks of average undergraduate student in dynamics; past observation has convinced writer that this trouble is primarily caused by introduction of thoroughly intangible quantity, mass, as fundamental unit in statement of familiar law, $F=Ma$.

E

ELECTRIC ARC

Mercury. New Type of Low-Voltage Mercury Arc, A. Bramley and W. B. Nottingham. Franklin Inst.—Jl., vol. 204, no. 4, Oct. 1927, pp. 487-490, 1 fig. New type of arc in which both anode and cathode are of mercury, but conditions at cathode or anode are controlled by special device, the mercury dropper, which simplifies mechanism of arc.

ELECTRIC CIRCUITS

Safety. Grounding Devices and Equipment, S. W. Borden. Elec. News, vol. 36, no. 22, Nov. 15, 1927, pp. 26-29, 2 figs. Term "safety circuit" has been suggested as practical and appropriate designation; it includes not only circuits used for grounding at main switch on customer's premises, but properly includes circuits for grounding all equipment such as motor frames, hand lamps, portable tools and appliances, etc., as well as protective grounds for fire alarm and police boxes, etc.

ELECTRIC CURRENTS, ALTERNATING

High-Frequency. High-Frequency Currents, E. W. Marchant. Instn. Elec. Engrs.—Jl., vol. 65, no. 371, Nov. 1927, pp. 977-988, 8 figs. Treats of phenomena of specific inductive capacity and dielectric loss, dielectric straight and magnetization at high frequencies; effect of distribution networks and overhead lines by high frequency currents.

ELECTRIC FURNACES

Melting. Electric Melting Furnaces Used in Making Steel for Bearings. Fuels & Furnaces, vol. 5, no. 11, Nov. 1927, pp. 1459-1462, 3 figs. Unique design of electric-arc melting furnaces proves very efficient in production of steel for bearings.

ELECTRIC GENERATORS, A.C.

Synchronous. Synchronous Machines, R. E. Doherty and C. A. Nickle. Am. Inst. Elec. Engrs.—Jl., vol. 46, no. 12, Dec. 1927, p. 1339. Torque-angle characteristics under transient conditions. Synopsis.

ELECTRIC LAMPS, INCANDESCENT

Internal Frosting. Chemical Engineering Contributes to Better Lighting, M. Pipkin. Chem. & Met. Eng., vol. 34, no. 11, Nov. 1927, pp. 660-663, 6 figs. Inside frosting of incandescent lamp bulbs has results not only in better but in cheaper light. See also Glass Industry, vol. 8, no. 12, Dec. 1927, pp. 285-288, 6 figs.

ELECTRIC LOCOMOTIVES

Storage-Battery. Performance of 120-Ton Storage Battery Locomotive, E. Taylor. Ry. & Locomotive Eng., vol. 40, no. 11, Nov. 1927, pp. 319-324, 1 fig. Summary of operation in three terminal freight yards in Chicago; advantages; tractive effort, 71,000 lb., maximum speed, 30 m.p.h.

ELECTRIC MOTORS

Small. Small Appliance Motors, G. I. MacKenzie. Elec. Light & Power, vol. 5, no. 12, Dec. 1927, pp. 30-32 and 92-93, 9 figs. Effect of secondary voltages of motor driven appliances; methods of preventing voltage drop in lighting circuits when small motors are started; compares 115-volt with 230-volt motors.

ELECTRIC POWER

Combined Light and Power Systems. Combined Light and Power Systems for A.C. Secondary Networks, H. Richter. Am. Inst. Elec. Engrs.—Jl., vol. 46, no. 12, Dec. 1927, pp. 1436-1441, 3 figs. Standardization suggested to fit most important requirements of industry; present status of application; qualitative analysis for apparatus connected to secondary system; quantitative analysis; relation of trends in industry to problem.

ELECTRIC RAILWAYS

Overhead Contact Design. Railway Inclined Catenary Standardized Design, O. M. Jorstad. Am. Inst. Elec. Engrs.—Jl., vol. 46, no. 12, Dec. 1927, pp. 1307-1313, 9 figs. Ideal inclined catenary based on originally discovered tension and weight relation formula; data of railroads using inclined catenary compared with ideal; standardization of overhead systems.

ELECTRIC TRANSMISSION LINES

CONSTRUCTION COSTS. Control of Construction Costs, O. W. Gatchell. Elec. World, vol. 90, no. 24, Dec. 10, 1927, pp. 1193-1195. Detailed cost reports lead to economies in construction of 150-mile steel tower line; foremen rated according to results of labour-charge analysis; supervision simplified and efficiency improved.

ISLE MALIGNE-QUEBEC. Isle Maligne-Quebec Power Line. Can. Engr., vol. 53, no. 21, Nov. 22, 1927, p. 550. Canadian 135-mile line with double circuit steel tower construction towers spaced 900 ft.; maximum voltage delivered 160,000, giving 100,000 h.p. available at Quebec.

OVERHEAD. Overhead Electric Line Design, W. T. Taylor. Elec. Rev., vol. 101, no. 2607, Nov. 11, 1927, pp. 810-811, 1 fig. Aspects of safety and standards of construction: review of latest American practice.

PROTECTION. Ground Relay Protection. Am. Inst. Elec. Engrs.—Jl., vol. 46, no. 12, Dec. 1927, pp. 1443-1447. Discussion of following papers: Ground-Relay Protection for Transmission Systems, Jones and Dodds; Directional Ground-Relay Protection, Breisky, King and North, published in Oct. and Nov. issues of Journal respectively.

QUEBEC. Quebec-Isle Maligne Line Operating, C. V. Christie. Contract Rec., vol. 41, no. 46, Nov. 16, 1927, pp. 1167-1170, 6 figs. 160-kv. transmission line of Shawinigan Water & Power Co. that supplies 100,000 h.p. over distance of 135 miles; topography; towers, conductors, transformers and generators.

RURAL. Rural Electric Lines, S. E. Britton. Elec. Rev., vol. 101, no. 2608, Nov. 18, 1927, pp. 849-851. Symposium of opinions of electrical engineers experienced in construction of overhead lines in rural areas, with examples of methods that have been, or are to be, adopted for distribution of electricity at low and medium pressures.

STABILITY, STATIC LIMITS OF. Static Stability Limits and the Intermediate Condenser Station, C. F. Wagner and R. D. Evans. Am. Inst. Elec. Engrs.—Jl., vol. 46, no. 12, Dec. 1927, pp. 1423-1430, 25 figs. In static stability calculations, loads represented by equivalent constant admittances and synchronous machines replaced by equivalent impedances; criterion with formulas for calculation of two- three- and four-machine cases; calculations of stability of practical transmission lines; improvements due to intermediate condenser.

ELECTRIC WELDING, ARC

APPLICATIONS. The Electric Arc and Its Function in the New Welding Processes, P. Alexander. Am. Inst. Elec. Engrs.—Jl., vol. 46, no. 12, Dec. 1927, pp. 1404-1410. Application to welding of metals; atomic-hydrogen process; shielded-arc process; deposition of metal; physics and chemistry of crate; welding in mixed gases; possibilities of electric arc and gas flame as replacing rivet cutting tools and foundry moulds.

ARC LENGTH. Correct Arc Length, J. B. Green. Welding Engr., vol. 12, no. 10, Oct. 1927, pp. 37-38, 2 figs. Study of metal transfer furnishes basis for determining proper length and practical means for maintaining it. See also Can. Machy., vol. 38, no. 20, Nov. 17, 1927, pp. 21-22.

DEVELOPMENTS. Electric Welding. Am. Inst. Elec. Engrs.—Jl., vol. 46, no. 12, Dec. 1927, pp. 1431-1435. Locomotive-boiler repairs; shipbuilding; welding structural steel for buildings; pipe lines; welding to replace castings; resistance welding. Report of committee on electric welding.

OIL-CRACKING VESSELS. Welding Oil Pressure Cracking Vessel, R. Stresau. Nat. Petroleum News, vol. 19, no. 47, Nov. 23, 1927, pp. 64-71, 8 figs. Type of design required for stills operating at 900 deg. Fahr. and pressures of 1,000 lb. per sq. in. or more must also be such that material used in every part of vessel is equally stressed; process developed by A. O. Smith Corp. in manufacturing pressure stills.

RAILS. Building Up Battered Rail Joints by Electric Arc Welding. Ry. Eng. & Maintenance, vol. 23, no. 12, Dec. 1927, pp. 522-524.

TANK SEAMS. Arc Welding Tank Seams at High Speeds, R. E. Kinkead. Boiler Maker, vol. 22, no. 11, Nov. 1927, pp. 307-308. Physical tests by E. V. Kesinger, of Empire Companies of Bartlesville, Okla.; both average and maximum strength of welds was increased in going from 120-160 amperes to 200 amperes.

ELECTRICAL MACHINERY

WINDINGS, HEATING OF. Heating of Windings Determined from Tests of Short Duration, J. Basta and F. Fabinger. Am. Inst. Elec. Engrs.—Jl., vol. 46, no. 12, Dec. 1927, pp. 1399-1403, 5 figs. Calculation of "hot spot" temperature rise in electric machine from data obtained by load test of short duration.

ELECTRICITY, APPLICATIONS OF

IRON AND STEEL INDUSTRY. Iron and Steel Industry. Am. Inst. Elec. Engrs.—Jl., vol. 46, no. 12, Dec. 1927, pp. 1348-1349. Electric lighting, heating main roll drives, auxiliary mill drives, welding, safety; measurements and instruments; replacing steam by electric drives. Annual report of committee on applications to iron and steel production.

ELECTROPLATING

CHROMIUM. The Theory of the Deposition of Chromium, E. A. Ollard. Metal Industry (Lond.), vol. 31, no. 19, Nov. 11, 1927, pp. 437-439, 3 figs., and discussion in no. 21, Nov. 25, 1927, pp. 485-486. Chemistry of chromium in relation to its deposition; ionization of chromium compounds; composition of chromium plating solutions.

EXCAVATION

CHANNEL DEEPENING. Deepening a Rock-Filled Channel, W. H. Abbott. Eng. & Contracting, vol. 66, no. 10, Oct. 1927, pp. 449-451. How slackline cableway with travelling head tower solved difficult excavating problem.

F

FACTORIES

DRIVEWAYS. Factory Streets and Lower Handling Costs, L. K. Urquhart. Factory, vol. 39, no. 5, Nov. 1927, pp. 827-834. Ideal driveway surface is one that is most nearly permanent so that heaviest and most destructive traffic will have little or no effect upon it; it also presents least resistance to load movements, is not slippery in wet weather, is dustless, drains quickly, is not excessive in first cost, and does not require frequent and expensive maintenance.

FANS

CHARACTERISTICS. Tests to Determine the Effects of Throttling the Inlet on the Characteristics for a Fan, H. Mawson. Instn. Civil Engrs.—Eng. Paper, no. 51, 1927, 16 pp., 9 figs. Object was to ascertain effects of altering suction pressure at eye of fan by throttling inlet; experiments were made on "Sirocco" ventilating fan.

FILTRATION PLANTS

RAPID SAND. Five Years of Rapid Sand Filtration at Cambridge, Mass., M. C. Whipple and H. C. Chandler. New England Water Wks. Assn.—Jl., vol. 41, no. 3, Sept. 1927, pp. 218-243. Operation and performance of plant, at time of its opening largest rapid sand filter plant in New England and at present only one municipally operated in state; some of its problems have been pioneer ones in this part of country; they may serve to furnish guidance for other similar plants that are bound to follow.

FLOORS

CONCRETE. Concrete Floors for Homes, A. Foster. Bldg. Age, vol. 49, no. 12, Dec. 1927, pp. 90-92, 6 figs. Advantages and disadvantages of various kinds; finish of surface to imitate wood, cork, etc.; places where they are of great advantage; fire protection, soundproofing.

FLOW OF WATER

CONTROL. Methods of Controlling Flow of Water, F. J. Taylor. Can. Engr., vol. 53, no. 18, Nov. 1, 1927, pp. 489-493, 7 figs. Types of apparatus employed in dams for regulating flow of water; limitations and hydraulic conditions of solid weir; multiple arch dams; stoney roller sluice; movable weirs; irrigation barrages.

FORGING

DIE DESIGN. Forging Machine Die Design for Deep Piercing, E. R. Frost. Am. Soc. Steel Treating—Trans., vol. 12, no. 6, Dec. 1927, pp. 954-967, 43 figs. Method and die design for producing upset machine forgings having deep holes pierced through them, procedure to be followed in design of dies and piercers, as well as pitfalls to be avoided; kind of material that can be forged; working temperatures and kind of steel and treatment for piercer tools.

Improved Die Design Increases Production, R. Henry. Iron & Steel World, vol. 1, no. 9, Oct. 1927, pp. 637-638. Savings in labour and material result from application of gang forging methods to manufacture of forgings of varying cross-section.

SAFETY CODE. Safety Code for Forging and Hot Metal Stamping. U.S. Bur. Labour Statistics—Bul., no. 451, Aug. 1927, 32 pp., 31 figs. Code applies to all classes of power-forging machinery for both drop forging and flat-die forging, including steam hammers, pneumatic hammers, mechanically operated hammers, hydraulic presses, trimming presses, bulldozers, upsetting, machines and bolt-heading and rivet-making machines, hot saws; and incidental operations in connection with such machinery.

FORGINGS

HEATING AND HANDLING. Furnace Aids in Modernizing Forgings, F. W. Manker. Forging—Stamping—Heat Treating, vol. 13, no. 11, Nov. 1927, pp. 431-432, 2 figs. Equipment used for heating and handling forgings at plant of Willys-Overland Co.

FOUNDRIES

FARM-IMPLEMENT PARTS. Casting Parts for Agricultural Implements, E. G. Brock. Can. Foundryman, vol. 18 no. 11, Nov. 1927, pp. 7-10, 7 figs. Efficient production of plows and other farm implements is achieved at Cockshutt Plow Co.'s plant at Brantford, Ont., by a minimum of skilled labour through simplification of operations and use of modern equipment. See also Can. Machy., vol. 38, no. 22, Dec. 1, 1927, pp. 20-23, 6 figs.

FUTURE PROSPECTS. Grey Iron Foundry Faces a New Era, E. A. Custer, Jr. Iron Age, vol. 120, no. 21, Nov. 24, 1927, pp. 1447-1449. Author declares that new methods in preliminary stages of development will make possible "come back" commercially and scientifically. See also Iron Trade Rev., and vol. 81, no. 21, Nov. 24, 1927, pp. 1294-1295.

MECHANICAL ORGANIZATION. The Mechanical Organization of Foundry Work, M. H. Magdelenat. Foundry Trade Jl., vol. 37, no. 585, Nov. 3, 1927, p. 88. Points out that French markets are not adapted for mass production; in industry in France men are more to be desired than machines, but as this desire is not likely to be fulfilled soon they must resolutely take up mechanical organization of foundry work, preceded by standardization.

RADIATOR. Radiator Foundry Requires Exacting Sand Control, F. G. Steinbach. Foundry, vol. 55, no. 23, Dec. 1, 1927, pp. 912-918 and 931, 11 figs. Radiators, burners, regulators and flues are manufactured complete at Newcomerstorn, O., plant of James B. Clow & Sons; special foundry in which cast parts of unit are made, contains number of interesting features, including special sand-handling and preparing unit, special rigs for pouring and shaking out castings, special moulding equipment, etc.

FOUNDRY EQUIPMENT

CONVEYORS. Piston Moulding Conveyor Units. Iron Age, vol. 120, no. 23, Dec. 8, 1927, pp. 1582-1583, 3 figs. Mould conveyors, hooded cooling conveyors and sand-handling system result in much labour saving in automobile foundry of Buick Motor Co., Flint, Mich.

CRANES. Modern Crane Equipment for a Foundry. Elec. Engr. of Australia & New Zealand, vol. 4, no. 7, Oct. 15, 1927, pp. 245-246, 3 figs. Recent installation at Yarraville, Victoria.

SAND-HANDLING. Foundry Output Increased by Sand-Handling Equipment, G. A. Gunther. Iron Age, vol. 120, no. 24, Dec. 15, 1927, pp. 1645-1649, 8 figs. Deals with continuous moulding and sand-conditioning unit at South Bend, Ind., plant of Studebaker Corporation; equipment is combination of conveying, elevating and sand-conditioning units so arranged that none of sand entering into making of castings is handled by hand, nor is any of heavy lifting, so typical of foundry work, done at man power.

Sand-Condition Plant Saves Labour. Iron Age, vol. 120, no. 22, Dec. 1, 1927, pp. 1512-1513, 3 figs. Combination of conveyors and elevators reduces time 20 per cent; smoother castings reported.

FUELS

COAL. *See Coal; Pulverized Coal.*

OIL FUEL. *See Oil Fuel.*

FURNACES, FORGING

ELECTRIC. Electrically Heated Forging Furnace, H. G. D. Nutting. Elec. World, vol. 90, no. 24, Dec. 10, 1927, pp. 1201-1202, 2 figs. Installed in Detroit automobile-parts plant to heat steel for upsetting purposes; known as Berwick metal heater and made by Am. Car & Foundry Co.

FURNACES, HEAT-TREATING

OIL-BURNING. Burning Oil in Heat-Treating Furnaces. Fuel Oil, vol. 6, no. 6, Dec. 1927, pp. 27-28 and 140. There is no one type of burner suitable for all heating requirements; essential features are that it be properly proportioned to oil and air, or steam pressures available, and so designed that all parts are accessible and permit of close adjustment, cleaning and convenient removal from furnace, without affecting operation of any other burner served by same piping system.

FURNACES, INDUSTRIAL

DESIGN. Practical Industrial Furnace Design, M. H. Mawhinney. Forging—Stamping—Heat Treating, vol. 13, no. 11, Nov. 1927, pp. 452-455, 3 figs. Furnace construction as it relates to members which are either castings or structural steel; physical characteristics of metals.

FURNACES, MELTING

DESIGN. A Note on Foundry Equipment, with Special Reference to Furnaces, C. A. Otto. Mech. World, vol. 82, no. 2133, Nov. 18, 1927, pp. 378-379. Review of developments in brass foundries ordinary; crucible furnaces are gradually being displaced by other furnaces of more up-to-date type, which are capable of dealing with much larger quantity of metal in considerably less time, taking up less space and requiring comparatively less labour to prepare metal; electric furnaces.

G

GAUGES

METALS FOR. Recent Experiments Relating to the Wear of Plug Gauges, H. J. French and H. K. Herschman. Am. Soc. Steel Treating—Trans., vol. 12, no. 6, Dec. 1927, pp. 921-945 and (discussion) 945-953. Results of tests made in laboratory wear tester in gauging file-hard high-carbon steel, an aluminum "piston alloy" and cast iron; in tests made in file-hard high-carbon steel in presence of non-metallic abrasive, stellite, high-carbon high-chromium iron alloy and chromium-plated gauges showed better resistance to wear than customary high-carbon steels or Nitralloy.

GARBAGE DISPOSAL

INDIANAPOLIS. Indianapolis Reaps Profit in Garbage, E. M. Reid. Am. City, vol. 37, no. 6, Dec. 1927, pp. 753-757. Garbage reduction plant designed to extract every saleable product possible by use of McCullough system; garbage collection.

GASOLINE

CRACKING PROCESSES. Gasoline, by Pressure Cracking of Canadian Shale Oil and Bitumen, R. E. Gilmore. Can. Chem. & Met., vol. 11, no. 11, Nov. 1927, pp. 289-291. Samples of Canadian crude shale oil and bitumen from bituminous sands were submitted to Universal Oil Products Co. and to Kansas City Testing Laboratory for pressure cracking tests, according to Dubbs and Cross processes respectively; results are summarized and will serve purpose of helping to decide value of crude shale oil and bitumen on comparative basis with crude petroleum and fuel oils now used as sources of motor fuels by pressure cracking processes.

GEAR CUTTING

HOBBING. Hobbing Brass Worm-Gears. Machy. (N.Y.), vol. 34, no. 4, Dec. 1927, p. 298, 2 figs. Describes fixture for hobbing worm gear on drilling machine.

HOBS. Cutting and Heat-Treating Gear Hobs, D. M. Duncan. Can. Machy., vol. 38, no. 22, Dec. 1, 1927, pp. 17-19. Discussion of problems incident to production of accurate gears and gear-cutting tools, together with description of methods of machining and heat-treating employed by Ontario concern.

INDEXING SEGMENT GEAR. Sine Bar Indexing Device for Segment Gear. Machy. (Lond.), vol. 31, no. 786, Nov. 3, 1927, pp. 137-138, 2 figs. Method of indexing by angular measurements devised by writer after regular indexing equipment had failed to give accuracy required in cutting segment gear and pinion for model of new machine; gears having prime numbers of teeth that cannot be readily spaced by dividing head can easily be cut by this method.

GEARS

NOISE TESTING OF GEAR BOXES. Gear Box Noise-Testing Machine. Machy. (Lond.), vol. 31, no. 786, Nov. 3, 1927, pp. 142-145, 8 figs. Apparatus for indicating and comparing magnitude of sound; by its use all kinds of gear units can be tested as simple production operation.

TOOTH-HARDNESS TESTING. Testing the Hardness of Gear Wheel Teeth. Engineer, vol. 144, no. 3751, Dec. 2, 1927, p. 635, 3 figs. Describes appliance produced by Vickers, Ltd., as adjunct to their diamond hardness-testing machine; in new attachment, mount of diamond is cut away so as to permit diamond to reach pitch line of tooth without interference from next succeeding tooth.

VARIABLE-SPEED. Novel Variable Gear. Autocar, vol. 59, no. 1674, Dec. 2, 1927, pp. 1166-1167, 6 figs. Two helical gear wheels and swashplate control mechanism, constituting multi-speed gear; operation; transverse-cam-rotation; obtaining reverse; clutch optional fitting.

GOLD MINES

QUEBEC. Developments in the Rouyn District, R. C. Rowe. Can. Min. Jl., vol. 48, no. 48, Dec. 1927, pp. 957-960, 3 figs. Real nature of district as gold-copper-zinc field was not realized until 1924; discusses origin of ores, Horne mine, Waite mine and prospects.

GOLD MINING

NOVA SCOTIA. Gold Mining in Nova Scotia, J. C. Murray. Can. Inst. Min. & Met.—Trans., Mar. 1926, 16 pp., 5 figs. Historical; Nova Scotia offers promise of large bodies of low- and medium-grade ore, and further assurance of abundant cheap power; super-added inducement of low working costs is due in part to cheap power, in part to character of ore deposits and in part to unusual accessibility of Nova Scotian gold fields.

GRINDING

AUTOMOBILE PARTS. Development in Cylinder Grinding, M. C. Hutto. Soc. Automotive Engrs.—Jl., vol. 21, no. 6, Dec. 1927, pp. 669-677, 13 figs. Manufacturing of more accurate pistons necessitated better cylinders; problem was to develop new grinding methods which would have four distinct improvements; greater accuracy, greater speed, better finish and lower cost; grinders recently developed have surpassed in performance expectations of designers.

External Grinding in Automotive Production, O. A. Knight. Soc. Automotive Engrs.—Jl., vol. 21, no. 6, Dec. 1927, pp. 708-712, 8 figs. Describes progress being made in machines and methods for external grinding, including plain cylindrical work, crankshafts, camshafts and other irregular work, and simultaneous grinding of two surfaces; classification of grinding finishes.

GRINDING MACHINES

CAM-GRINDING ATTACHMENT. Norton Automatic Indexing Cam-Grinding Attachment. West. Machy. World, vol. 18, no. 11, Nov. 1927, p. 552, 2 figs. Applied to Norton type A and type BA cylindrical grinding machines and used for grinding cams integral with shaft.

FACE-MILL. Oliver Face-Mill Grinder. West. Machy. World, vol. 18, no. 11, Nov. 1927, p. 551, 1 fig. For sharpening face-milling cutters; grinds face and periphery of cutting blade at one pass of wheel and forms circular corner joining two; adaptable to grinding requiring radial motion of grinding wheel or combination of straight and radial grinding.

SURFACE. Vertical Spindle Internal and Surface-Grinding Machine. Machy. (Lond.), vol. 31, no. 788, Nov. 17, 1927, pp. 206-207, 2 figs. Specially designed for internal grinding of laminations in stator cases, though it may be equally well employed on general internal-grinding operations, where work can revolve.

TOOL-SPINDLE. Heavy Duty Self-Contained Machine Tool Spindle Grinding Machine. West. Machy. World, vol. 18, no. 11, Nov. 1927, pp. 552-553, 1 fig. Developed by Cincinnati Grinders, Inc., for giving good finish and accurate surface to large machine-tool spindles; massive wheel slide; forced lubrication of tableways.

H

HEAT, CEMENT

HEAT CHANGES DURING SETTING. Heat Changes During Setting of Alumina and Portland Cements, A. A. Jakkula. Eng. News-Rec., vol. 99, no. 24, Dec. 15, 1927, pp. 955-956, 3 figs. Tests show temperature of alumina cement mix four times that of portland and heat generated twice as great.

HEATING AND VENTILATION

OFFICE BUILDINGS. Saving Heat in Skyscrapers, F. C. Houghten and M. E. O'Connell. Am. Soc. Heat. & Vent. Engrs.—Jl., vol. 33, no. 11, Nov. 1927, pp. 639-652, 16 figs. Air-leakage studies on metal windows in modern office building reveal effectiveness of weather-stripping in reducing heat losses. See also Dom. Eng. (N.Y.), vol. 21, no. 10, Dec. 3, 1927, pp. 23-25 and 43, 45, 47-48 and 51, 16 figs.

HEATING, HOUSE

FUELS FOR. Tests of Various Fuels Made in a Domestic Hot-Water Boiler at the Fuel Testing Station in Co-operation with the Dominion Fuel Board, E. S. Malloch and C. E. Baltzer. Can. Dept. Mines—Investigations of Fuels and Fuel Testing, no. 671, 1927, pp. 33-63, 7 figs. Investigation to ascertain relative value of various fuels for domestic heating; this was accomplished by comparing behaviour of each fuel, when burned in standard type of domestic heater, with that of typical sample of American anthracite coal.

HIGH VOLTAGES

HAZARDS PREVENTION. Prevention of High-Voltage Hazards in Industrial Substations, W. C. Wagner. Indus. Eng., vol. 85, no. 11, Nov. 1927, pp. 525-526, 3 figs. Reviews present problems, indicates progress of recent developments, and outlines trend of rules and regulations upon which to depend for guidance.

HIGHWAYS

CALCIUM CHLORIDE, USE OF. Use of Calcium Chloride for Highways, H. F. Clemmer. Can. Engr., vol. 53, no. 18, Nov. 1, 1927, pp. 495-497. Elimination of dust nuisance on gravel roads; method of application; curing concrete and accelerating setting. Paper presented at Southwest Road School and Show, Wichita, Kansas.

HYDRAULIC PRESSES

WELDED. Welded Press Has 1,000-Ton Capacity. Welding Engr., vol. 12, no. 10, Oct. 1927, pp. 29-31, 7 figs. When Pacific Steel Boiler Corp. needed new heavy-duty hydraulic press, conventional designs were discarded and new and unique construction was devised in order to take fullest advantage of strength and economy of welded joints.

HYDRAULIC TURBINES

DESIGN. A Method of Obtaining the Leading Dimensions and of Setting Out the Blade-Forms for Hydraulic Turbines of the Francis Mixed-Flow and Propeller Types, H. Mawson. Inst. Civil Engrs.—Eng. Paper, no. 48, 1927, 22 pp., 8 figs. Conditions under which turbines are required to operate differ widely, and it is necessary to prepare designs for wide range of specific speeds; configuration of runner and shape of blades alter for different conditions; shows how these may be adjusted to satisfy various requirements.

HYDRAULICS

EROSION, NIAGARA FALLS. Experimental Work at Niagara Falls. Can. Engr., vol. 53, no. 20, Nov. 15, 1927, pp. 523-524. Erosion at centre of Horseshoe Falls proceeding at rate of 6 ft. per year; construction of islands proposed to distribute flow over entire length of crest; large model of falls built for experimental purposes.

HYDRO-ELECTRIC DEVELOPMENTS

NEW BRUNSWICK. Construction Methods on Grand Falls, N.B., Hydro-Electric Development. Contract Rec., vol. 41, no. 47, Nov. 23, 1927, pp. 1187-1192, 14 figs. Construction details of dam, tunnel, intake, power house and penstocks.

CANADA. Canadian Electrical Development, F. R. Ewart. World Power, vol. 8, no. 47, Nov. 1927, pp. 246-252. Explains financial basis of Hydro-Electric Power Commission of Ontario; influence of cheap electricity on development of mining, pulp and papermaking industries in Northern Ontario; effects of policy of service in development of domestic load is evidenced by citation of few convincing statistics; possibilities of power development.

Hydraulic Power Developments in British Columbia. Engineer, vol. 144, no. 3751, Dec. 2, 1927, pp. 622-623, 4 figs. on p. 630. Account of Bridge river project; Alouette, Stave Falls and Ruskin development.

The Alouette Power Project of the British Columbia Electric Railway Co. Contract Rec., vol. 41, no. 46, Nov. 16, 1927, pp. 1160-1164, 7 figs. Construction of dam, tunnel, power house and transmission line at Alouette lakes near Vancouver.

HYDRO-ELECTRIC PLANTS

GRAND FALLS, N.B. Power Development at Grand Falls, N.B., A. C. D. Blanchard. Can. Engr., vol. 53, no. 22, Nov. 29, 1927, pp. 559-562, 6 figs. Constructional features of hydro-electric development for St. John River Power Co. Paper presented before Toronto Branch of Eng. Inst. of Canada.

I

INDUSTRIAL MANAGEMENT

COMPLAINTS, HANDLING. How to Handle Complaints, A. J. Smith. Indus. Mgmt. (Lond.), vol. 14, no. 11, Nov. 1927, pp. 412-413. Vital importance of complaints and their possible effect upon future business is in many works sufficient to justify appointment of special executive to deal with all such matters; where such procedure is not possible it will be found on whole that subject can better be dealt with on sales side of organization rather than production side.

DEPRECIATION. Depreciation, J. C. Rath. Soc. Indus. Engrs.—Bul., vol. 9, no. 10, Oct. 1927, pp. 9-17. Its meaning and importance in present-day business practice.

MANUFACTURING OPERATIONS, ANALYSIS OF. How to Analyze Manufacturing Operations, A. B. Segur. Soc. Indus. Engrs.—Bul., vol. 9, no. 10, Oct. 1927, pp. 3-8. To author's mind, most accurate method, in every way, is calculation of rate from time laws of motion and from motion required to obtain quality desired on that particular operation.

NON-PRODUCTIVE PLANNING DEPARTMENT. Linking Maintenance with Production and Costs, C. L. Bonnett. Indus. Mgmt. (N.Y.), vol. 74, no. 6, Dec. 1927, pp. 343-349, 4 figs. Non-productive work as referred to covers that phase of work involved in furnishing and maintaining buildings, machinery, tools, gauges miscellaneous equipment and all items that make up plant and property.

PLANT-ENGINEERING DEPARTMENT. Management and the Plant Engineer, K. D. Hamilton. Factory, vol. 39, no. 5, Nov. 1927, pp. 815-817 and 854. Points out that management too often overlooks direct relation which exists between operation or production expense and low maintenance costs; plant-engineering department, while not actively engaged in production, maintains and operates equipment to keep machinery in continuous production.

PRODUCTION CONTROL. Simplified Production Control, K. R. Wood. Indus. Mgmt. (N.Y.), vol. 74, no. 6, Dec. 1927, pp. 350-353, 5 figs. Describes signaling system for directing work in various divisions of plant, that brings in close touch control department and production departments, all centralized so as to be under one-man control.

PRODUCTION PLANNING. Planning for the Small Manufacturer, F. A. R. Paton. Indus. Mgmt. (Lond.), vol. 14, no. 11, Nov. 1927, pp. 409-411. Shows how schemes may be advantageously applied to small works, and how they may be introduced.

TIME STUDY. *See Time Study.*

INDUSTRIAL PLANTS

MECHANIZATION. Mechanizing of Industrial Establishments, G. F. Zimmer. Indus. Mgmt. (Lond.), vol. 14, no. 11, Nov. 1927, pp. 397-399, 3 figs. Demonstrates that while mechanizing of industry was successfully accomplished half a century ago when labour was inexpensive, logical conclusion of that fact should be universal application of such mechanizing to-day, when labour is so much more expensive.

INTERNAL-COMBUSTION ENGINES

CONNECTING RODS, SHOCKS. Shocks in Connecting-Rod Heads (Contribution à l'étude des chocs dans les têtes de bielles), A. Planiol. Technique Automobile et Aérienne, vol. 18, no. 138, May 30, 1927, pp. 76-84, 12 figs. Importance of subject; theoretical analysis on basis of old Bertin theory; experimental study of a Winterthur engine.

CORROSION. Corrosion Detected by D.O.C. Test, H. J. Young. Oil & Gas Jl., vol. 26, no. 27, Nov. 24, 1927, pp. 146-148. Severe corrosion having occurred on pins and journals of crankshafts of two motorships it fell to author to ascertain cause and if possible to find remedy; he devised what he calls direct oil-corrosion test, performed by means of apparatus whereby warm oil is run continuously over warm steel, white motal, brass, copper or any other metal.

EXHAUST-GAS ANALYSIS. Interpretation of Exhaust Gas, C. C. Minter. Soc. Automotive Engrs.—Jl., vol. 21, no. 5, Nov. 1927, pp. 573-575. Author explains chemistry involved in combustion in effort to arrive at more accurate knowledge of constituents of exhaust gas; sets forth simple stoichiometric relations that exist between products of combustion of hydro-carbon fuel; correction factors that must be introduced in applying these ideal relations to combustion under actual engine conditions.

ITALIAN CONGRESS. Italian Engineers Hold Internal Combustion Engine Congress. Automotive Industries, vol. 57, no. 25, Dec. 17, 1927, pp. 900-901. Motor fuels, detonation, control of combustion in cylinders; flexibility of engine operation and vibration discussed; tribute paid to Bernardi; transformation of gaseous mixture during working stroke; inertia phenomena in intake systems.

See also Airplane Engines; Diesel Engines; Oil Engines.

L

LAKES

LEVELS, CHANGING. Conservation or Confiscation. Minn. Federation Arch. & Eng. Soc.—Bul., vol. 12, no. 11, Nov. 1927, pp. 11-24. International Joint Commission is investigating and preparing to report as to whether levels of certain lakes forming boundary between Minnesota and Ontario shall be changed; plan is to make certain changes in dams and to build seven new storage dams.

LEAD METALLURGY

EXTRACTION. Lead—Its Extraction and Application, R. C. Rowe. Can. Machy., vol. 38, no. 20, Nov. 17, 1927, pp. 15-18. Discussion of utility of lead in every-day life from earliest times to present day; past and present processes for extracting lead from its ores.

LOCOMOTIVES

OIL-ELECTRIC. Oil-Electric Locomotive Shows Fitness for Passenger Service. Compressed Air Mag., vol. 32, no. 12, Dec. 1927, p. 2251. Results of test which consisted of run of 183.7 miles on Erie Railroad from Hornell, N.Y., to Meadville, Pa.; performance was outstanding success.

STOKER FIRING. Stoker Firing of Engines. Ry. Jl., vol. 33, no. 12, Dec. 1927, pp. 33-34. Subcommittee's report before Ry. Fuel Agents' Convention. There is still, without doubt, great opportunity on most railroads to effect further reduction in fuel consumption on locomotives through improved firing practice.

LUBRICATION

SYSTEM FOR MACHINES. Dot Centralized Lubricating System. Am. Mach., vol. 67, no. 24, Dec. 15, 1927, pp. 953-954, 2 figs. Number of bearings upon machine or group of machines or upon line and countershaft oiled simultaneously from central point; comprises pump or means to introduce oil, metering valve, knuckle relief valve, pipe and fittings; hand or power operation.

LUMBER

DRYING. The Practicability of Drying Green Lumber, W. I. Willard. Woodworker, vol. 46. no. 9, Nov. 1927, pp. 35-37, 2 figs. Drying of green or nearly green stock is phase of lumber treatment which is receiving more and more attention; lumber should be thoroughly dried at point of production, and in most economical manner; emphasizes practicability of drying green stock successfully. Offsets erroneous impression that air seasoning is essential factor in successful drying of lumber.

M

MACHINE SHOPS

POWER DISTRIBUTION. Power Distribution in a Large Machine Shop, F. E. Gooding and C. E. Brown. Indus. Eng., vol. 85, no. 11, Nov. 1927, pp. 520-522, 8 figs. Cincinnati Milling Machine Co.'s layout for power and lighting; a.c. and d.c. used purchased from outside; 150 kw. of a.c., 150 kw. of d.c. is maximum power requirement.

MACHINE TOOLS

LUBRICATION. Lubricating Machine Tool Bearings, F. Horner. Can. Machy., vol. 38, no. 21, Nov. 24, 1927, pp. 15-18, 11 figs. Discusses and illustrates variety of ways in which machine-tool lubrication may be accomplished for preservation of bearing surfaces against frictional deterioration or seizure.

STANDARDIZATION. Tool Standardization. Soc. Automotive Engrs.—Jl., vol. 21, no. 5, Nov. 1927, pp. 576-578, 4 figs. Tools and details of jigs and fixtures standardized in Beloit plant.

SWAGING. Dayton-Torrington Improved 4-Die Swaging Machine. Am. Mach., vol. 67, no. 23, Dec. 8, 1927, pp. 921-922. Increased capacity for No. 3 size.

MACHINING METHODS

LOBE-SHAPED BORES. Machining Casting with Lobe-Shaped Bore. Machy. (Lond.), vol. 31, no. 787, Nov. 10, 1927, pp. 180-181, 4 figs. Fixtures and tools designed for machining operations on exhaust-pump castings.

MAGNETIC FIELDS

GRAPHICAL DETERMINATION. Graphical Determination of Magnetic Fields Theoretical Considerations, A. R. Stevenson, Jr., and R. H. Park. Am. Inst. Elec. Engrs.—Jl., vol. 46, no. 12, Dec. 1927, p. 1389. History; ordinary rules for plotting magnetic flux in air and in current-carrying copper; additional rules for checking accuracy of field plots; theoretical methods for mathematically calculating distribution of field in certain cases.

INTERPOLAR. The Interpolar Fields of Saturated Magnetic Circuits, T. Lehmann. Am. Inst. Elec. Engrs.—Jl., vol. 46, no. 12, Dec. 1927, pp. 1411-1414, 4 figs. Effect of assuming infinite permeability in iron on accuracy of calculations of interpolar fields in electric machines; direct development of sketch in air gap in interpolar space and in slots when magnetic circuit is saturated.

MANGANESE STEEL

LOW-CARBON. Some Characteristics of Low-Carbon Manganese Steel, V. N. Krivobok, B. M. Larsen, W. B. Skinkle and W. C. Masters. Am. Inst. Min. & Met. Engrs. Tech. Publication, no. 24, Nov. 1927, 30 pp., 32 figs. It can be manufactured in either basic or acid open-hearth or electric furnaces, available manganese alloys giving any desired composition; finishing of manganese heat in furnace, and use of silico-manganese for making low-carbon heats involve special problems in furnace operation which are not yet entirely solved and deserve further study; it may be useful chiefly in field of cheaper alloy steels, where large tonnages are desired of steel with properties superior to those of ordinary open-hearth carbon steels; double heat treatment is necessary to bring out best properties.

MATERIALS HANDLING

DUMPING MACHINERY. Mechanical Dumping (Maschineller Kippbetrieb), F. Heintze. Bautechnik, vol. 5, no. 48, Nov. 4, 1927, pp. 695-698, 8 figs. Construction and operation of Krupp and other German elevating and dumping belt conveyors, on booms as long as 72 m., combined with bucket excavators; uses in mining, dam construction, earthwork, etc.

METALS

COLD-ROLLED. The Structure of Cold-Rolled Metals (Beiträge zur Kenntnis der Struktur kaltgewalzter Metalle), F. Wever and W. Schmidt. Mitteilungen aus dem Kaiser-Wilhelm-Institut für Eisenforschung zu Düsseldorf, vol. 9, no. 17, paper no. 90, 1927, pp. 265-272, 39 figs., partly on supp. plates. Deals with structure analysis of rolled aluminum, copper and silver; recrystallization process of aluminum.

IMPURITIES. Impurities. Metallurgist (Supp. to Engineer), Nov. 25, 1927, pp. 162-163. In cases mentioned effects of impurities are most important from point of view of mechanical properties of metals and alloys concerned; from viewpoint of electrical industry, however, electrical and magnetic properties are even more important, and this opens up wider field of research and one involving study of much more minute quantities of impurity as affecting properties of high-purity metals.

MICROSCOPIC EXAMINATION. The Microscopic Examination of Engineering Materials, A. B. Everest. Rugby Eng. Soc.—Proc., vol. 21, 1926-1927, pp. 15-36, 31 figs. Demonstrates how microscope is becoming more and more basis of testing of many engineering materials; microstructure of metals, and its relation to thermal and mechanical treatment; in special case, relation between microstructure and physical properties of series of alloys is discussed, showing how, within limits, microscope can form basis of investigation of such series; micro-examination of some special materials, notably of electrical insulators.

MINING INDUSTRY

BRITISH COLUMBIA. Mining Conditions in British Columbia, H. Browning. Can. Min. Jl., vol. 48, no. 48, Dec. 1927, pp. 963-965. Mining companies still find many attracting propositions; copper, gold, lead and non-metallic production statistics.

MOULDING METHODS

AMERICAN PRACTICE. American Foundry Practice. Foundry Trade Jl., vol. 37, no. 586, Nov. 10, 1927, p. 102, 3 figs. Moulding methods in America are very different from British, and this difference is constituted of many items, such as extended use of wooden moulding boxes; large number of snap-flask boxes; varying qualities of moulding sand; different bonds used in sand; and many small items which tend to create speed.

MOULDS

DRIERS. Electric Mould-Drying Unit. Iron Age, vol. 120, no. 21, Nov. 24, 1927, p. 1456. Heating unit for drying large sand moulds in brass, steel or iron foundries, designed by Gen. Elec. Co. to obviate attention required by kerosene lamps, stoves, coke or coal fires usually employed.

WATER-COOLED. Water-Cooled Moulds in Brass Foundries. Metal Industry (Lond.), vol. 31, no. 20, Nov. 18, 1927, pp. 465-466, 7 figs. Probably most serviceable and convenient type of chill mould is Junker water-cooled mould; these moulds are scientifically designed and calculated to give continuous and effective service of precisely the nature to give best physical structure, density and condition in resulting slabs, and therefore to produce ultimately far better and more uniform sheets than can be obtained by use of old-fashioned cast-iron chill moulds.

MOLYBDENUM

USES. Molybdenum and Its Uses, W. H. Phillips. Can. Machy. & Mfg. News, vol. 38, no. 18, Nov. 3, 1927, pp. 23-24. Forging and rolling; ease with which molybdenum can be added to iron or steel insures good results in melting operation; alloy recovery is exceptionally high, running up to 98 to 99 per cent; molybdenum in all scrap can be fully recovered; its use in iron. Abstract of lecture presented before Montreal Chapter of Am. Soc. for Steel Treating.

MOTOR BUSES

DESIGN. Motorcoach Design, K. J. Ammerman. Soc. Automotive Engrs.—Jl., vol. 21, no. 6, Dec. 1927, pp. 653-659, 6 figs. Topics discussed include effects of excessive overhang, importance of proper weight distribution, baggage problem, value of sturdy appearance, economy of standard body building and costs imposed by deviations from standardized design; methods of construction; views of several leading types of motor coach.

GENERAL MOTORS CO. New General Motors Buses Powered with Buick Engines, A. F. Denham. Automotive Industries, vol. 57, no. 23, Dec. 3, 1927, pp. 834-835. Two chassis, designed for city and school service respectively, are announced; former has wheelbase of 162 in.; school bus seats 42, city 21, balloon tires used dual on rear.

OLYMPIA SHOW, ENGLAND. The Commercial Vehicle Exhibition at Olympia. Engineering, vol. 37, nos. 3227, 3228 and 3229, Nov. 18, 25 and Dec. 2, 1927, pp. 655-658, 694-696 and 703-705, 55 figs. partly on supp. plates. Tendency in design as featured by exhibits; it is considered essential that commercial vehicles, particularly those of passenger type, should be capable of relatively high speeds, and this has led to adoption of highly efficient engines; employment of low-level frames. See also Elec. Ry. & Tramway Jl., vol. 57, no. 1426, Nov. 18, 1927, pp. 324-340, 34 figs.. and Engineer, vol. 144, nos. 3749 and 3750, Nov. 18 and 25, 1927, pp. 566-568 and 596-598, 13 figs.

STREET-CAR TYPE. Will New Street Car Models Extend Economic Field of the Bus? D. Blanchard. Automotive Industries, vol. 57, no. 25, Dec. 17, 1927, pp. 894-897, 5 figs. Increased carrying capacity to give wider field without offsetting increase of operating costs; three makes on market; body maintenance uncertain; reduced storage costs.

MOTOR TRUCK TRANSPORTATION

FLEET-OPERATING COSTS. Using Truck-Opreating Costs to Increase Delivery Efficiency, A. W. Herrington. Soc. Automotive Engrs.—Jl., vol. 21, no. 5, Nov. 1927, pp. 535-538, 2 figs. In line with devising standard method of recording fleet operating costs so that they can be utilized comparatively, author cites supposed company in retail dairy business which has fleet of 30 vehicles, assumes definite monetary values for several factors constituting total cost, and analyzes entire problem in way to demonstrate fundamental principles of comprehensive system of accounting that will make evident all information sought.

RAILWAY AND. Co-ordinated Rail and Motor Truck Transportation, G. W. Dixon. Soc. Automotive Engrs.—Jl., vol. 21, no. 6, Dec. 1927, pp. 680-681. Five principal uses for motor truck and two secondary uses are cited; analysis is made of each of motor truck usages mentioned; it is stated that motor truck and semi-trailers bid fair to become economical auxiliaries to all-rail transportation.

N

NICKEL ALLOYS

NICKEL CAST IRON. Nickel Cast Iron, A. E. Hanson and E. J. Bothwell. Tech. Eng. News, vol. 8, no. 6, Nov. 1927, pp. 258-259 and 278, 4 figs. Description of properties of this new alloy, with reference to its economical use as engineering material.

NUTS

DRIVING MACHINES. Reynolds Nut-Driving Machine. Am. Mach., vol. 67, no. 32, Dec. 1, 1927, pp. 872-873, 2 figs. Such work as assembling of bearing caps; valve bonnets, motor end plates, connecting rods preparatory to reaming, or any work that requires nuts or caps to be driven and tightened in pairs; can be performed on two-spindle machine made by Metalwood Mfg. Co. See also Automotive Industries, vol. 57, no. 24, Dec. 10, 1927, pp. 874-875, 1 fig.

O

OIL ENGINES

DEVELOPMENTS. Oil Engines, J. F. Alcock. Instn. Petroleum Technologists—Jl., vol. 13, no. 63, Aug. 1927, pp. 601-607. Chief feature of year is construction of high-powered engines, mostly for passenger liners; high-speed engines; two-stroke engines; fuel injection; supercharging; hot-bulb engines.

HEAVY OIL. Economics of the Crude Oil Engine Plant, J. H. Dodd. Commonwealth Engr., vol. 15, no. 2, Sept. 1, 1927, pp. 54-56, 1 fig. During past five years considerable progress has been made in Australia in connection with installation of crude-oil engine plants; these installations have been mainly for generation of electrical energy.

LUBRICATION. How Lubricating Oil Can Retain Its Youth, B. C. Oldham. Power, vol. 66, no. 21, Nov. 22, 1927, pp. 788-791, 3 figs. At least three problems are involved in lubrication of oil engines; one is method employed, another is selection of suitable grade of oil, and third is manner in which oil is handled; lubrication within crankcase; trunk-piston engine lubrication; carbon troubles.

SUPERCHARGING. A New System of Supercharging. Mar. Engr. & Motorship Bldr., vol. 50, no. 603, Nov. 1927, pp. 415-416, 2 figs. With object of obtaining more power from given cylinder volume than is possible with their standard system of scavenging with double row of superimposed parts, Sulzer Bros., Switzerland, have developed new method of supercharging two-stroke cycle heavy-oil engines of their design, whether of land or marine type; essential feature of new method consists in introducing certain quantity of charging air at about 0.8 atmos. pressure into working cylinder immediately after termination of normal scavenging process.

OIL FIELDS

BRITISH EMPIRE. Progress and Prospects of Production, E. H. Cunningham-Craig. Empire Min. & Met. Congress—Advance Paper, Aug. 22-Sept. 29, 1927, 18 pp. Possibilities of future production from (1) producing fields, (2) probable fields, (3) areas of retortable material in India, Trinidad, Canada, Barbados, Australia, New Zealand, South Africa, Great Britain, etc.

CANADA. Petroleum and Natural Gas in the Dominion of Canada, J. Ness. Empire Min. & Met. Congress—Advance Paper, for mtg. Sept. 20, 1927, 127 pp., 15 figs. Review of Dominion's proved, possible and probable oil fields; oil and gas in Maritime provinces, Ontario, great plains of western Canada, foothills belt of Alberta and British Columbia and Mackenzie river area.

OIL FUEL

AUTO-IGNITION TEMPERATURE. Study of Auto-Ignition Temperatures, H. J. Masson and W. F. Hamilton. Indus. & Eng. Chem., vol. 19, no. 12, Dec. 1927, pp. 1335-1338, 1 fig. Study of various factors affecting auto-ignition temperatures; as result new form of apparatus has been developed of high accuracy and sensitivity together with simplicity of construction and operation; apparatus and technic may be modified to determine auto-ignition temperatures of solids and gases in any surrounding atmosphere at ordinary or increased pressures.

HOUSE HEATING. Mercoids Features Forecast of Oil-Burner Development, P. E. Fansler. Heat. & Vent. Mag., vol. 24, no. 11, Nov. 1927, pp. 110-111. Author conceives of home having in its cellar, or buried in ground, machine that will make from common oil fuels, stable gas, in quantities and at times wanted; machine might be of instantaneous type, making gas exactly as required, or it might incorporate small storage, maintaining this reserve always at definite minimum; this stable gas can be piped into and through home, supplying heat from combustion taking place in a specially designed heating plant that conceivably might show overall efficiency of 90 per cent; gas from same source would supply kitchen stove, domestic water heater, refrigerating unit, air-conditioning plant, etc.

MEASURING. Measuring Fuel Oils, A. F. Brewer. Indus. Power, vol. 8, no. 6, Dec. 1927, pp. 56-58, 3 figs. In fuel-oil burning systems both horizontal and vertical shortage tanks are encountered; to gauge or measure amount of fuel in such tanks, depth of oil can either be measured directly or distance from a fixed or gauging point at top of tank to surface of oil can be taken; by first method so-called "innage" is determined; second method is termed measuring "outage."

SYNTHETIC. Synthetic Fuels, A. W. Nash and O. C. Elvins. Instn. Petroleum Technologists—Jl., vol. 13, no. 63, Aug. 1927, pp. 597-601. Review of progress; pressure process for methyl alcohol is commercial success; it can be modified to yield liquids suitable for use as fuels, but evidence is not yet forthcoming that such modifications will be economic success; hydro-carbon formation at atmospheric pressure holds much promise for future of synthetic gasoline.

OPEN-HEARTH FURNACES

REFRACTORIES. Open-Hearth Steelworks Refractories, A. T. Green. Foundry Trade Jl., vol. 37, no. 583, Oct. 20, 1927, pp. 50-52. Bricks for port and top courses; highly converted silica unsuitable for open hearth; corrosion and erosion of open-hearth silica bricks; mechanism of corrosion and erosion; bricks from furnace roofs; thermal characteristics of chequerwork; materials for regenerators.

OIL INDUSTRY

LIGHTNING PROTECTION. Lightning Protection for the Oil Industry, E. R. Schaefer. Am. Inst. Elec. Engrs.—Jl., vol. 46, no. 12, Dec. 1927, pp. 1358-1364, 11 figs. Design of system to offer high degree of protection for storage tanks in actual use; record of several hundred installations; network of pipe lines as ground for towers compared with single shaft driven vertically downward; their advantages.

OIL SHALES

DISTILLATION. Distillation of Oil Shale with Circulation of Uncondensed Gases, A. A. Swinnerton. Can. Dept. Mines—Investigations of Fuels and Fuel Testing, no. 671, 1927, pp. 176-184, 1 fig. Three runs at different rates of circulation were made on standard oil shale sample for purpose of determining comparative value of distilling oil shale with circulation of hot uncondensed gases.

OILS

ANALYSIS. Analyses of Oils and Liquid Fuels, P. V. Rosewarne. Can. Dept. Mines—Investigations of Fuels and Fuel Testing, no. 671, 1927, pp. 167-175. Results obtained from analyses of miscellaneous samples of oils and liquid fuels submitted to fuel testing laboratories for examination by various departments of government, by corporations and by private individuals.

OXY-ACETYLENE CUTTING

ECONOMICAL APPLICATIONS. Economical Oxy-Acetylene Cutting Needs Intelligent Supervision. J. L. Anderson. Iron Trade Rev., vol. 81, no. 23, Dec. 8, 1927, pp. 1421-1423 and 1428, 3 figs. Calls attention to importance of oxy-acetylene cutting process from oxygen-consumption standpoint; factors that enter into economical application of this process.

OXY-ACETYLENE WELDING

ANNEALING PIPE JOINTS. Annealing Welded Pipe Joints. Acetylene Jl., vol. 29, no. 5, Nov. 1927, pp. 195-196, 3 figs. High-pressure steam main, 18 in. in diameter with steel wall ½ in. thick was constructed with chamfered edges for oxy-acetylene welding of joints; following completion of each weld, all joints were annealed six inches on each side of weld, being heat treated with use of McKneat atomizing burner.

ENGINE CASTINGS. Oxy-Acetylene Welding of Oil Engine Castings. Oil Engine Power, vol. 5, no. 12, Dec. 1927, pp. 829-830, 1 fig. Problems involved in welding large complicated grey iron castings such as are used in oil engines consist mainly in controlling heat of welding operations so that there will be no warping out of true nor cracking due to internal stresses.

PIPE LINES. 500,000 Ft. of Welded Piping in One Building, C. Kandel. Acetylene Jl., vol. 29, no. 5, Nov. 1927, p. 202. In erection of new 16-storey Nurses' Home forming part of Mt. Sinai Hospital, New York, all steam, brine and hot-water pipe lines are welded.

PRACTICAL APPLICATIONS. Practical Oxy-Acetylene Welding, R. Granjon, P. Rosemberg and A. Desgranges. Welding Jl., vol. 24, nos. 284, 285, 286, 287, 288 and 289, May, June, July, Aug., Sept. and Oct. 1927, pp. 140-143, 174-176, 208-211, 237-239, 264-266 and 319-321, 142 figs. May: Welding of cast iron. June: Special and malleable cast iron; welding of aluminum. July: Light alloys of aluminum. Aug.: Duralumin and special alloys; welding of copper. Sept.: Welding of brasses. Oct.: Bronzes and miscellaneous metals and alloys.

PRESSURE VESSELS. Searching Tests of Welded Joints. Iron Age, vol. 120, no. 21, Nov. 24, 1927, pp. 1445-1446. Sponsored by International Acetylene Assn. in study of pressure vessels; value of various gases for cutting flame compared.

STEAM PIPES. Built for the Ages. Oxy-Acetylene Tips for the Linde Ox-Welder, vol. 6, no. 4, Nov. 1927, pp. 61-62, 4 figs. Welded steam piping for heating and snow removal sealed permanently in masonry walls of great cathedral on Morningside Heights in New York City.

P

PAVEMENTS

STEEP GRADES. Types and Costs of Paving on Steep Grades. Am. City, vol. 37, no. 6, Dec. 1927, p. 730. New York states practice where grades are 5 per cent or greater.

PAVEMENTS, ASPHALT

MAINTENANCE MACHINE. Welding Pavements with Oil Heat, C. M. Perkins. Fuel Oil, vol. 6, no. 6, Dec. 1927, pp. 19-20. Luts surface heater consists of oil flame generator contained in hood, by means of which heat can be applied to spot seven feet square; hood is attached by two hinged steel members to frame of rugged truck, and two cables, actuated by hydraulic cylinder using oil from power-driven pump, raise or lower hood when desired.

MIXTURES. The Theory and Practice of Asphalt Paving Mixtures, A. W. Dow. Good Roads, vol. 70, nos. 9 and 10, Sept. and Oct. 1927, pp. 390-392 and 436-437. Sept.: Investigations to determine general formula for asphalt paving mixtures; studies of void determinations on mineral aggregates; surface mixtures. Oct.: Selective absorption; stability vs. pliability.

PAVEMENTS, BRICK

BASES. Bases for Brick Pavements. Highway Mag., vol. 18, no. 12, Dec. 1927, pp. 318-320. Deals with concrete and rolled-stone bases; resurfacing old pavements.

PIPE, CAST-IRON

BRONZE-WELDED JOINTS. New High-Strength Joint. Oxy-Acetylene Tips, vol. 6, no. 4, Nov. 1927, pp. 72-76, 5 figs. Shear-vee type joint for bronze-welding cast-iron pipe develops practically full strength of pipe.

An Improved Joint Design for Bronze-Welded Cast Iron Pipe, T. W. Greene and F. G. Outcault. Gas Age-Rec., vol. 60. no. 20, Nov. 12, 1927, pp. 741-742, 4 figs. Average results of tests indicate that strength of bronze collar joint is only about 55 per cent of strength of pipe.

PNEUMATIC TOOLS

RIVETING AND DRILLING. Pneumatic Tools for Riveting, Drilling and Other Operations. Iron Age, vol. 120, no. 23, Dec. 8, 1927, p. 1596, 1 fig. Semi-portable radial pneumatic general-purpose tool of Guardian Products Co., Cleveland, consists of frame that swings on wall bracket, air-operated mechanism and pneumatic hammer that is clamped to two arms that form outer end of frame.

USES OF. Some New Uses for Pneumatic Tools, A. P. Darcel. Can. Engr., vol. 53, no. 22, Nov. 29, 1927, pp. 569-572, 5 figs. Brief survey of air tools used in timber construction work; records of performance; labour-saving features; where air tools are used; use of tools on dock construction at Wolfe's Cove, P.Q.

POLES

STEEL-CONCRETE. Fabricated Pole Requires No Skilled Labour. Elec. World, vol. 90, no. 22, Nov. 26, 1927, p. 1085. Steel-concrete poles for transmission lines have been developed for use in Australia in endeavour to produce pole that is strong, cheap and readily assembled; they consist essentially of two standard rolled steel channel sections, which form basis for pole construction and may be shipped in quantities to field and when bolted together filled with mixture of concrete, stone and sand.

PRODUCER GAS

BOILER FIRING. The Application of Producer Gas Firing to Waste-Heat Boilers, C. F. W. Rendle. Gas World, vol. 87, no. 2258, Nov. 12, 1927, pp. 450-457 and (discussion) 457-458, 7 figs. Describes new plant working on such lines which has been installed at Redditch; reasoning which led to adoption of boiler dealing jointly with flue gases from retort settings and products from combustion of producer gas made in separate producer. See also Gas Jl., vol. 180, no. 3365, Nov. 16, 1927, pp. 451-457, 8 figs.

PULLEYS

COMPRESSED SPRUCE. Compressed Spruce Pulleys and Gears. Chem. & Met. Eng., vol. 34, no. 12, Dec. 1927, p. 766, 2 figs. Laminated spruce blocks are being used in manufacture of wide variety of sizes of gears and pulleys.

PULVERIZED COAL

CENTRAL STATIONS. Pulverized Fuel Plants, L. C. Harvey. World Power, vol. 8, no. 47, Nov. 1927, pp. 262-270, 12 figs. Economic possibilities of pulverized fuel for power-house applications lie not alone with central system, but with recently developed self-contained unit system; for superpower-station purposes, central system is advocated, but for lesser power station examples are cited in evidence of advance made with unit pulverized equipment; progress has been due to reduction in equipment cost, cost of maintenance of mill parts, power consumption and by introduction of turbulent mixing of fuel and air supplies.

MARINE BOILERS. Pulverized Coal Tests of Marine Watertube Boiler, T. B. Stillman. Mar. Eng. & Shipg. Age, vol. 32, no. 12, Dec. 1927, pp. 669-675, 12 figs. Results of tests with standard Babcock and Wilcox watertube boiler show that pulverized coal can be burned efficiently at high rates of combustion; directly comparable tests using oil, pulverized coal and hand-fired coal were made on this same boiler; efficiency curve of these three methods of firing are shown.

PULVERIZERS. The Rema Pulverizing Mill. Eng. & Boiler House Rev., vol. 41, no. 5, Nov. 1927, p. 239, 2 figs. Low-speed pulverizing mill embodies free-running grinding ring made of manganese or other very hard steel, inside which three specially hard crushers revolve, top crusher being mounted on driving shaft and forms driver.

TURBULENT BURNERS FOR. Turbulent Burners for Pulverized Coal, S. C. Martin. Power Plant Eng., vol. 31, no. 22, Nov. 15, 1927, pp. 1181-1185, 12 figs. To secure proper mixture of pulverized coal and combustion air and to shorten flame travel, thus decreasing furnace volume, various types of burners have been developed.

PUMPING STATIONS

STANDBY UNITS. Standby Units for Pumping Stations, R. C. Dennett and G. L. Swan. Can. Engr., vol. 53, no. 22, Nov. 22, 1927, pp. 547-549. Reliability features of electrically-operated pumping stations; storage tanks, steam pumps, internal combustion engines and electric motors are some of units. Paper presented to New England Water Wks. Assn.

PUMPS

AIR-JET LIFT. The Air-Jet Lift, S. C. Martin. Indus. & Eng. Chem., vol. 19, no. 12, Dec. 1927, pp. 1346-1348, 4 figs. Device comprises arrangement of piping and valves connected by foot piece which constitutes pump proper, together with compressed-air supply pipe and eductor or discharge pipe; equipment required for operation of lift consists of compressor, air receiver, necessary pipe lines and discharge piece or fitting.

R

RADIATORS

TESTING. Proposed Methods for Testing Radiators, F. C. Haughton and S. R. Lewis. Am. Soc. Heat. & Vent. Engrs.—Jl., vol. 33, no. 12, Dec. 1927, pp. 697-706, 1 fig. Defines radiators, castings, relation of radiator room and occupant and describes ideal and practical test room with methods of testing.

RADIOTELEGRAPHY

ANTENNAS. Directional Radiation with Horizontal Antennas, A. Meissner. Inst. Radio Engrs.—Proc., vol. 15, no. 11, Nov. 1927, pp. 928-934, 7 figs. Attempt was made to concentrate radiation energy by combining several antennas.

RADIOTELEPHONY

AMPLIFIERS. A Compact Direct-Current Amplifier, H. C. Curl. Bell Laboratories Rec., vol. 5, no. 2, Oct. 1927, pp. 46-48. 6031-A amplifier made by West. Elec. Co.

RECEIVERS. The Power Supply of Wireless Sets. Elec. Rev., vol. 101, no. 2608, Nov. 18, 1927, pp. 856-857, 1 fig. "Batteryless" receiver; experience of engineer who constructed a set which incorporates three thermionic valves with indirectly heated filaments.

RAILS

TRANSVERSE FISSURES. Transverse Fissure Still a Mystery. Iron Age, vol. 120, no. 21, Nov. 24, 1927, p. 1435. There is no inherent reason for attaching responsibility for display of transverse fissures in rails to manufacturing conditions, either in making or rolling of steel, according to conclusions reached by Bur. of Safety, Interstate Commerce Commission, on basis of investigations it has conducted.

RAILWAY MOTOR CARS

DIESEL-ELECTRIC. The First All-American Diesel Rail Car. Oil Engine Power, vol. 5, no. 12, Dec. 1927, pp. 839-855, 13 figs. Description of Foos Diesel replacing old gasoline engine; also electric drive and its advantages; after month of operation on run between Monticello and Calmar, Iowa, indications are that on 200-mile trip per day there will be saving of from $3,500 per year for fuel alone.

STEAM. Rail Car Driven by Steam. Ry. Mech. Engr., vol. 101, no. 12, Dec. 1927, pp. 768-771. International Harvester high-pressure power plant, also adaptable to switch-engine drive, is distillate-burning, direct mechanical-drive unit designed to be noiseless, smokeless and easy riding, with ample power for hauling additional trailer tonnage; known as "Locomotor"; but one operator is required; passenger-baggage car 73 ft. long for 63 passengers. See also Fuel Oil, vol. 6, no. 6, Dec. 1927, pp. 54 and 56, 1 fig.

STREET-RAILWAY SERVICE. Mexican Street Cars Are Powered with Automobile Motors, T. Croft. Elec. Ry. Jl., vol. 70, no. 21, Nov. 19, 1927, pp. 933-935. In Merida, Yucatan, cars are all driven by standard Ford automobile engines; standard Ford parts are used wherever feasible; Ford gasoline tank is installed either horizontally under car seat or vertically in vestibule.

RAILWAY OPERATION

TRAIN CONTROL. Train Control Equipment on the C. & O. Ry. Elec. Engr., vol. 18, no. 11, Nov. 1927, pp. 373-379, 2 figs. Intermittent inductive type used on greater portion of line; testing device and methods for checking operation of apparatus.

RAILWAY SIGNALLING

AUTOMATIC. Buffalo, Rochester & Pittsburgh Has High Standard of Signal Maintenance. Ry. Signalling, vol. 20, no. 12, Dec. 1927, pp. 463-468. Signals are G.R.S. Model 2A, top-post mechanism except for distance of 24.91 mi., where Model 2A a.c. signals are in use; signals have been in service about 14 years; explanation of methods followed in signal department maintenance programme.

AUTOMATIC BLOCK. Colour-Light Automatic Block Signals Installed on the New York Central. Ry. Signalling, vol. 20, no. 12, Dec. 1927, pp. 451-455. Line control employed with centre-fed track circuits; special switch relays used to eliminate necessity of carrying line wires through switch boxes; equips West Shore line on section of West Shore from Selkirk, N.Y., to Utica and from Syracuse west to Buffalo.

RECTIFIERS

CUPROUS-OXIDE. Cuprous-Oxide Rectifier for Alternating Current. Engineering, vol. 124, no. 3226, Nov. 11, 1927, pp. 615-616, 6 figs. Consists essentially of disk of copper, on one face of which a layer of cuprous oxide has been formed at high temperature; it has been found that plate of this kind is unsymmetrical conductor of electricity; that is, resistance to passage of current in direction from oxide to copper to passage of current in opposite direction is in ratio of about 1:1,000 or even higher.

METAL. Westinghouse Metal Rectifiers. Elec. Times, vol. 82, no. 1883, Nov. 24, 1927, pp. 667-668, 4 figs. It has no contacts, moving parts or other features requiring maintenance; it is electronic device depending for its operation on electronic action at permanent junction between copper and copper oxide.

RAILWAY YARDS

CAR-REPAIR TRACKS. Modern Car Repair Tracks. Ry. Mech. Engr., vol. 101, no. 12, Dec. 1927, pp. 789-791. Central of New Jersey improves facilities at its Penobscot classification yard; Ashley planes unique feature in railroad operation; short time in which cars containing rush shipments can be repaired and returned to service is one of features in operation of repair tracks.

CAR RETARDERS. Modern Yard Operation, W. B. Rudd. Can. Ry. Club—Official Proc., vol. 26, no. 7, Oct. 1927, pp. 21-29. Points out advantages of car retarder for hump-yard operation.

RELAYS

OVERLOAD. Thermal Overload Relays. Power Engr., vol. 22, no. 261, Dec. 1927, pp. 446-447, 1 fig. Notes on protective devices for motors, based on thermal rather than electromagnetic principles; thermal overload relay is one of most pronounced advancements recently made for protecting motors in industrial service.

RESEARCH

FUNCTIONS. The Functions of Research, C. F. Kettering. Indus. & Eng. Chem., vol. 19, no. 11, Nov. 1927, pp. 1212-1216. Interpretation of science to public; one great function of research is determination of facts in terms of commercialism; translation of technical details into results; research organization.

PROFITABLE RESULTS FROM. Research—Source of New Profits, L. A. Hawkins. Factory, vol. 39, no. 5, Nov. 1927, pp. 796-799. Engineer of Research Laboratory of Gen. Elec. Co., Schenectady, gives numerous examples of benefits accruing from research; result of research competently carried on is often new product; two things are needed to make research laboratory successful; competent director, and adequate support from management; best results are attained with close co-operation, but complete independence of responsibility.

SCIENTIFIC. Specialization and Co-operation in Scientific Research, K. T. Compton. Science, vol. 66, no. 1715, Nov. 11, 1927, pp. 435-442. Suggests accomplishments and opportunities of research and indicates directions in which to bring about even more fruitful service of science to society in future.

RESERVOIRS

CONCRETE. Movable Forms Used in Construction of Concrete Reservoirs, E. F Rockwood. Boston Soc. Civ. Engrs.—Jl., vol. 14, no. 9, Nov. 1927, pp. 502-504, 2 figs. Wall and roof forms used in construction of covered reservoir on Neutaconkanut Hill and covered reservoir at Longview.

MERCIER RIVER, CANADA. The Mercier Reservoir on the Gatineau River. Contract Rec., vol. 41, no. 47, Nov. 23, 1927, pp. 1182-1185, 10 figs. Storage area created for benefit of power plants at Chelsea, Farmers and Paugan; features of project of impounding 95 billion cu. ft. of water in one lake by 10 dams; lake surface, 64,000 acres.

RIVETS

TENSILE STRESSES. Tensile Working Stress for Rivets, C. R. Young. Can. Engr., vol. 53, no. 18, Nov. 1, 1927, pp. 505-512, 12 figs. Results of tests conducted at Univ. of Toronto and other researches. Paper presented at Am. Inst. of Steel Construction.

WORKING STRESS. Tensile Working Stress for Rivets, C. R. Young. Can. Machy., vol. 38, no. 19, Nov. 10, 1927, pp. 34-37, 12 figs. Author emphasizes that determination of proper working stress for rivets is matter demanding serious consideration. Paper presented at Am. Inst. of Steel Construction.

ROADS

ASPHALTIC OIL SURFACES. Preserving Road Investment by Asphalt Surfacing. Eng. News-Rec., vol. 99, no. 23, Dec. 8, 1927, pp. 923-925. Growing field for bituminous secondary-type roads and for utilizing old surfacing as bases for asphaltic surfacing, discussed by Asphalt Road Conference; it has been found that rigid pavements nearing end of their service life can be preserved and made component part of new pavement by asphalt surfacing. Reviews four papers, as follows: Dimensions of America's Public Roads Undertaking, T. H. MacDonald; Gravel and Stone Bases for Asphalt Wearing Courses, K. N. Seymour; Cost and Service of Asphalt Surfacing on Low Cost Roads, C. N. Conner; Asphalt Surfaces for Reclaiming Concrete Roads, V. L. Ostrander.

CORRUGATIONS. Rhythmic Corrugations in Highways. State College of Wash. Eng. Bul., vol. 19, no. 9, Feb. 1927, 29 pp., 15 figs. Results of studies based on experiments carried out with oscillographic recorder in tonneau of car which gives record of variation in distance between rear axle and body while going over "washboards" and various other obstructions; tests show that rear axle frequently vibrates through vertical amplitudes many times greater than depth of corrugations; laboratory model of rear end of automobile was built; curves taken show relationship in time between rear axle and road surface and that at certain speeds greatest pressure of tire on road comes in trough of corrugation.

ROADS, EARTH

SURFACE TREATMENT. Surface Treatment of Topsoil Roads, J. T. Pauls. Pub. Roads, vol. 8, no. 9, Nov. 1927, pp. 191-202, 16 figs. Exposition of materials and methods to be used in surfacing top soil roads in South Carolina; experiments on 8 miles of road in Anderson county.

ROADS, GRAVEL

OILING. "Turnover" Method of Road Oiling. Pub. Wks., vol. 58, no. 10, Oct. 1927, pp. 377-381. California Highway Dept. has developed method of applying asphaltic oil to gravel road surfaces which has been given name of "turnover" method, and which is considered to produce excellent road at low cost. See also description, by E. B. Bail, in Roads & Streets, vol. 67, no. 10, Oct. 1927, pp. 429-432.

ROADS, MACADAM

CONSTRUCTION. Roads and Road Construction, J. A. Ryan. Instn. Civil Engrs. of Ireland—Trans., vol. 52, 1927, pp. 68-82. Water and tar-bound macadam; Trinidad asphalt macadam; bitumen-grouted roadway; cement-grouted macadam.

ROLLING MILLS

BLOOMING MILLS. Reversing-Blooming-Mill Practice, G. A. Russell. Mech. Eng., vol. 49, no. 12, Dec. 1927, pp. 1331-1334. Résumé of current practice, dealing with cogging, draughting practice, driving main rolls, reversing steam engines and motor drives, mill-train design, etc.

CALCULATIONS. Rolling Mill Calculations, J. D. Keller. Iron & Steel World, vol. 1, nos. 1, 2, 3, 4 and 5, Feb., Mar., Apr., May and June, 1927, pp. 37-42, 127-130, 199-200, 271-276 and 343-346, 20 figs. Analysis of stresses in 44-in. blooming mill for determining constants for use in design of new mills. Feb.: Gripping or biting of steel by rolls; stresses in rolls. Mar.: Maximum bearing pressure on roll necks; stresses in housings, screws and screw box. Apr.: Torsional strength of spindles and wobbler; stresses in pinions. May: Means to prevent overheating of motors. June: Time in mill approximately equals time on tables.

ELECTRIC DRIVE. Cold Rolling Mill of Recent Design, E. W. Duston. Blast Furnace & Steel Plant, vol. 15, no. 11, Nov. 1927, p. 551, 1 fig. Special design of electrically driven mill of six units which offers several distinct advantages, especially in manufacture of bolts and nuts.

Main Drives 10" Merchant Mill at McKinney Steel Company, A. F. Kenyon. Iron & Steel Engr., vol. 4, no. 11, Nov. 1927, pp. 455-457, 7 figs. Mill has roughing train driven by 1,000-h.p., 200/600-r.p.m. motor, intermediate train driven by 2,000-h.p., 137/275-r.p.m. motor and four finishing stands driven by 1,200-h.p. 300/550-r.p.m. motor.

ROPE DRIVE

CALCULATIONS FOR. Rope Transmission, L. T. Rutledge. Can. Machy., vol. 38, no. 23, Dec. 8, 1927, pp. 15-16. American or continuous drive; English or multiple-rope drive.

S

SAND, MOULDING

CONTROL. Practical Moulding Sand Control, N. D. Ridsdale. Foundry Trade Jl., vol. 37, no. 585, Nov. 3, 1927, pp. 79-82, 9 figs. Deals mainly with green sands such as are used for iron and brass founding, and indicates nature and value of small-scale tests both within and without laboratory for assisting practical moulder to use his sands to best advantage.

SEWAGE

CHLORINATION. Recent Developments in Sewage Chlorination. Pub. Works, vol. 58, no. 12, Dec. 1927, pp. 465-468. Effects and advantages, determination of amount required and point of application to secure best results.

SEWAGE DISPOSAL

ACTIVATED SLUDGE. Activated Sludge Digestion Characteristics, G. M. Fair and C. L. Carlson. Boston Soc. Civ. Engrs.—Jl., vol. 14, no. 9, Nov. 1927, pp. 487-494, 2 figs. Reports on certain experiments that were undertaken with view of determining digestion characteristics of activated sludge that might be manifested under different conditions of digestion; experiments discussed are results of digestion under six different conditions being given for purposes of comparison.

AERATION. Note on the Aeration of Water, G. J. Fowler and S. N. Chatterjee. Surveyor (Lond.), vol. 72, no. 1855, Aug. 12, 1927, p. 139. 1 fig. Results recorded show clearly truth of contention expressed by C. H. Hurd in Eng. News-Rec., Aug. 16, 1923, p. 248, that advantage of air circulation over mechanical agitation lies in fact that with equal opportunity for economy due to surface absorption of oxygen, there is assurance of always having sufficient quantity of entrained air to give positive oxidation throughout sewage mass. See also Eng. News-Rec., vol. 99, no. 23, Dec. 8, 1927, p. 922, 1 fig.

MIXING CHANNELS. Design of Mixing Channel Having Small Loss of Head, G. N. Cox. Pub. Works, vol. 58, no. 11, Nov. 1927, pp. 426-428, 3 figs. Experiments to determine type of baffled channel giving most thorough mixing with least loss of head.

PUMPING STATIONS. Future Pumping Station Used for Sewage Treatment, H. Burdett. Pub. Wks., vol. 58, no. 10, Oct. 1927, pp. 373-374, 1 fig. Plant designed for treatment by sedimentation and chlorination provides for present necessities, but when desirable can be converted in sewage pumping station serving six times area.

SCREENING. Digestion of Sewage Screenings, H. Heukelekian. Pub. Wks., vol. 58, no. 12, Dec. 1927, pp. 455-457, 3 figs. Digestion of screenings from fine screen, seeded with ripe sludge, was tried out with and without fresh solids; frequent gas measurements and occasional gas analyses were made; results indicate that digestion of screenings, either separately or in conjunction with fresh solids, is feasible.

TREATMENT PLANTS. Operating Sewage Treatment Plants. Pub. Works, vol. 58, no. 1, Nov. 1927, pp. 431-432. Reasons for unsatisfactory results; suggested operating details for septic and Imhoff tanks, sprinkling filters, contact filters and sand beds.

Two Years' Operation of the Sewage Treatment Plant at Worchester, Mass., R. S. Lanphear. Boston Soc. Civil Engrs.—Jl., vol. 14, no. 8, Oct. 1927, pp. 450-460. Plant consists of two grit chambers, each having a bar screen at outlet end, twelve double Imhoff tanks, four pairs of dosing tanks, 13.68 acres of trickling filters and four final settling basing; designed to care for daily average flow of 28 million gallons of sewage, or estimated population of 242,000 in 1934.

SEWER CONSTRUCTION

SWAMPS. Laying Water-Tight Sewer in Swamp, J. O. Miller. Pub. Wks., vol. 58, no. 10, Oct. 1927, pp. 372-373. Sewer laid in cradles through swamp; asphaltic jointing material used; methods of handling pipe and making joints.

SEWERS

INFILTRATION INTO. Infiltration Into Sewers. Pub. Wks., vol. 58, no. 10, Oct. 1927, pp. 363-366, 1 fig. Reports from large number of engineers from all parts of country describing their experiences and observations.

SHEARS

SHEET MATERIAL. Capacity of Sheet Shear Increased, P. J. Edmonds. Forging—Stamping—Heat Treating, vol. 13, no. 11, Nov. 1927, p. 443. By addition of mechanical contrivance output of shear is raised to 30 tons daily; sheet steel sheared.

SMOKE

ABATEMENT. The Gas Industry's Contribution to Smoke Abatement, F. W. Goodenough. Gas World, vol. 87, no. 2259, Nov. 19, 1927, pp. 484-488. General conclusion is that while gas industry has already materially reduced industrial smoke there is every prospect of great and early extension of this process through far more widespread use of gas; ultimate aim for great majority of industrial purposes must be elimination of solid fuel altogether. Abstract of paper presented to Public Works, Roads and Transport Congress. See also Gas Jl., vol. 180, no. 3365, Nov. 16, 1927, pp. 465-469.

SNOW REMOVAL

METHODS AND EQUIPMENT. Snow Removal and Snow Problems, H. G. McKelvey. Highway Engr. & Contractor, vol. 17, no. 5, Nov. 1927, pp. 28-32. Snow fence; effect of trees; programmes for winter miantenance; equipment for snow removal; operating costs; handling deep drifts.

NORTH DAKOTA. Snow Handling in North Dakota. Pub. Works, vol. 58, no. 12, Dec. 1927, pp. 454-455. Snow prevention more effective than removal; four prevention methods; experience in different parts of state led to certain conclusions which are given.

STEAM ENGINES

BLEEDING. Bleeding Steam Engines (Le soutirage dans le fonctionnement des machines à vapeur), H. Tripier. Chaleur & Industrie, vol. 8, no. 91, Nov. 1927, pp. 625-635, 14 figs. Theoretical foundations of increasing thermodynamic efficiency by single or multiple bleeding.

HIGH-PRESSURE. The Application of High-Pressure to the Reciprocating Marine Steam Engine, S. G. Visker. Shipbldg. & Shipg. Rec., vol. 30, no. 21, Nov. 24, 1927, pp. 583-587, 4 figs. Conversion of machinery of steamer "Borneo" from ordinary triple-expansion installation working with superheated steam of 180-lb. pressure into high-pressure one of 500 lb.

STEAM PIPES

RISERS. Engineers and Contractors Agree on Steam Riser Capacities. Heat. & Vent. Mag., vol. 24, no. 11, Nov. 1927, pp. 61-65 and 87, 6 figs. Critical velocities obtained in research laboratory tests offer basis for figuring capacities of upfeed risers for one- and two-pipe systems.

STEAM POWER PLANTS

HIGH-PRESSURE. 12-lb. Turbine Shows 80 Per Cent Efficiency. Power Plant Eng., Paper Industry, vol. 9, no. 8, Nov. 1927, pp. 1323-1331, 6 figs. Productive capacity increased and great savings effected by reconstruction of plant.

STEAM TURBINES

HIGH-PRESSURE. 12-Lb. Turbine Shows 80 Per Cent Efficiency. Power Plant Eng., vol. 31, no. 22, Nov. 15, 1927, pp. 1186-1188, 3 figs. 7,000-kw. unit is 10 per cent more efficient than 300-lb. equipment with which it operates, of which there is installed capacity of 160,000-kw.; turbine improves station economy 3 per cent.

MANUFACTURE AND TESTING. The Manufacture and Testing of Steam Turbines in the Brown-Boveri Works. Mech. World, vol. 82, no. 2132, Nov. 11, 1927, pp. 365-366, 2 figs. Firm has developed a number of special devices and processes of great interest, which have been incorporated in normal manufacturing system; testing and treatment of materials receive special attention; investigations into vibration of disks.

MARINE. Installation of Dummy Piston and Cylinder in Main High Pressure Turbine of U.S.S. Leviathan, H. J. Reuse. Am. Soc. Naval Engrs.—Jl., vol. 39, no. 4, Nov. 1927, pp. 624-635, 9 figs. Installation of new piston and cylinder has resulted in more even distribution of load on four shafts and marked increase in fuel economy.

STEEL

FRACTURE. The Cause of Cup-Shaped Fractures in Tensile Test Pieces, Fremont. Int. Ry. Congress Assn.—Bul., vol. 9, no. 10, Oct. 1927, pp. 821-828, 48 figs. Phenomenon of deformation makes it clear that beginning of breakage of test piece takes place at centre after which it continues by peripheral tearing following interior curve of crescent section ring; complete or partial collar is due to striction of metal in groove, which in drawing down, by opposing any local extension, makes crescent section ring at bottom of groove more ductile. Translated from Génie Civil.

HIGH TEMPERATURES, EFFECT OF. Properties of Materials at High Temperatures, H. J. Tapsell and W. J. Clenshaw. Eng. Research—Special Report, no. 2, July 1927, 16 pp., 8 figs. Mechanical properties of 0.51 per cent carbon steel and 0.53 per cent carbon cast steel. See abstract in Metallurgist (Supp. to Engineer), Nov. 25, 1927, pp. 172-174.

MANGANESE. *See Manganese Steel.*

TESTING. Notes on the Spark Testing of Steel, G. M. Enos. Am. Soc. Steel Treating—Trans., vol. 12, no. 6, Dec. 1927, pp. 976-981. Sparks given off when ferrous materials are touched to rapidly revolving grinding wheel are characteristic of composition and type of iron or steel in question; author describes technique of making such test and spark characteristics typical of selected group of irons and steels.

STEEL CASTINGS

CUTTING. Cutting of Stainless Steel Castings, C. J. Holslag. Welding Engr., vol. 12, no. 10, Oct. 1927, p. 48, 1 fig. In general, as to electric welding, d.c. is best with copper-base rustless alloys and a.c. for chrome- and nickel-base alloys. See also Machy. (N.Y.), vol. 34, no. 4, Dec. 1927, p. 289.

FOUNDRY PRACTICE. Steel Foundry Practice, A. D. Kirby. Foundry Trade Jl., vol. 37, no. 588, Nov. 24, 1927, pp. 144-146, 1 fig. Deals with sands used; method of moulding and manufacture of steel; methods of strickle work.

MANUFACTURE. Steel Making, with Special Reference to the Manufacture of Steel Castings, J. Deschamps. Foundry Trade Jl., vol. 37, no. 587, Nov. 17, 1927, pp. 125-127. Describes various processes used at present in steel foundries for production of plain carbon steels and discusses their respective merits and disadvantages. See discussion in Foundry Trade Jl., vol. 37, no. 588, Nov. 24, 1927, pp. 141-142.

STEEL, HEAT TREATMENT OF

HARDENING. Electrifying the Hardening Room. Iron Age, vol. 120, no. 23, Dec. 8, 1927, pp. 1584-1586. 100 per cent electric heat treatment of steel practised in some plants; economic and other advantages brought out at Yale Conference, New Haven, Conn.; Pratt & Whitney hardening-room equipment; production costs reduced by electricity.

The Water Hardening of Tool Steels, A. Mumper. Forging—Stamping—Heat Treating, vol. 13, no. 11, Nov. 1927, pp. 444-446, 3 figs. Author's experiences in handling steel of various descriptions; suggestions for improving practice.

STEEL WORKS

POWER GENERATION IN. Power Generation in the Steel Industry, G. Fox. Power, vol. 66, no. 22, Nov. 29, 1927, pp. 819-822, 3 figs. Heat balance in American type of steel plant and total by-product heat available to meet demands; electric power system in steel plant can be made effective pool for by-product fuel utilization only if there is sufficient load at all times to absorb power resulting from fuels not feasible of storage, notably from blast-furnace gas.

STREAM POLLUTION

INDUSTRIAL WASTES AND. Industrial Wastes, a Forward View of Their Disposal, A. E. Fales. Factory, vol. 39, no. 5, Nov. 1927, pp. 810-811, 9 figs. Liquid wastes are generally discharged into near-by streams from industries and result in serious pollution; public opinion is becoming more insistent on abatement of such pollution.

STRESSES

WIRE MODEL ANALYSIS. Brass Wire Models Used to Solve Indeterminate Structures, A. Bull. Eng. News-Rec., vol. 99, no. 23, Dec. 8, 1927, pp. 920-922, 5 figs. Calibrated stock of wire facilitates easy and cheap preparation of models; deflections measured with ordinary scale; brass calibrated wire used in place of cardboard celluloid sheet on tempered steel splines; mechanical method of stress analysis devised by G. E. Beggs, of Princeton Univ.

STRUCTURAL STEEL

CONCRETE VS. Steel and Concrete Engineering, R. Modjeski. Can. Engr., vol. 53, no. 22, Nov. 29, 1927, pp. 573-574. Relative merits of steel and reinforced concrete construction. Paper presented before Am. Inst. Steel Construction.

CONSTRUCTION DEVELOPMENTS. Steel Construction Developments in 1927, L. H. Miller. Can. Machy., vol. 38, no. 22, Dec. 1, 1927, pp. 27-29. Outlines progress in fireproofing of structural steel; welding to replace riveting; study of wind stresses; and standardization of light steel floor construction.

SUBSTATIONS

AUTOMATIC. Automatic Mercury Arc Rectifier, G. Rogers. Elec. Times, vol. 72, no. 1881, Nov. 10, 1927, pp. 588-590, 4 figs. Examples of recent automatic substation plant.

OUTDOOR. Modern Outdoor Stations of High Voltage, P. G. Groodinsky and J. M. Ioffiev. Electritchestvo, no. 10, 1927, pp. 334-342, 22 figs. Historical review of development; plans and description of operating stations in Russia and projects of new substations for Moscow.

PORTABLE. 1,000-Kw. Complete Automatic Portable Substation for B.C.E.R. Company. Elec. News, vol. 26, no. 22, Nov. 15, 1927, p. 25. Can substitute for full automatic stationary substation supplying either 11,500 volts a.c. or 600 volts d.c., operates on load demand, has service-restoring feeders and is fully protected.

SURVEYING

QUANTITY. Quantity Surveying and the Architect, C. L. Weeks. Can. Engr., vol. 53, no. 20, Nov. 15, 1927, pp. 529-530. Presentation of principles of quantity surveying to owner with assistance of architect. Paper presented at Am. Inst. Quantity Surveyors.

T

TAPS

DESIGN. Design and Construction of Taps, A. L. Valentine. Machy. (N.Y.), vol. 33, nos. 8, 9, 10, 11, 12, and vol. 34, nos. 1 and 4, Apr., May, June, July, Aug., Sept. and Dec. 1927, pp. 561-565, 648-652, 767-770, 835-839, 910-914, 57-61 and 284-286, 23 figs. With special reference to taps having ground threads. See also Machy. (Lond.), vol. 30, nos. 771 and 778, July 21 and Sept. 8, 1927, pp. 489-493 and 705-709, 9 figs.

TELEGRAPHY

PRINTING TELEGRAPHS. Printing Telegraphs on Non-Loaded Ocean Cables, H. Angel. Am. Inst. Elec. Engrs.—Jl., vol. 46, no. 12, Dec. 1927, pp. 1381-1389, 13 figs. Improvements in apparatus and operation; telegraph codes, relation to speed and applicability to printer operation; transmission methods, shaping of signals, variable lag and effect of earth currents; manual, semi-automatic and full automatic operation of long ocean cables; regenerative repeaters; operation of printers.

TELEPHONY

COMBINED LINE AND RECORDING. Combine Line and Recording Method, S. B. Cousins. Telephony, vol. 93, no. 21, Nov. 19, 1927, pp. 27-28. Method contemplates recording call and establishing connection immediately while subscriber remains at telephone; this method eliminates special recording team, combining outward and recording work at line positions.

TEXTILE MILLS

TRANSPORT SYSTEM. Selecting a Plant Transport System, A. H. Church. Indus. Mgmt. (N.Y.), vol. 74, no. 6, Dec. 1927, pp. 368-371. Advantages of runways and ramps, served by tractors with trailers, elevating trucks, etc., in textile plant; system described not only facilitates transport within plant, but " ties in " conveniently with storage of goods, in process or finished.

TIME STUDY

NEGLECTED VALUES. Neglected Values of Time-Study, J. C. Mottashed. Soc. Automotive Engrs.—Jl., vol. 21, no. 6, Dec. 1927, pp. 691-692. Time study should touch organization at many points; author discusses some neglected points of contact.

RATE SETTING. Time Study for Rate Setting, E. C. Van Orsdell. Indus. Mgmt. (N.Y.), vol. 74, no. 6, Dec. 1927, pp. 330-333. Team work by foremen and operatives essential to success.

TRACTORS

TRAILERS. Tractor-Trailer Express-Transfer Operation, M. T. Hanrahan. Soc. Automotive Engrs.—Jl., vol. 21, no. 6, Dec. 1927, pp. 678-679. Transport of solid loads of express between various railroad terminals in Chicago by eliminating waiting time of both power plant and chauffeur, fleet of tractors and semi-trailers has proved to be prompt, economical and satisfying for this work.

TRANSFORMERS

CHARACTERISTICS. Characteristics Govern Transformer Choice, D. R. Dalzell. Indus. Eng., vol. 85, no. 11, Nov. 1927, pp. 513-516, 4 figs. In selection of transformers for industrial installation it is advisable for operator to obtain benefit of central stations' experience with this class of apparatus; certain characteristics must be definitely established for manufacturer to fill order at minimum expense; many characteristics are set forth.

RATIO CONTROL FOR INTERCONNECTED SYSTEMS. Characteristics of Interconnected Power Systems as Affected by Transformer Ratio Control, L. F. Blume. Am. Inst. Elec. Engrs.—Jl., vol. 46, no. 12, Dec. 1927, pp. 1365-1372, 13 figs. Operation of systems, in which constant voltage is maintained by varying generator fields, compared with operation when in addition transformers equipped with ratio control are used; comparison with synchronous condensers for improving regulation; conditions governing current distribution in transmission line loop.

SHORT-CIRCUIT EFFECTS. Short-Circuit Effects Upon Current Transformers, G. L. E. Metz. Elec. Rev., vol. 101, no. 2609, Nov. 25, 1927, 892-894, 3 figs. Author suggests that time has come when current transformers, like oil circuit breakers, should be designed for definite short-circuit ratings, and gives suggestions to that end.

TUNNELS

VEHICULAR. Holland Tunnel Between New York and New Jersey Opened—November 12. Am. Soc. Heat. & Vent. Engrs.—Jl., vol. 33, no. 12, Dec. 1927, pp. 726-734, 8 figs. Gives details and dimensions; ventilation, lighting, lining and fire-fighting equipment.

VENTILATION. Ventilation Experiments in the Moffat Tunnel, G. E. McElroy and C. A. Betts. Eng. News-Rec., vol. 99, no. 24, Dec. 15, 1927, pp. 956-959, 4 figs. Determination of air-flow friction factors as basis for design of plant for removing gas and smoke discharged by locomotives.

TUNNELLING

CLAY TUNNEL. Driving 2,000-Ft. Clay Tunnel, C. Christianson. Eng. & Contracting, vol. 66, no. 10, Oct. 1927, pp. 471-472. Use of portable air compressors and compressed-air tools.

PLASTIC CLAY. Tunnelling Methods in Plastic Clay at Detroit. Eng. News-Rec., vol. 99, no. 24, Dec. 15, 1927, pp. 948-954, 12 figs. Tests of half-diameter concrete and brick rings determine lining design for 10-mile tunnel; contract conditions, construction methods and plant.

V

VACUUM TUBES

AMPLIFIERS. On the Values and the Effects of Stray Capacities in Resistance—Coupled Amplifiers, M. von Ardnenne and W. Stoff. Inst. Radio Engrs.—Proc., vol. 15, no. 11, Nov. 1927, pp. 895-901, 4 figs. General theory of stray capacities is developed with due consideration to phase conditions mentioned, and values and effects of stray capacities are discussed for 3-stage amplifier of practical dimensions.

OSCILLATORS. The Short Wave Limit of Vacuum Tube Oscillators, C. R. Englund. Inst. Radio Engrs. Proc., vol. 15, no. 11, Nov. 1927, pp. 914-927, 17 figs. Investigation has indicated that physical limits for ordinary commercial tubes lie between 3.5 and 1.5 m., depending on type of tube used. Bibliography of short-wave vacuum-tube oscillator work is attached.

THERMIONIC VALVES. The Performance of Valves in Parallel, R. P. G. Denman. Experimental Wireless, vol. 4, no. 50, Nov. 1927, pp. 669-674, 6 figs. Examines general case of number of valves operating in parallel on common load, in order to judge extent of losses which are liable to occur in practice, and decide how far it may be necessary or possible to redress balance by means of separate grid bias, etc., for individual valves.

VENTILATION

SCHOOLS. School Ventilation Studies in Toronto, R. F. Heath and J. S. Patterson. Am. Soc. Heat. & Vent. Engrs.—Jl., vol. 33, no. 12, Dec. 1927, pp. 715-725, 3 figs. Alexander Muir school in Toronto; observations on temperature, humidity and air velocity in inlets and outlets.

VOLTMETERS

SPHERE-GAP. The Relation Between Frequency and Spark-Over Voltage in a Sphere-Gap Voltmeter, L. E. Reukema. Am. Inst. Elec. Engrs.—Jl., vol. 46, no. 12, Dec. 1927, pp. 1314-1321, 4 figs. Test of sphere-gap as possible standard for measuring peak values of voltage at high frequencies; experimental data and calibration curves for sphere-gap voltmeter plotted for frequencies from 28,000 to 425,000 cycles per sec.; effect of high frequency.

W

WAGES

PIECE RATES VS. BONUS. Piece Rates or Bonus—Which? Factory, vol. 39, no. 5, Nov. 1927, pp. 803-805. Report of vice-president of manufacturing to his board of directors at board's request.

WATER MAINS

RECONSTRUCTION. Reconstruction of Inadequate Water Distribution Systems, C. E. DeLeuw. Am. Water Wks. Assn.—Jl., vol. 18, no. 5, Nov. 1927, pp. 548-556. Writer has prepared plans for improvement of existing systems in three Illinois municipalities: Riverside, Taylorville and Libertyville, which are described.

WATER PIPES

FRICTION IN ELBOWS. The Friction of Water in Elbows, F. E. Giesecke, C. P. Reming and J. W. Knudson, Jr. Domestic Eng. (Chicago), vol. 121, no. 11, Dec. 10, 1927, pp. 30-34 and 66, 5 figs. Results of investigation to determine friction of water in standard 90-deg. elbows. Method of testing.

WATER POWER

MANITOBA. Water Power Resources of Manitoba. Can. Engr., vol. 53, no. 21, Nov. 22, 1927, pp. 553-556, 4 figs. Industrial Development Board of Manitoba issues report dealing with developed and undeveloped water powers in province; over three million horse power available at minimum flow; present turbine installation is 225,800 h.p.; description of more important rivers and head, and power available at more important undeveloped power sites.

WATER SOFTENING

PRACTICE. Water Softening Practice Developments, C. P. Hoover. Can. Engr., vol. 53, no. 20, Nov. 15, 1927, pp. 531-534, 5 figs. Respective merits of various processes employed. Paper presented at Am. Water Wks. Assn.

WATER TREATMENT

CHLORINATION. Chlorination Control in Chicago, A. E. Gorman. Am. City, vol. 37, no. 5, Nov. 1927, pp. 613-621, 9 figs. During last three years there has developed system of chlorination control in Chicago in connection with which many interesting practical problems have been encountered and solved.

PROCESSES. Studies of Efficiency of Water-Purification Processes, H. W. Streeter. Pub. Wks., vol. 58, no. 12, Dec. 1927, pp. 473-474. Undertaken as part of stream pollution investigations of Public Health Service; relationships between bacterial quality of raw water and quality of effluents from purification plants. Report issued as Public Health Bul., no. 172.

WATERWAYS

BULKHEADING. Bulkheading on Inland Waterways in Hollywood, Fla., J. G. Rakowsky. Eng. & Contracting, vol. 66, no. 10, Oct. 1927, p. 452. Gravity masonry wall made of native Ojus rock boulders.

WELDING

MOTOR FRAMES. Welded Steel for Motor Frames, K. F. Rauderbaugh. Iron Age, vol. 120, no. 22, Dec. 1, 1927, pp. 1507-1508 and 1567, 3 figs. History of application to induction motors; findings in costs of material, labour, inventory, toolroom expense and overhead.

OXY-ACETYLENE. *See Oxy-Acetylene Welding.*

PIPE FITTINGS. Templets for Welded Pipe Fittings. Domestic Eng. (Chicago), vol. 121, no. 8, Nov. 19, 1927, pp. 18-20 and 72, 10 figs. Brings up question of pipe patterns or templets and gives suggestions; clements of templet construction; development of pipe surface; templet for 45-degree intersection; metal templets.

PRESSURE VESSELS. Welding Pressure Vessels, T. M. Jasper. Welding Engr., vol. 12, no. 11, Nov. 1927, pp. 35-37, 8 figs. Examples of products in service which show dependability of welding and a few tests to show sort of research work back of these products.

PROTECTIVE GLASSES FOR. Protective Glasses for Gas and Electric Welding, J. W. Forrest. Am. Mach., vol. 67, no. 23, Dec. 8, 1927, pp. 893-894. Recent research has produced glass with ultra-violet absorption to eliminate external effects of short-wave radiation; visible absorption to take away glare and retinal fatigue, and infra-red absorption to prevent retinal or corneal effect; typical specifications for various shades.

STEEL CASTINGS. What Are the Justifiable Uses of Welding in Production of Steel Castings? R. A. Bull. Iron Trade Rev., vol. 81, no. 24, Dec. 15, 1927, pp. 1475-1477 and 1488, 4 figs. Deals with policy on welding adopted by group of electric steel foundries.

WELLS

DEPTH MEASUREMENT. Machine for Measuring the Depths of Deep Wells, C. E. Van Ostrand. Wash. Acad. Sciences—Jl., vol. 17, no. 19, Nov. 19, 1927, pp. 481-487, 4 figs. Apparatus described is intended primarily for use while lowering cable into well.

WHARVES

NEW ORLEANS. Types of Wharves in the Port of New Orleans, S. M. Young. World Ports, vol. 16, no. 1, Nov. 1927, pp. 17-37, 10 figs. Describes old wharves in use prior to 1901, new wharves of wood and of steel, railroad facilities and inner harbour canal. Paper presented before Am. Assn. of Port Authorities.

WIND TUNNELS

STANDARDIZATION TESTS. Standardization Tests in the Wind Tunnel, E. N. Fales. Soc. Automotive Engrs.—Jl., vol. 21, no. 5, Nov. 1927, pp. 497-507, 15 figs. Points out that two defects in technique of wind-tunnel testing have not yet been overcome; first, aeronautical engineering coefficients derived from tests of small-scale models often require correction for scale effect before they can be applied to full-size design; use of this scale-correction factor has not been standardized; secondly, results obtained from different wind tunnels do not always check, and uncertainty regarding correctness of coefficients may result.

WALL INTERFERENCE. The Effect of the Walls in Closed Type Wind Tunnels, G. J. Higgens. Nat. Advisory Com. for Aeronautics—Report, no. 275, 1927, 18 pp., 30 figs. Series of tests has been conducted during period 1925-1927 in variable-density wind tunnel on several airfoil models of different sizes and sections to determine effect of tunnel-wall interference and to determine correction which can be applied to reduce error caused thereby; Prandtl theoretical corrections give best results, and their use is recommended for correcting closed wind tunnel results to conditions of free air; in appendix experimentally determined effect of walls on tunnel velocity very close to their surface is given; this is of special interest because a " scale effect " was found in boundary layer with change in density of tunnel air.

WIRE ROPE

OIL FIELDS. Oil Country Wire Rope, Its Use and Care, M. G. Ensinger. Nat. Petroleum News, vol. 19, no. 46, Nov. 16, 1927, pp. 85-87. Rope records should be religiously kept so that each manufacturer's product can be correlated and compared with producer's service record so that he can determine which is best construction for service required; type of report is suggested by writer as practical to most users' conditions; this report stays with same reel of rope throughout its life; its success depends upon field man.

WOODWORKING MACHINERY

PLANING AND MATCHING. Four-Roller High-Speed Planing and Matching Machine. Ry. Gaz., vol. 47, no. 22, Nov. 25, 1927, pp. 654-655, 1 fig. Suitable for large planing mills; railway car works and shipbuilding yards; planes up to 250 ft. per hour.

WOODWORKING PLANTS

CHAIRS. Methods of a Specialized Chair Factory, C. C. Campbell. Wood-Worker, vol. 46, no. 9, Nov. 1927, pp. 30-32, 10 figs. Marble & Shattuck Chair Co., Cleveland, O., was able to increase its production by 25 per cent on 44-hr. week over what is formerly produced on 60-hr. schedule with only small increase in size of plant.

Z

ZINC METALLURGY

LEACHING. Recent Developments in Ammonia Leaching for Zinc Ores, H. M. Lawrence. Univ. Missouri School of Mines & Metallurgy—Bul., vol. 10, no. 3, May 1927, pp. 3-12. Ammonia leaching, as process for extraction of zinc from complex ores or other zinc bearing materials, has certain possibilities that are pointed out.

Engineering Index

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A

AIR CONDITIONING

HEATING ONLY OR. What Will the Engineer Choose—Heating Only or Air Conditioning for the Modern Plant? H. P. Grant. Am. Soc. Heat. and Vent. Engrs.—Jl., vol. 34, no. 1, Jan. 1928, pp. 1-10, 8 figs. Comparison of first cost and operating expense of various types of heating as well as air-conditioning systems for industrial plants; plans shown of actual building in which air-conditioning system is to be installed.

AIR PREHEATERS

UTILITY. Air Preheaters and Their Utility, C. F. Wade. Colliery Eng., vol. 4, no. 46. Dec. 1927, pp. 494-495. Economies and advantages of air preheaters for combustion and process work; while they cannot compare with exhaust-steam systems of air heating when air is required for manufacturing processes, direct heating of air for such work from sensible heat of waste gases is much more economical than employment of live steam coils; integral type of preheater; as compared with economizers, air heaters occupy less space, require no insurance premiums against explosion and are generally lower in first cost.

Preheated Air for Boiler Furnaces, P. H. N. Ulander. Eng. and Boiler House Rev., vol. 41, no. 6, Dec. 1927, pp. 274-276, 2 figs. Reviews reasons why air preheater has become apparatus of general importance to modern boiler-house practice, and problems arising from use of preheated air.

AIRCRAFT

RADIO DIRECTION FINDING. Radio Direction Finding, L. A. Hyland. Aviation, vol. 24, no. 1, Jan. 2, 1928, pp. 30-33, 5 figs. Fifth of radio series; aims of radio direction finding to direct aircraft along dark airways, to determine accurately limits of airport and to effect landing regardless of visibility; rotating coil compass not suitable; radio compass valuable on isolated routes; radio beacon; comparison of three types of direction finders; development of beam transmitters; no known remedy for "night effect"; beacon emergency landings possible; airplane direction finding by radio not automatic.

SPECIFICATIONS. Manufacturers' Specifications on American Commercial Airplanes and Seaplanes, as Compiled by Aviation. Aviation, vol. 24, no. 1, Jan. 2, 1928, pp. 42-43.

AIRPLANES

AIRFOILS. The Characteristics of the N.A.C.A. 97, Clark Y, and N.A.C.A. -M6 Airfoils, with Particular Reference to the Angle of Attack, G. J. Higgins. Nat. Advisory Committee for Aeronautics—Tech. Note, no. 270, Dec. 1927, 4 pp., 8 figs. Aerodynamic characteristics as determined in variable-density wind tunnel at Langley Field; differences in geometric and absolute angles of attack; drag-coefficient curves and lift curves; polar curves and curves of profile-drag coefficient plotted against lift coefficient; curves of induced-drag coefficient.

WELDING. Airplane Construction and Welding, R. M. Mock. Acetylene Jl., vol. 29, no. 7, Jan. 1928, pp. 284-289, 7 figs. Discussion of advantages of welded construction and some of important joints in which welding is essential; welding is now practically confined to tubular members, though there is some tendency towards building trusses of pressed sheeting.

ALLOY STEELS

HEAT TREATMENT. Nitralloy and the Nitriding Process, H. A. DeFries. Machy. (N.Y.), vol. 34, no. 5, Jan. 1928, pp. 358-359. Special alloy steels which can be surface-hardened by being subjected to action of ammonia gas for from two to ninety hours, while material is heated to 875 deg. Fahr. without subsequent quenching; standard electric furnaces easily adaptable; composition, properties and uses; heat treatment previous to nitriding; nitriding process and equipment; depth and hardness of case.

PRODUCTION AND USES. The Production and Uses of Ni-Cr-Fe and Co-Cr-Fe Castings, J. F. Kayser. Iron and Steel of Can., vol. 10, no. 12, Dec. 1927, pp. 367-369. Treats of alloys made with Ni, Cr, Fe and Co, and used for high-grade steel as well as stainless or non-corrosive steels; composition of alloys used in United States and England is given.

ALLOYS

DIE CASTING. *See Die Casting.*
LEAD. *See Lead Alloys.*

PROPERTIES. Alloys for Casting Under Pressure (Les alliages pour la coulée sous pression). Fonderie Moderne, vol. 21, Dec. 10, 1927, pp. 502-503. Alloys with lead, tin, zinc and aluminum bases; gives physical properties, uses of each and advantages for particular cases; maximum weight possible to cast for each alloy.

ALUMINUM

MELTING. Melting Pot and Crucible Furnaces in the Aluminum Industry, E. R. Thews. Metal Industry (Lond.), vol. 31, no. 26, Dec. 30, 1927, pp. 597-599, 1 fig. Great hope is being placed upon suitability of electric furnaces, but it appears that for time being satisfactory results can only be obtained with fuel-fired furnaces, with reverberatory, crucible and melting-pot furnaces; disadvantages of last-named is strong affinity of molten aluminum for iron, which causes rapid wear of pots and inevitable contamination of aluminum with iron; results of corrosion experiments; corrosion of pot walls.

METALLURGY. Aluminum and Its Alloys Feature Meeting of Institute of Metals. Can. Chem. and Met., vol. 11, no. 12, Dec. 1927, pp. 313-316. Review of papers presented before Institute of Metals of Great Britain, dealing with protection of aluminum and its alloys against corrosion; constitution of alloys of aluminum with silicon and iron; constitution and physical properties of some alloys of copper, zinc and cadmium; effect of work and annealing on lead-tin eutectic; reaction between solid magnesium and liquid tin.

AMMONIA COMPRESSORS

DESIGN. Developments in the Design of Refrigerating Compressors, O. Henckel. Refrig. Eng., vol. 14, no. 6, Dec. 1927, pp. 186-187, 2 figs. Contribution from chief engineer of Sulzer Brothers, Wintertur, Switzerland; discusses in general terms history which has had its parallel in American practice; deals with valves, bearings and frames, packing, dry and compound compression.

ELECTRIC DRIVE. Driving Two Compressors with One Motor. Power, vol. 67, no. 2, Jan. 10, 1928, pp. 65-66, 1 fig. Discusses plan of connecting two machines to one motor; machines are placed with shafts end to end, in a straight-line pattern, with motor mounted between them; this may be properly termed duplex-coupled arrangement, and is usually called simply "duplex" for short.

AMPLIFIERS

RADIO. The Amer Tran Amplifier, L. M. Cockaday. Popular Radio, vol. 13, no. 1, Jan. 1928, pp. 20-22 and 77, 3 figs. Unit described, it is claimed, not only furnishes ideal form of distortionless low-frequency amplification for any high-frequency pack, but supplies all operating voltages for any set that employs AC valves.

ARBORS

VERTICAL. Uses of the Vertical Work Arbor. Can. Machy., vol. 38, no. 25, Dec. 22, 1927, pp. 15-16, 12 figs. Describes vertical work arbors for tables of milling, slotting and gear-cutting machines and some grinding machines; uses loose base and overhead support if necessary; methods of using arbors for various kinds of work and advantages of each.

ARCHES

LONG-SPAN. Hooped Cast-Iron and Long-Span Arches. Concrete, vol. 22, no. 12, Dec. 1927, pp. 692-707, 24 figs. Treats of long-span arches where hooped cast iron has reduced size of members and economized material cast.

ARSENIC DEPOSITS

CANADA. Arsenic-Bearing Deposits in Canada, M. E. Hurst. Geol. Survey—Economic Geology Series, no. 4, 1927, 172 pp., 21 figs. Mineralogy of arsenic; general geology; description of occurrences; principal sources of arsenic at present time are: silver-cobalt ores of Cobalt, South Lorrain and Gowganda, Ontario; arsenopyrite-gold ore of Hedley Gold Mining Co., Hedley, B.C.; concentrates from gold-quartz veins and slate belts in Nova Scotia.

ASBESTOS

STATISTICS. Asbestos, B. H. Stoddard. U.S. Bur. Mines—Mineral Resources, no. II:19, 1927, pp. 195-201. Production, review by states, prices, uses, imports and exports and world's production.

ASBESTOS PRODUCTS

MANUFACTURE. Manufacture of Mixtures of Asbestos and Cement (La fabrication des agglomerés d'amiante et de ciment). Revue Industrielle, vol. 58, no. 2222, Jan. 1928, pp. 1-8, 20 figs. How mixtures of cement and asbestos are made in corrugated sheet form and as shingle for walls and roofs, also as sheet for partitions; composition and fabrication machinery described.

ASPHALT

MATERIALS. Use of Asphaltic Materials, W. L. Hempelmann. Elec. Traction, vol. 24, no. 1, Jan. 1928, pp. 35-36, 2 figs. Asphaltic materials have numerous uses in track construction, for floor and roof coverings, and for waterproofing and general protective purposes on electric railways.

AUTOMOBILE PLANTS

CADILLAC. Cadillac Doubles Plant Output, L. P. Fisher. Mfg. Industries, vol. 14, no. 6, Dec. 1927, pp. 411-414, 4 figs. During past two years company has made far-reaching changes in plant and product involving creation of entirely new car, the LaSalle, and change of Cadillac model; new models were put into production with increase in annual output of from 22,000 to possible 50,000 to 60,000 cars; more efficient use of production equipment, improved types of machinery, rearrangements of plant layout, and better methods of materials handling have effected increased output with addition of 24% to working force.

AUTOMOBILES

BODIES, MANUFACTURE. The All-Steel Automobile Body as a Manufacturing Problem, J. W. Meadowcroft. Am. Mach., vol. 68, no. 1, Jan. 5, 1928, pp. 9-11, 7 figs. Present-day streamline design and large quantities making necessary use of expensive dies and extensive welding equipment; early history and underlying principles; progressive assembly line as pace setter and problems arising from it; materials selection.

ELECTRIC. Electrical Equipment of Electric Road Vehicles, L. W. de Grave. Elecn., vol. 99, no. 2584, Dec. 9, 1927, pp. 719-720, 5 figs. Battery vs. resistance control; controllers with shunted or parallel fields; permanent series field and shunts of 50 per cent and 10 or 20 per cent best; objections to controllers which interlock with brake; regenerative control; electric brakes; controller contacts and fingers; ampere-hour meters should read level.

MANUFACTURE. Efficient Production, with Particular Reference to the Motor Car Industry, H. E. Taylor. Machy. (Lond.), vol. 31, no. 790, Dec. 1, 1927, pp. 265-275, 13 figs.

TIRES, IMPROVEMENTS IN. Another Step in Tire Evolution. Motor Transport, vol. 46, no. 1190, Jan. 2, 1928, pp. 7-8, 3 figs. Startling development in pneumatic-tire construction; how low-pressure tire can be improved and new oval tire with less height and abnormal width affording maximum width of air cushion and tread without changing diameters of wheels or brake drums; tire can be made at less cost and 33 to 40 per cent lighter.

AUTOMOTIVE FUELS

KNOCK CHARACTERISTICS. Comparison of Methods of Measuring Knock Characteristics of Fuels, G. Edgar. Soc. Automotive Engrs.—Jl., vol. 22, no. 1, Jan. 1928, pp. 41-48, 4 figs. Analysis of data obtained from nine laboratories and methods used; rating of fuels in terms of quantity of tetraethyl lead needed to make fuels equal to standard better than they are; rating of fuels themselves in terms of some other standard fuel to which anti-knock or benzol has been added; discussion of experimental results.

AXLES

FATIGUE. Fatigue Cracks in Axles. Metallurgist (Supp. to Engineer), Dec. 30, 1927, pp. 181-183. It is desirable that simple and practical methods of inspection be devised whereby fatigue cracks might be detected at early stage; refers to work of H. F. Moore (Bul. No. 165, Univ. of Ill. Eng. Experimental Station, June 1927), describing series of experiments made on small laboratory specimens to obtain data regarding efficacy of "oil and whiting" method; mentions work carried out at Bureau of Standards in connection with somewhat analogous problem.

B

BELTS AND BELTING

SPECIFICATIONS. A.P.I. Belt Specifications and Results of Use, F. O. Prior. Oil Weekly, vol. 48, no. 2, Dec. 30, 1927, pp. 47-50 and 52, 8 figs. Specifications have provided belts better suited for particular needs and code for care has increased term of usefulness; fatigue or endurance tests; belt records; elastic properties of belting.

BLAST FURNACES

AIR DRYING. Use of Silica Gel for Air Drying in Blast Furnaces (L'emploi du gel de silice pour dessecher le vent des hauts fourneaux), A. Bidault des Chaumes. Génie Civil, vol. 91, no. 27, Dec. 31, 1927, pp. 661-664, 7 figs. Installation at steel works in Scotland of new process of air drying originating in America; results of test since April 1927.

FUELS. The Effect of Varying Ash in the Coke on Blast-Furnace Working, C. S. Gill. Iron and Steel of Can., vol. 10, no. 12, Dec. 1927, pp. 374-376, 2 figs. Gives quantities of ash found in coke used in blast-furnace operation and sulphur in pig iron and analyzes effect of ash on pig obtained from furnace 55 ft. high, 18 ft. diameter; considered a small furnace.

OPERATION. Pig Iron Quality Is Affected by Scrap Additions to Blast Furnace, J. L. Jones. Foundry, vol. 56, no. 1, Jan. 1, 1928, pp. 32-34, 4 figs. Specifications for scrap for use in blast furnaces; increasing tendency of large castings to crack and difficulties in machining may be expected as consequence of lack of uniformity of pig iron made by adding scrap to blast furnace; use of forehearths or large mixing ladles, in connection with cupola or electric-furnace melting, should give more uniform product even if heterogeneous material must be charged.

BOILERS

CONTROL. Modern Boiler Room Control, J. M. Drabelle. Power Plant Eng., vol. 32, no. 1, Jan. 1, 1928, pp. 34-35. Automatic control as applied in modern plants; it is function of automatic boiler-control equipment to duplicate as closely as possible results obtained under test conditions.

DESIGN. Modern Boilers, Their Design and Construction—Methods of Increasing Power Plant Efficiency, E. R. Fish. Steam Coal Buyer, vol. 8, no. 5, Nov. 1927, pp. 38-41. How boilers are made to stand present high pressures; great demand for new boilers of large sizes; water walls are necessary; chimney losses are reduced; superheaters used, necessary to select right equipment for case at hand.

BOILER FEEDWATER

REGULATION. Measurement and Regulation of Feedwater. Power Plant Eng., vol. 32, no. 1, Jan. 1, 1928, pp. 32-33. Measurement of quantity of water is most accurately made by weighing it in tanks where quantity to be measured is not too large and short time determinations are not required; where it is desirable to have continuous observations, some form of meter is advisable; types of meters; feedwater regulators.

TESTING. Testing Treated Feedwater. Power Plant Eng., vol. 32, no. 1, Jan. 1, 1928, pp. 30-31, 1 fig. Regular routine tests are made and records kept as guide to operation; titration provides simple method; control of blowdown secured by tests.

Tests of Raw Water Involve Many Processes. Power Plant Eng., vol. 32, no. 1, Jan. 1, 1928, pp. 26-27, 1 fig. Following careful analysis of water, regular routine tests are made by power-plant personnel and records kept; tests should be made for following: Total alkalinity, carbonate, bicarbonate and hydrate alkalinity, hydrogen-ion concentration, chlorides, dissolved oxygen, total solids, suspended solids, turbidity and total hardness.

TREATMENT. A Method of Feedwater Treatment. Gas Engr., vol. 43, no. 620, Dec. 1927, pp. 323-324. Non-chemical method called "Filtrator" system used at Weston-super-Mare, England; introduces small stream of colloid substances into feedwater or boiler; source of "colloid" is commercial uncrushed linseed; cost very small compared to water-softening plant, and effect as good.

Purification and Treatment of Feedwater, S. T. Powell. Power Plant Eng., vol. 32, no. 1, Jan. 1, 1928, pp. 24-26. Present tendencies in methods of testing feedwaters and their subsequent purification and treatment for use in modern power-plant boilers are toward combination of systems; continuous blowdown methods and adoption of zeolite process increasing in use; electrolytic methods have possibilities.

Treat Feedwater for Its Specific Duty. Power Plant Eng., vol. 32, no. 1, Jan. 1, 1928, pp. 27-30, 5 figs. It is claimed that treatment methods should be individually determined; factors involved in choice of filter; concentration control; corrosive action reduced by degasification.

FURNACE GASES, STRATIFICATION OF. Effect of Stratification of Furnace Gases on Steam Boiler Losses, F. M. Marquis, P. Bucher and H. M. Faust. Ohio State Univ. Studies—Bul., no. 34, Nov. 1927, 82 pp., 44 figs. Investigation of combustion conditions and of interrelations of boiler losses in boilers located in Ohio State University power plant; description of boiler units on which tests were run; method of conducting tests; programme of tests, and discussion of some of more important results, together with their graphical presentation.

FURNACE TUBES. Designing Furnace Tubes for Horizontal Internally-Fired Land Boilers. Boiler Maker, vol. 22, no. 12, Dec. 1927, pp. 354-355, 16 figs. Defects caused by expansion and contraction of furnace tubes of internally-fired boilers have brought about many changes in design of these tubes, which are discussed; modifications of Adamson furnace; cone-shaped furnace rings.

FURNACES—OPERATION. Continuous Combustion at High Pressures, E. C. Wadlow. Engineer, vol. 144, no. 3754, Dec. 23, 1927, pp. 704-705, 5 figs. Description of experimental furnace which writer constructed to supply quantity of gas at elevated temperatures and pressures; experiments show that satisfactory continuous combustion can be maintained in chamber of small capacity; heat losses are considerable; statements are based upon experience gained during about 150 hours running with combustion taking place.

LOCOMOTIVE. *See Locomotive Boilers.*

RATING. Is Boiler Rating an Engineering or a Trade Problem? Heat. and Vent. Mag., vol. 25, no. 1, Jan. 1928, pp. 89-90. Analysis of boiler rating code problem by well-known consulting engineer approaches subject from new point and suggests that, after all, matter is industrial rather than engineering.

BRASS FOUNDRIES

METALLURGICAL CONTROL. Brass Foundry Tests Every Heat, E. Bremer. Foundry, vol. 56, no. 1, Jan. 1, 1928, pp. 2-6 and 14, 6 figs. Modern brass foundry that maintains most complete metallurgical and chemical department according to present-day standards is Mueller Brass Co., Port Huron, Mich.; details of labour-saving devices and methods employed.

BRIDGES

CONCRETE. Concrete Bridges Unite St. Petersburg Island, J. Ludwick. Concrete Products, vol. 33, no. 6, Dec. 1927, pp. 49-51, 3 figs. Bridges total 1,400 ft. in length; construction methods described; system requires three bridges; approximate quantities of materials used are shown in table.

The Aulon Viaduct, Memphis, W. G. Stromquist. Pub. Wks., vol. 59, no. 1, Jan. 1928, pp. 29-32, 4 figs. Construction of concrete viaduct with approaches, totalling nearly 3,000 feet, over three sets of railroad tracks; slab instead of girder and beam construction.

DESIGN. Bridge Design for Various Conditions, J. A. L. Waddell. Can. Engr., vol. 54, no. 2, Jan. 10, 1928, pp. 129-130. Suitability of various types of bridges for different conditions encountered at crossings; concrete vs. timber piles; erection methods; cantilevering and semi-cantilevering; temporary spans for erection; types of bridges; reinforced-concrete or timber trestles; reinforced-concrete arch bridges; steel trestles; cantilever bridges. Paper read before West. Soc. Engrs. (To be continued.)

Bridge Design for Various Conditions, J. A. L. Waddell. Can. Engr., vol. 54, no. 1, Jan. 3, 1928, pp. 105-108. Suitability of various types of bridges for different conditions encountered at erossings. Reprinted from Jl. of Western Society of Engineers. (To be continued.)

HIGHWAY. Grade Line Treatment for Highway Bridges, C. B. McCullough. Roads and Streets, vol. 67, no. 11, Nov. 1927, pp. 494-496, 7 figs. General considerations of grades on and approaching bridges; requirements of camber and grade-line treatment; concave and convex intersections; structures on curves; need of following certain rules to prevent appearance of sag on bridge railing.

Highway Bridge Destruction Tests, N. C. Mcloud. Concrete, vol. 32, no. 1, Jan. 1928, pp. 34-36, 3 figs. Water-power developments present opportunity for making unusual series of tests on concrete arch bridge in North Carolina; bridge to be tested to destruction; will study concrete arch stresses; scope of tests; method of making tests; engineering societies co-operate; 1,069-ft. bridge over Yadkin river between Albemarle and Mt. Gilead, erected in 1922.

SURVEYS. Bridge Surveys for New Structures, W. W. Hadley. Purdue Univ.—Bul., vol. 21, no. 3, May 1927, pp. 22-38. Enumerates various points to be investigated by engineer previous to establishing location of new bridge, necessity for care in such work and recommendations to be made previous to final choice of location and structure.

BRONZE FOUNDING

PROGRESS IN. Developments in Engineering Bronze Founding. Metal Industry (Lond.), vol. 31, no. 22, Dec. 2, 1927, pp. 511-512. Progress in bronze castings; tilting furnaces; electric furnace for foundry work; gas absorption in bronze; grain size and strength; worm-wheel blanks; tin and tin substitutes. Paper read before joint meetings of Inst. of Metals & Inst. of Brit. Foundrymen. See also Foundry Trade Jl., vol. 37, no. 591, Dec. 15, 1927, pp. 195-198, 2 figs.

BUILDINGS

STEEL. Windbracing for Steel Structures, C. T. Morris. Contract Rec., vol. 41, no. 51, Dec. 21, 1927, pp. 1285-1289, 3 figs. Ross method of analyzing stresses recommended as more satisfactory than any of approximate methods now in common use; no definite data as to proper wind-pressure figures; refers to various papers on this subject with comments; analysis of wind stresses in 48-storey office building in Columbus, O.; mention of effects of Florida hurricane on several steel-framed buildings in Miami.

WELDED STEEL. Fabrication Costs for an Arc-welded Steel Frame Building. Elec. News, vol. 37, no. 2, Jan. 15, 1928, pp. 45-46. Power, wire and labour costs per net ton given for various steels; Sharon building of Westinghouse Co. largest building ever constructed by arc-welding method of fabricating steel; presents some useful data on arc-welding; welding process.

C

CARBON DIOXIDE COMPRESSORS

DEVELOPMENT. The Progressive Development of Carbon Dioxide Refrigerating Methods, J. C. Goosmann. Refrig. Eng., vol. 14, no. 6, Dec. 1927, pp. 188-189. History of development of CO_2 machines; nearly all of European CO_2 compressors are designed along standard lines, either horizontal or vertical, single or double acting; condensers, valves and other auxiliary parts show very little deviation from conventional forms; there are two distinct types of fully enclosed rank-case machines, distinguished as "step-piston" and "straight-piston" type; advantages and disadvantages of each.

CARBURETORS

AIR CLEANERS. Air-Cleaning Mountings. Soc. Automotive Engrs.—Jl., vol. 22, no. 1, Jan. 1928, p. 107, 1 fig. Series of carburetor air-horn dimensions developed for air-cleaner mountings; table including sizes of carburetor larger and smaller than those used at present for attachment of air cleaners.

FLANGE STANDARDS. New Duplex-Carbureter Flanges. Soc. Automotive Engrs.—Jl., vol. 22, no. 1, Jan. 1928, p. 106, 1 fig. Dimensional specifications for five standard sizes developed by subdivision; four-bolt mounting; two centre holes optional; distance between centres of centre holes increased by ⅛ in.; some holes have been moved 1/16 in. away from barrel for wrench clearance; spacing between barrels increased in 1¼-in. size.

CARS, TANK

GLASS-LINED. Conveyance of Milk in Glass-Lined Tank Wagons. Ry. Gaz., vol. 47, no. 24, Dec. 9, 1927, pp. 723-727, 9 figs. Design of vehicles for this traffic co-operation between United Dairies, Ltd., and Great Western and L.M.S. Railways; collecting and filling plants; economics of bulk transport of milk; hygienic advantages.

CASE-HARDENING

PRINCIPLES. Facts and Principles Concerning Steel and Heat Treatment, H. B. Knowlton. Am. Soc. for Steel Treat.—Trans., vol. 13, no. 1, Jan. 1928, pp. 142-154. Explains what case-hardening is, reviews history; reasons for case-hardening; selection of steels; S.A.E. specifications for plain carbon case-hardening steels; presents table giving chemical composition of alloy steels commonly used for case-hardening.

CAST IRON

FATIGUE. Fatigue of Cast Iron, C. H. Bulleid and A. R. Almond. Engineering, vol. 124, no. 3232, Dec. 23, 1927, p. 827, 6 figs. Data on an iron suitable for light castings and typical cylinder iron; from results of these two irons and those obtained previously, it appears that ratio of fatigue stress to transverse stress varies greatly in different irons, and may be very low.

MACHINABILITY. Effects of Nickel on the Machinability of Cast Iron. West. Machy. Wld., vol. 18, no. 12, Dec. 1927, pp. 591-592, 2 figs. Brief article with purpose of examining difficulties encountered in machining grey cast iron, and by means of metallurgical laws. microscope and chemical analysis pointing out causes; effect of combined carbon; hard spots and remedy; high silicon content and slow cooling promote internal shrinks; nickel in grey iron supplements silicon without inducing internal shrinking; nickel makes pre-annealing unnecessary.

MECHANICAL PROPERTIES. Some Mechanical Properties of Cast Iron. Metallurgist (Supp. to Engineer), Dec. 30, 1927, p. 188. Review of report by Moore, Lyon and Inglis (Bul. No. 164, Univ. of Ill. Eng. Experimental Station); material was drawn from following sources: 6-in. pipe cast by centrifugal process; hollow cylinders cast in green-sand moulds with dry-sand cores; and inner wall of double-walled cylinder casting.

CASTINGS

DESIGN. Some Faults in the Design of Castings, W. J. May. Mech. Wld., vol. 82, no. 2137, Dec. 16, 1927, pp. 447-448, 7 figs. Suggestions for castings made with cast-on flanges and other projections; castings in which ribs are introduced for purposes of stiffening and adding extra strength; designing of machines having parts awkward to mould or cast; question of suitability of metal for particular purposes.

CHAIN DRIVE

LIMITATIONS. Limitations of Silent Chain Drives, A. B. Wray. Indus. Engr., vol. 85, no. 12, Dec. 1927, pp. 589-591, 4 figs. Maximum horse power using chain drive; ratios of sprockets in train, proper centre distances, number of teeth in sprockets; installation economies in chain-drive gearing shown by examples.

CHIMNEYS

REINFORCED CONCRETE. Design and Construction of Tapering Reinforced Concrete Chimneys, W. A. Jassoy and H. B. Schneider. Contract Rec., vol. 42, no. 1, Jan. 4, 1928, pp. 2-4, 5 figs. Designing methods, forms for construction, methods of constructing foundation and chimney itself; list of chimneys erected in Canada of reinforced concrete by one company, maximum height 250 ft.

CHROMIUM PLATING

ANODES FOR. Anodes for Chromium Plating, O. P. White. Metal Industry (Lond.), vol. 31, no. 24, Dec. 16, 1927, pp. 563-565. Tests of effect of anode materials upon solution and upon deposit; anodes used were chromium, lead, iron and steel, nickel and iron silicon, iron-chromium, nickel-chromium, nickel-silicon and nickel-chromium-silicon alloys. Paper read at Am. Electrochem. Soc.

CORROSION PREVENTION. Chromium as a Corrosion Preventative, L. Wright. Metal Industry (Lond.), vol. 31, no. 25, Dec. 23, 1927, pp. 577-579, 16 figs. Early hopes for production of permanent corrosion-resistant coating of chromium have been hardly realized; failure of carefully stored chromium-plated brass articles in about fortnight forced author to conclusion that many factors, other than corrosion, were at work in causing breakdown of chromium; it has become apparent that failure is not haphazard; discusses number of definite types of failure and attributes to each article definite cause for its breakdown.

CHUCKS

HYDRAULIC. Gridley Hydraulic Unit to Operate Chucks. Am. Mach., vol. 67, no. 26, Dec. 29, 1927, pp. 1033-1034, 2 figs. To operate chucks of screw machines, chucking machines, automatic lathes and other production machinery hitherto actuated pneumatically; consists of tank to hold quantity of oil, cover with motor-driven pump, accumulator for building up air pressure, gauges to indicate pressure and valves to regulate oil flow.

PNEUMATIC. Air Chucks and Fixtures. Machy. (Lond.), vol. 31, nos. 791 and 793, Dec. 8 and 22, 1927, pp. 289-291 and 381-384, 12 figs. Pneumatically operated equipment designed to save time and labour in quantity production; air-operated clamping unit, incorporated in various types of work-holding fixtures and jigs; chucks with pressure-equalizing mechanisms; expanding mandrels used in gripping both ends of long housings during lathe operation; fixture for vertical machine; simple drill jig; line cuts showing details of devices.

CITIES AND TOWNS

PLANNING. Civic Developments at Montreal. Can. Engr., vol. 54, no. 1, Jan. 3, 1928, pp. 115-116. Town-planning activities; work accomplished; several boulevards planned; financing municipal improvements; other cities co-ordinated; working on system; boulevard plans.

STREETS. Arterial Roads in Relation to Town Planning, W. R. Davidge. Roads and Road Construction, vol. 5, no. 60, Dec. 1, 1927, pp. 377-379. Function of by-pass; for by-pass to fulfill its purpose there are two salient things it must do: to skirt town situated on highway so that capacity of streets in town is not unnecessarily strained, and to serve as swift and direct route past town. (Concluded.)

COAL

SPONTANEOUS COMBUSTION. The Reactions Between Oxygen and Coal, W. Francis and R. V. Wheeler. Chem. Soc.—Jl., Dec. 1927, pp. 2958-2967, 3 figs. Work forms part of research on spontaneous combustion of coal which is being carried out for Safety in Mines Research Board; studies more particularly behaviour of hydrogen-containing groupings of ulmin molecule during oxidation of coal, as disclosed by formation of water.

COAL MINES AND MINING

EXPLOSIONS. Explosion in Hillcrest Mine, Alberta, Sept. 19, 1926, G. S. Rice. Can. Min. and Met. Bul., no. 189, Jan. 1928, pp. 121-150, 2 figs. Writer was invited to conduct an investigation into causes of disaster, and to make such recommendations as seemed advisable with view to minimizing as far as possible chance of future explosions.

POWER SUPPLY. The Power System of the Dominion Coal Company, Limited, S. C. Mifflen, A.M.E.I.C. Can. Min. Jl., vol. 48, no. 49, Dec. 9, 1927, pp. 986-990 and 999, 4 figs. Until recent years, power supply in mines proper consisted almost entirely of compressed air; within past five years electrification of all main pumping plants of all collieries together with some auxiliary pumps has been effected; unlikely that electric coal cutters will predominate due to more or less gaseous nature of coal seams.

VENTILATION. The Measurement of Air Quantities and Energy Losses in Mine Entries, A. C. Callen and C. M. Smith. Univ. of Ill. Bul., vol. 25, no. 14, Dec. 6, 1927, 73 pp., 17 figs. Object to see whether pitot-tube traversing methods could be applied with reasonable accuracy at any desired location in mine entry without building measuring station and without special preparation of section.

GEOLOGY. Prospecting Strip Coal Areas, W. J. Borries. Min. Congress Jl., vol. 14, no. 1, Jan. 1928, pp. 48-50, 2 figs. Investigation of successful coal-strip property involves principles of engineering and prospecting and geological study of conditions embodying property; procedure advocated.

COLUMNS

DESIGN. A Simplified Column Formula of the Secant Type, J. B. Hunley. Am. Ry. Eng. Assn.—Bul., vol. 29, no. 300, Oct. 1927, pp. 197-226, 22 figs. Study of effect of various terms of secant formula has suggested another form which is quite simple and yet retains to remarkable degree all desirable features of original formula.

COMBUSTION

CONTROL. Combustion Control Formulas, E. A. Uehling. Power, vol. 67, no. 1, Jan. 3, 1928, pp. 12-14, 2 figs. Application of formulas to test data; heat-loss formulas; it is evident that per cent of CO_2 and CO, temperature of gas on leaving boiler and square root of boiler draught are fundamental data required for intelligent and effective control of boiler operation.

COMPRESSED AIR

AUTOMOBILE MANUFACTURE, USE IN. Compressed Air in an Automobile Plant, C. H. Vivian. Compressed Air Mag., vol. 33, no. 1, Jan. 1928, pp. 2295-2301, 23 figs. Tools driven by compressed air for automobile production are explained; their advantages discussed; applied to plant at Elizabeth, N.J., making Star cars; tires are inflated automatically; air compressors described.

CONCRETE

CONSTRUCTION. Contractor Saves 30 Per Cent Through Quality Control, L. Charron. Concrete, vol. 32, no. 1, Jan. 1928, pp. 37-40, 3 figs. Quality control permitted reducing cement content per cubic yard of concrete in building foundations for greater Penobscot building in Detroit, Mich.; building 47 stories high; description of concrete-plant layout, aggregates and mixes used.

CURING. Curing Concrete, J. Singleton-Green. Concrete, vol. 22, no. 12, Dec. 1927, pp. 687-691, 1 fig. Sixteen conclusions regarding curing of concrete, with diagram for relative compressive strengths for mortars and concretes of any age.

MIXING. Comparison of Water-Cement Ratio Mixes and Ordinary Mixes, C. F. Dingman. Concrete, vol. 32, no. 1, Jan. 1928, p. 24. Effect of workability requirements on amount of cement needed per cubic yard of concrete; mixture must be plastic and workable; comparison is shown of certain mixes, with strengths assumed for them according to Boston building law.

The Modern Idea in Concrete Mixing, J. E. Foster. Contract Rec., vol. 41, no. 52, Dec. 28, 1927, pp. 1330-1331. Water-cement ratio law interpreted in terms of Canadian sacks of cement and imperial gallons; class of concrete to use; calculating quantity of concrete.

PROPORTIONS. Estimation of the Proportions for Concrete, H. W. Coultas. Concrete, vol. 22, no. 12, Dec. 1927, pp. 727-744, 8 figs. Shows how various factors in connection with water-cement ratio theory of specifying quantities for concrete can be put to practical use; expresses mathematically relations between various factors; and shows how to specify use of this theory in practice.

CONCRETE, REINFORCED

STRESSES. Chart Showing Stress Characteristics of Reinforced Concrete Under Bending and Direct Compression, and Notes of Their Construction, S. M. Cotten. West. Constr. News, vol. 2, no. 24, Dec. 25, 1927, pp. 49-51, 2 figs. Writer recently engaged upon some analyses which warranted preparation of series of similar diagrams, two of which are presented herewith; facts are of two different varieties, one group with respect to stress behaviour, and another with respect to methods which were found adapted to preparation of diagrams.

CONDENSERS, STEAM

AIR AND STEAM MEASUREMENTS. Air and Steam Measurements Most Difficult. Power Plant Eng., vol. 32, no. 1, Jan. 1, 1928, pp. 59-62, 10 figs. Instruments showing air and steam conditions in condenser moisture in steam cannot be measured; various methods of measuring air discharged are used, most accurate being bell or gasometer.

DESIGN. Condenser Design and Construction Progress, G. A. Orrok. Power Plant Eng., vol. 32, no. 1, Jan. 1, 1928, pp. 55-56, 2 figs. Decreased surface and high heat transfer are results of improved design of condensers and auxiliaries; water-side problems remain to be solved.

PROBLEMS OF. Condensate Handling Presents Many Problems. Power Plant Eng., vol. 32, no. 1, Jan. 1, 1928. pp. 62-64, 6 figs. With surface condensers return of condensed steam to boiler-feed system offers many possibilities which should all be analyzed; on method of measurement which offers no possibility of argument is direct measurement of weight with calibrated scales.

WATER SUPPLY FOR. Circulating Water Supply Extremely Important. Power Plant Eng., vol. 32, no. 1, Jan. 1, 1928, pp. 64-66, 7 figs. If natural supply is not available, spray pond must be provided entailing additional investment and auxiliary power; quantity of circulating water can be found from heat balance.

CONTAINERS

FREIGHT, THEORY OF USE. The General Theory of Container Use, B. Allen. Soc. Automotive Engrs.—Jl., vol. 22, no. 1, Jan. 1928, pp. 74-76. Unit containers for transportation of freight by rail and highway; container operation in United States; full benefit dependent on general use; benefits to railroads; advantages to be gained by shippers; two container sizes seem logical; rquirements to be met in design; field for container use.

CONVEYORS

CHAIN. Carrying Engines on 1½-Mile Conveyor. Iron Age, vol. 120, no. 26, Dec. 29, 1927, p. 1784, 1 fig. Chain-type conveyor said to be longest installed in any industrial plant is being used by Buick Motor Co., Flint, Mich., for taking engines from test room to car-assembly plant.

ROLLER BEARINGS IN. Roller Bearings in Conveyors, M. Weckstein. Indus. Engr., vol. 85, no. 12, Dec. 1927, pp. 575-577 and 591, 12 figs. Application of anti-friction bearings to conveyor rolls and drive mechanism; this covers horizontal and inclined rollers for belt conveyors and conveyor wheels; analyzes loads and oiling methods for roller bearings only.

CORES

MACHINES FOR MAKING. Makes Changes in Design of Core Machine. Foundry, vol. 56, no. 1, Jan. 1, 1928, p. 41, 1 fig. American Foundry Equipment Co., Mishawaka, Ind., has made number of changes in its extrusion-type core machine; new machine is equipped with force-feed rod and mixer to insure uniform sand for all sizes of cores.

CRANES

ELECTRIC TRAVELLING. Some Modern Types of Steel Mill Cranes, W. D. Keller. Iron and Steel Engr., vol. 4, no. 12, Dec. 1927, pp. 506-508. Describes features of overhead travelling cranes; 4-girder type used for ladles; one-piece trolley and use of worm gears advocated; anti-friction bearings used and interlocked gear type of trolley.

JIB. Dock Cranes with Inclinable Overhang (Grue de quai, a volée inclinable). Bul. Technique de la Suisse Romande, vol. 53, no. 26, Dec. 31, 1927, p. 317, 1 fig. Jib crane mounted on movable frame rolling on track; overhand of jib variable, load at maximum overhang of 20 m. is 3 tons; minimum overhang, 8 m. movements of crane are all by electric motors.

CULVERTS

DESIGN. The Design of Deep Culverts, C. S. Chettoe. Surveyor (Lond.), vol. 73, no. 1876, Jan. 6, 1928, pp. 5-8, 9 figs. Treats of external forces on deep culvert, resolves them and applies elastic theory to design of deep sizable culverts with and without invert; outlines method of obtaining stresses on cross-section. (To be concluded.)

CUPOLAS

Control. Control of Cupolas (Controle des cubilots), H. Carra and R. Fric. Chaleur et Industrie, vol. 8, no. 92. Dec. 1927, pp. 673-678, 2 figs. Discusses heat radiation, specific heat of gases, measurement of gas pressure, analysis of gas, CO and CO_2 and amount of air necessary for combustion; relation between real and calculated percentages of CO and CO_2.

D

DAMS, ARCH

Design. Analysis of Arch Dams by the Trial Load Method, C. H. Howell and A. C. Jaquith. Am. Soc. Civ. Engrs.—Proc., vol. 54, no. 1, Jan. 1928, pp. 61-95, 16 figs. Method based on assumption that arch dam is composed of systems of horizontal arches and vertical cantilevers, that each system carries proportion of total load, and that deflections of two systems are equal; series of assumed proportional loads applied; deflections computed when proportionate loading found that gives equal deflections at all points for both systems.

Gravity. Notes on Arched Gravity Dams. Discussion by P. Bauman of paper by B. F. Jakobsen. Am. Soc. Civ. Engrs.—Proc., vol. 54, no. 1, Jan. 1928, pp. 219-232, 12 figs. States that there is insufficient justification for ignoring effect of arch action in case of curved gravity dam, such as Exchequer dam; contributes analysis of stresses in Exchequer dam; shows effect of arch support, and that no tensile stresses exist at upstream face, but that appreciable compressive stresses occur, especially in lower portions of dam.

DIE CASTING

Alloys for. Die-Casting Alloys. Machy. (Lond.), vol. 31, no. 793, Dec. 22, 1927, pp. 397-398. Alloys can be conveniently divided into three groups, namely, those of low melting point, which include tin-base, lead-base and zinc-base alloys; aluminum-base alloys; and copper-base alloys, which include 60/40 brass, aluminum bronze, high-tensile brass and aluminum-brass, each of which is discussed.

DIES

Punching. Die for Producing Hunting Tooth Gear. Machy. (Lond.), vol. 31, no. 793, Dec. 22, 1927, p. 390, 2 figs. Punch and die employed in production of two-tooth hunting gears commonly used in mechanical accounting devices; die is of progressive type, having three positions.

DIESEL ENGINES

Ignition. Diesel Engine Ignition Lag Largely Influenced by Preheating, P. M. Heldt. Automotive Industries, vol. 57, no. 26, Dec. 24, 1927, pp. 936-938, 5 figs. Density of air also factor; development of high-speed ignition-compression engine for automotive service in Europe; several new models.

Lubrication. Lubricating Power Cylinders of Diesel Engines, W. C. Northcutt. Eng. World, vol. 32, no. 1, Jan. 1928, pp. 26-29. Purpose of this paper is to offer constructive criticism of present methods of applying lubricating oil to power cylinders of Diesel engines, and to recommend method which is believed to be improvement; discussion, data and conclusions based on experimental study of this phase of Diesel-engine lubrication.

DRILLS, TWIST

Grinding. Remarks on Grinding of Twist Drills, W. M. Gladding. Abrasive Industry, vol. 9, no. 1, Jan. 1928, p. 3. Brief account of important features in drill-point grinding; tables of drill clearance angles and of point-pressure and torque data; standard drill angles; disadvantages in too much or insufficient lip clearance.

DRY KILN

Steam-Jet-Blower. Design of Lumber Dry Kilns, H. L. Alt. Heat. and Vent. Mag., vol. 25, no. 1, Jan. 1928, pp. 101-102, 2 figs. Describes new type of steam-jet-blower dry kiln with chart showing air and moisture conditions during ordinary lumber-drying process.

DURALUMIN

Properties. "Duralumin," L. Atchison. Metal Industry (Lond.), vol. 31, no. 26, Dec. 30, 1927, p. 602. Discusses its properties and heat treatment; it is produced and used in all known forged forms; it is most conspicuous nonferrous material which has to be completely heat-treated, that is, hardened by quenching and tempered; it is subject to corrosion to certain extent, but is less corrosive than steel. Lecture given before Co-ordinated Societies in Birmingham, England.

E

ECONOMIZERS

Corrosion. Internal Corrosion of Fuel Economizers, E. Ingham. Mech. Wld., vol. 82, no. 2138, Dec. 23, 1927, p. 467. Corrosion caused by pure water is generally believed to be due to presence in water of dissolved gases, oxygen or carbonic acid; corrosion may be avoided by using pure water entirely free from dissolved gases; a great deal may be done to prevent corrosion due to presence of dissolved gases in feedwater by introducing with feed certain reagents; remarks are confined to ordinary cast-iron economizer.

ELECTRIC CABLES

High-Tension. Influence of Internal Vacua and Ionization on the Life of Paper Insulated High-Tension Cables, A. Smouroff and L. Mashkileison. Am. Inst. Elec. Engrs.—Jl., vol. 47, no. 1, Jan. 1928, pp. 24-28, 9 figs. Results of experimental research undertaken at high-voltage laboratory of Electrotechnical Institute in Leningrad; aim of research was to clear up causes in formation of internal vacua, then to determine values of those vacual and decrease of life duration of cable under influence of latter; research is not yet finished and only preliminary results are reported.

Underground. Underground System Temperatures, T. G. Hieronymus. Elec. World, vol. 90, no. 26, Dec. 24, 1927, pp. 1299-1300, 3 figs. Studies are in progress on system of Kansas City Power & Light Co. to determine definite carrying capacity of lead-covered, paper-insulated cables under local conditions of climate and construction practice; conditions so far discovered are related.

ELECTRIC CIRCUIT BREAKERS

Oil. High-Voltage Oil Circuit Breakers for Transmission Lines. Am. Inst. Elec. Engrs.—Jl., vol. 47, no. 1, Jan. 1928, pp. 57-64. Discussion of paper by Wilkins and Crellin published in Dec. 1927 issue of Journal.

ELECTRIC CIRCUITS, SAFETY

Safety. Electrical Safety Circuits—Their Uses and Construction, W. M. Runyon. Iron and Steel Engr., vol. 4, no. 12, Dec. 1927, pp. 508-512, 2 figs. Safety circuit defined; its need, point of installation, features of design and points to observe for high- and low-voltage circuits.

ELECTRIC CONDENSERS

Synchronous. Synchronous Condensers. Am. Inst. Elec. Engrs.—Jl., vol. 47, no. 1, Jan. 1928, p. 54. Discussion of paper by P. L. Alger published in Dec. 1927 issue of Journal.

ELECTRIC CONDUCTORS

Direct-Current. Chart for Selecting Direct-Current Conductors, C. A. Kuhmann. Power, vol. 67, no. 2, Jan. 10, 1928, pp. 68-69, 1 fig. Presents alignment nomograph based on resistance per mil-foot of copper conductor, and value used is 10.37 ohms, as given by Copper and Brass Research Association.

ELECTRIC CONVERTERS

Rotary. Small Inverted Rotary Converters, B. H. Chatto. South Power Jl., vol. 46, no. 1, Jan. 1928, pp. 42-44, 5 figs. Recent increase in demand for small quantities of alternating current in localities served by direct current has resulted in development of small inverted rotary converters of design which has overcome many faults usual to such units.

ELECTRIC FURNACES

High-Frequency. Crucible Steel Production in a High-Frequency Electric Steel Furnace. Ry. Engr., vol. 49, no. 576, Jan. 1928, pp. 10-15, 6 figs. Ajax-Northrup high-frequency electric steel furnace effects revolution in production of tool steel by increasing capacity of crucible from 60 to 450 lb., and reducing time of melting from 4 to hours to 1 hour, while also affording better control.

High-Frequency Induction Melting, D. F. Campbell. Iron and Steel of Can., vol. 10, no. 12, Dec. 1927, pp. 363-366, 5 figs. Describes high-frequency furnace used in Sheffield Steel Works for melting lots of 400 to 500 lb. of steel; 18 per cent tungsten steel in 300-lb. lots can be melted in 45 min.; very low-carbon alloys can easily be made; 150-kva. generator used.

ELECTRIC GENERATORS

Alternating Current. Maintaining Correct Voltage and Frequency. Power Plant Eng., vol. 32, no. 1, Jan. 1, 1928, pp. 67-69, 5 figs. Proper operation of a.c. generators demands accurate knowledge of factors which affect voltage and frequency; voltage variation is accomplished either by hand or by means of automatic voltage regulator; in latter case, Tirrill-type regulator is customarily used, although motor-operated face-plate rheostat is also used.

Alternating Current, Design. Alternator Characteristics Under Conditions Approaching Instability, J. F. H. Douglas and E. W. Kane. Am. Inst. Elec. Engrs.—Jl., vol. 47, no. 1, Jan. 1928, pp. 24-28, 9 figs. Comparatively recent discovery of generator instability is discussed; method of testing synchronous machinery in unstable as well as in stable range; results of test performed on two machines; conclusion is drawn that design of customary machines will have to be improved, synchronous condensers installed on many long lines or inefficient underloading of units will have to be tolerated.

Alternating Current, Short Circuits. Calculation of Sustained Short Circuits, H. B. Dwight. Elec. World, vol. 90, no. 25, Dec. 17, 1927, pp. 1243-1245. Practical method for use with alternators to calculate 3-phase and single-phase short circuit currents; simple formulas are given; methods of utilizing generator characteristics in calculation of sustained values of current for short circuits of several types.

Operation. Load, Power Factor and Temperature Control. Power Plant Eng., vol. 32, no. 1, Jan. 1, 1928, pp. 69-72, 6 figs. Economical loading of electric generators demands consideration of individual and grouped efficiencies of units; effect of power factor is important.

ELECTRIC INDUSTRIES

Canada. The Progress and Improvements of the Canadian Electrical Industry for the Year 1927. Elec. News, vol. 37, no. 2, Jan. 15, 1928, pp. 31-33. Nearly 7 per cent increase in hydro installations; several high-tension transmission lines constructed; automatic and supervisory principles grow apace; increasing demand for industrial electric furnaces; new construction; distribution system.

ELECTRIC LAMPS

Voltage Standardization. Voltage Standardization, M. D. Cooper. Nat. Elec. Light Assn.—Bul., vol. 15, no. 1, Jan. 1928, pp. 28-31. Voltage Standardization Subcommittee of Lamp Committee has just completed nation-wide survey of lighting voltage and has issued book showing lighting voltage in 18,868 communities in this country; table gives detailed statistical summary of new voltage book, as well as comparison with similar data for 1923.

ELECTRIC LINES

Coupling Capacitors. Coupling Capacitors for Carrier-Current Communication Over Power Lines. Am. Inst. Elec. Engrs.—Jl., vol. 47, no. 1, Jan. 1928, pp. 51-52, 2 figs. Discussion of paper by T. A. E. Belt, published in Oct. 1927 issue of journal.

High-Tension. Extra High-Tension Transmission Lines—A Review of the Leading Overhead Power Transmission of the World, S. E. Barratt. Wld. Power, vol. 8, no. 48, Dec. 1927, pp. 317-328, 6 figs. Insulators, towers and conductors used; 110- and 220-kv. lines, Pacific Gas & Electric Co.; 110-kv. distribution, Germany; 132-kv. line, Catalana; 132-kv. line, Trollhattan to Vesteras (Sweden); 120- and 150-kv. lines in France; 132-kv. line S.E.C. of Victoria (Australia); 165-kv. line of Knoxville Power Co.; 220-kv. Big Creek line, Southern California Edison Co.

110-Kv. Great Falls-Winnipeg Line, L. M. Hovey. Elec. News, vol. 37, no. 2, Jan. 15, 1928, pp. 27-29, 5 figs. Electrical characteristics of new 2-circuit steel-tower transmission line of Manitoba Power Co.; large towers and long spans a feature; method of calculating performance of lines; synchronous-condenser operation; river-crossing cables.

Simplified Diagram of Drop in Tension in a Line (Diagramme simplifié de la chute de tension dans une ligne), R. Fric. Revue Générale de l'Electricité, vol. 22, no. 25, Dec. 24, 1927, pp. 1129-1132, 7 figs. Describes simple alignment diagram of drop in tension in high-tension distribution line of moderate size.

Insulation. Transmission Line Insulation, A. O. Austin. Elec. World, vol. 90, nos. 26 and 27, Dec. 24 and 31, 1927, pp. 1293-1299, and 1345-1347, 16 figs. Dec. 24: Advantages and limitations of wood; theory of insulation developed; test data in line and field; economic balance outlined. Dec. 31: Practical considerations and successful use of wood indicate inherent advantages of this material; steel-tower and pole-construction practices compared.

Location Survey. Transmission Line Location Survey, A. C. Goodwin. Can. Engr., vol. 53, no. 23, Dec. 6, 1927, pp. 587-589, 6 figs. Ontario Hydro-Electric Power Commission employs aerial survey for locating new 220,000-volt transmission line from Gatineau river to Toronto, distance of 200 miles; method of procedure described; by use of these aerial pictures expensive preliminary field surveys were eliminated and work of line location much facilitated.

Parallel Load Distribution. Load Distribution Between Parallel Lines, E. Baughn. Elec. Wld., vol. 91, no. 2, Jan. 14, 1928, pp. 99-100, 3 figs. Simple graphical method based on Perrine-Baum line-regulation diagram has been used by writer to solve both simple parallel lines and also quite complicated networks; results for different assumed load conditions are quickly and easily determined.

Voltage Control. Load Ratio Control, L. F. Blume. West. Soc. Engrs.—Jl., vol. 32, no. 10, Nov. 1927, pp. 341-355 and (discussion) 356-360, 13 figs. Discussion on how to maintain normal voltage on transmission line or network under varying conditions of load; using simple and rugged machinery in place of rather complicated apparatus which has been in use but has now become impracticable on account of growth in size of plants and transmitted loads.

ELECTRIC LOCOMOTIVES

SWITCHING. Switching Locomotives. Type Ee 2/2 of the Swiss Federal Railways (Les locomotives de manœuvre, type Ee 2/2 des chemins de fer féderaux suisses), A. E. Muller. Bul. Technique de la Suisse Romande, vol. 53, no. 25, Dec. 17, 1927, pp. 298-302, 10 figs. Describes switching locomotive recently put in service at Sion, Switzerland; built at Geneva by Secheron Shops; weight 25½ tons, traction effort at starting 6,000 kg.; control board, transformers, trucks and motors treated.

ELECTRIC MACHINERY

WESTINGHOUSE. Westinghouse Engineering Developments for the Electrical Industry in 1927. C. K. Lee. Nat. Elec. Light Assn.—Bul., vol. 15, no. 1, Jan. 1928, pp. 35-38, 8 figs. Reviews developments in steam turbines; steam-turbine generator; synchronous converters; mercury rectifiers; transformers; big power transformers; switchgear; and circuit breakers.

ELECTRIC METERS

INDICATING AND RECORDING. Indicating and Recording Electric Meters. Power Plant Eng., vol. 32, no. 2, Jan. 15, 1928, pp. 134-138, 9 figs. In addition to development of several new types of meters, improved testing equipment has been devised; Mann short-interval timer to measure short intervals of time within accuracy of human factor; automatic timing device developed for use in calibrating master rotating standard watthour meters is shown schematically.

ELECTRIC NETWORKS

CALCULATION. Approximate Solution for Electrical Networks When These Are Highly Oscillatory, E. A. Guillemin. Am. Inst. Elec. Engrs.—Jl., vol. 47, no. 1, Jan. 1928, pp. 36-40. General solution to slightly damped network is expressed in terms of undamped solution by means of series expansions; gives method for evaluating complex roots of determinantal equation, and shows how expansions may be correlated with Heaviside formula to form complete approximate solution; example illustrates application to simple network.

ELECTRIC TRANSFORMERS

MOUNTING. Safety Features for Transformer Mounting, O. A. Perchway. Elec. World, vol. 90, no. 27, Dec. 31, 1927, p. 1351, 1 fig. Outdoor substations composed of not more than three 100-kva. power and one lighting transformer with pole mountings are used on system of Fulton Light, Heat & Power Co.; to secure greater safety for linemen and other operating and maintenance employees, company has improved type of support generally used for these installations.

TESTING. Analysis of Current Transformer Tests, E. C. Goodale. Elec. West, vol. 60, no. 1, Jan. 1, 1928, pp. 26-27, 3 figs. Effect of certain "misconnections" following single-phase tests verify "vector average" law; secondary series connections discussed are normally results of accident and not of intent.

ELECTRIC TRANSMISSION AND DISTRIBUTION

SYSTEMS. Electric Distribution Systems, L. G. Smith. Power Plant Eng., vol. 32, no. 1, Jan. 1, 1928, pp. 73-76, 6 figs. Types and voltage of primary systems; distribution feeder layouts; regulation; rural systems.

ELECTRIC WELDING, ARC

NON-FERROUS METAL. Non-Ferrous Metal Arc Welding, A. Churchward. Welding Engr., vol. 12, no. 12, Dec. 1927, pp. 41-42. Process of welding copper, brass, monel, bronze, nickel, aluminum and machinable cast-iron welds; what to do and not to do in welding non-ferrous metals; electrodes of various kinds for such welding.

ELECTRIC WELDING MACHINES

ARC. Motor-Driven Arc Welder. Boiler Maker, vol. 22, no. 12, Dec. 1927, p. 338, 1 fig. Most recent addition to Fuzon line of arc welders is d.c. machine operated by 3-phase a.c. motor, either 220 or 440 volts supply.

SINGLE-OPERATOR TYPE. General Electric Single-Operator Type Welder. Am. Mach., vol. 67, no. 26, Dec. 29, 1927, pp. 1039-1040, 1 fig. Machine includes four-bearing, ball-bearing motor-generator set with flexible coupling; generator rated at 300 amperes, one hour, 50 deg. cent., and driving motor at 15 h.p., 40 deg. cent., continuous rating; field control unnecessary; meters have metal front except for glass over scale; for stationary or portable use.

ELECTRICAL ENGINEERING

MECHANICS. Mechanics and Electrical Engineering, V. Karapetoff. Elecn., vol. 99, no. 2585, Dec. 16, 1927, p. 749. Problems in mechanics arising in 30 years of professional activity; anticipating future developments; branches for further study; research problems; electrical machinery; transmission lines; electric railways; mechanical forces due to magnetic fields; electromechanical applications; communication engineering; galvanometers and oscillographs; waves and oscillations; vector analysis; theory of elasticity; general laws of motion; statistical mechanics.

ELECTROPLATING

PROGRESS. Progress of Electroplating, W. Blum. Metal Industry (N.Y.), vol. 26, no. 1, Jan. 1928, pp. 25-27. Technical developments in past 25 years; plating processes and equipment; plating specification; future possibilities.

ELEVATORS

CHAIN. Chain Elevators, E. J. Tournier. Indus. Engr., vol. 85, no. 12, Dec. 1927, pp. 558-560, 6 figs. Description of chain elevators at U.S. Pipe & Foundry Co., Burlington, N.J., used to raise barrels; also outfit used in warehouse in Eastern N.Y., 5 storeys high, 150 by 300 ft.; tray elevator used.

RELAYS. Sequence Relay on Elevator Prevents Fuses Blowing, O. F. Dubruiel. Power, vol. 67, no. 1, Jan. 3, 1928, pp. 29-31, 3 figs. To overcome troubles experienced, author made sequence and relay and connected it into potential-switch coil circuit; controller cannot function except when landing doors are closed before controller is pulled to on position.

ENGINEERING EDUCATION

POLICIES AND PRACTICES. Opinions of Professional Engineers Concerning Educational Policies and Practices. Jl. of Eng. Education, vol. 18, no. 4, Dec. 1927, pp. 215-275, 24 figs. Summary of inquiries by A.S.C.E. and A.I.M.M.E., A.S.M.E., A.I.E.E. and A.I.C.E. arranged in two sections; first is based on inquiries and relates to engineering education in general; includes summary of general inferences and conclusions, opinions concerning extent and means of influence of engineering profession in engineering education; second, devoted to results of inquiries.

ENGINEERING MATERIALS

X-RAY TESTING. X-Raying Engineering Materials, G. L. Clark. Soc. Automotive Engrs. Jl., vol. 22, no. 1, Jan. 1928, pp. 130-131. Abstract of paper on New Advances in the Study of Engineering Materials by Means of X-Rays; work with spectroscope in study of detonation in internal-combustion engines; continuous spectrum of hydroxyl present during burning of all kinds of gasoline; knocking due to extension of radiation; applications of X-ray examination; structures of iron, steel, copper and brass; their behaviour under strains, results of annealing.

F

FACTORIES

LIGHTING. Telltales Showing Good Factory Lighting, R. A. Palmer. Mfg. Industries, vol. 14, no. 6, Dec. 1927, pp. 439-441, 5 figs. Abundance of high-power lamps does not mean best illumination; location of lights, size, brightness, contrast, diffusion, reflection, shadows, are all factors helping to increase production, reduce spoilage and accidents, and improve morale, where lighting system is good.

VENTILATION. Aeration of Industrial Buildings, W. C. Randall. Am. Soc. Heat. and Vent. Engrs.—Jl., vol. 34, no. 1, Jan. 1928, pp. 11-28, 14 figs. Treats of flow of air against, into and through industrial buildings without mechanical agencies; pressure of air against windows, movement of air due to temperature changes and factors which control flow of air are discussed; field surveys and correlation of model tests with surveys.

FLOOD CONTROL

PROTECTION. Protection of River Banks and Levees, O. S. Scheifele. Can. Engr., vol. 54, no. 2, Jan. 10, 1928, pp. 119-123, 15 figs. Employment of angular submerged willow-tree planting to stop erosion and slides of earth banks of rivers, canals, lakes, levees, cuts and fills and for general flood control; some projects in Canada and United States described; highway-bank protection; system of river control by willow-pole planting.

MISSISSIPPI RIVER. Mississippi River Flood Control, W. W. DeBerard. Eng. News-Rec., vol. 100, no. 2, Jan. 12, 1928, pp. 63-66, 3 figs. Brief summary of events and conditions; engineering problems presented by history's greatest flood in valley; some of many factors which must be considered in preparing plans for flood relief: breaking up large land holding becoming necessity; reforestation; reservoirs; channel auxiliaries; economics of land use; cost apportionment; map of portion of Mississippi river valley subject to overflow.

OHIO RIVER. Flood Control, with Special Reference to the Mississippi River—A Symposium. Am. Soc. Civ. Engrs. Proc., vol. 54, no. 1, Jan. 1928, pp. 190-199. Discussion by M. Knowles of symposium published in Dec. 1927 issue of Journal. Describes work of Pittsburgh Flood Commission and flood control in Ohio river basin; Pittsburgh problem; effect of encroachments; local solution not sufficient; reservoir possibilities; effect on lower rivers; national character of problem; no conflict with power uses; authoritative review.

FLOW METERS

AIR. A New Form of Compressed Air Meter, E. J. Laschinger. Engineer, vol. 144, no. 3755, Dec. 30, 1927, pp. 747-748, 6 figs. Summary of various types of meters; none being found suitable for underground mines, author devised one combining two strong points of gate and orifice types; theory of meter, which establishes relation of various factors, was to make equal angular movements correspond to equal increments of flow; called F.M.L. graphic recorder.

STEAM. Measuring and Recording the Flow of Steam. Power Plant Eng., vol. 32, no. 1, Jan. 1, 1928, pp. 46-49, 9 figs. Flow meters consist of primary element acted on by fluid and secondary element transforming action of primary element into indication or record of amount of flow; flow nozzles; thin-plate orifice; fundamental equation of flow.

FLOW OF AIR

EFFECT OF TEMPERATURE ON VISCOSITY OF AIR. On the Effect of Temperature on the Viscosity of Air, R. S. Edwards and A. O. Rankine. Roy. Soc.—Proc., vol. 117, no. A776, Dec. 1, 1927, pp. 245-257, 4 figs. Ratios of viscosities of air at various temperatures between 15 and 444.5 deg. cent. have been determined, using constant-volume method and vapour jackets to obtain definite temperatures; results are compared with work of previous observers.

FLOW OF STEAM

MEASUREMENT. Measurement of Steam Flow in Works Practice, H. C. Armstrong. Eng. and Boiler House Rev., vol. 41, no. 6, Dec. 1927, pp. 270-273, 2 figs. Calls attention to very valuable economies that result from use of steam meters for investigation of actual steam consumption of different steam-consuming process in factory and that of individual machines and apparatus working under plant conditions; illustrates practical method by which sound investigations may be carried out in simple and efficacious manner by any works engineer.

FOUNDRY PRACTICE

UNITED STATES. Foundry Practice in the United States of America, E. Longden. Foundry Trade Jl., vol. 37, no. 593, Dec. 29, 1927, pp. 227-231, 14 figs. Based on author's visit to American foundries in 1926; deals with industrial combinations, vocational training, methods of production, mass production, quality of metals used, etc.

FUEL ECONOMY

MANAGEMENT INTEREST AND. Fuel Economy Affected by Management Interest, H. W. Morgan. Power, vol. 67, no. 1, Jan. 3, 1928, pp. 16-18.

FURNACES

HEAT-TREATING. Furnace Development in Heat Treating and Forging, W. M. Hepburn. Am. Soc. Steel Treat.—Trans., vol. 13, no. 1, Jan. 1928, pp. 126-138 and (discussion) 138-141, 7 figs. Scientific developments in furnace equipment, with particular reference to combustion, refractories, insulation and temperature controls; outstanding modern gas-fired installations; trend of development has been to expand problem far beyond that of simple inventions into that of advancing science.

TEMPERATURE CONTROL. Combustion Control for Industrial Furnaces, J. Ryan. Iron and Steel Engr., vol. 4, no. 12, Dec. 1927, pp. 493-498, 9 figs. Treats of advantages of automatic control from both fuel and product standpoint in gas and oil-fired furnaces; control valve governs by-pass, main flow and speed of heating; cites various industries using automatic furnace control.

G

GAUGES

PLUG. Cylindrical and Thread Plug-Gauges. Soc. Automotive Engrs.—Jl., vol. 22, no. 1, Jan. 1928, pp. 24-26, 3 figs. Recommendations of independent committee offered for approval of society; dimensions for handles and gauging plugs for sizes from ¼ to 1½ in.; full-page table of thread-plug dimensions giving go and not-go diameters; general specification for thread plugs; table giving handles and cylindrical plugs; line cuts illustrating dimensions.

GEARS

BRASS CASTINGS FOR. Bronze and Brass Castings for Gears. Machy. (N.Y.), vol. 34, no. 5, Jan. 1928, p. 390. Recommended practice approved by American Gear Manufacturers' Assn.; use and chemical composition; chemical analysis; sampling; inspection; rejection.

REDUCTION. Speed Reducer Types, C. G. Wennerstrom. Concrete, vol. 32, no. 1, Jan. 1928, pp. 113-115, 8 figs. Discussion of several types of speed reducers, their design, capacities and suitability for various industrial uses.

TESTING. The Influence of Elasticity on Gear-Tooth Loads. Mech. Eng., vol. 50, no. 1. Jan. 1928, pp. 65-67. Progress report No. 9 of A.S.M.E. special research committee on Strength of Gear Teeth. Test runs with cast-iron gears; calculated amounts of separation on these gears show much greater variations than on hardened and ground steel gears; in general, cast-iron gears show greater amounts of separation than semi-steel gears.

GRINDING

SURFACE. Precision Surface Grinding, E. C. Larke and F. C. Smith. Machy. (Lond.). vol. 31, nos. 791 and 793, Dec. 8 and 22, 1927, pp. 308-312 and 351-354. 21 figs. Dec. 8: Precision surface grinding dependent upon skill of operator, accuracy of machine and correct composition of grinding wheel; fundamental rules governing choice of wheels; results of wrong choice; grades of wheels; form wheels; mounting of wheels; hollowing and cornering; wheel speeds; feeds; preparation for lapping; machine maintenance; swiveling angle plate; magnetic chucks; producing accurate angles on wheels. Dec. 22: Correcting chuck jaws; two-jaw chucks; correcting chasers for spacing of pitch; use of slip gauges; grinding of form tools of simple and more complicated type; measurement methods; dovetail-type form tool; grinding form tool; producing accurate radii on wheels; 12 line cuts showing details.

GRINDING MACHINES

EQUIPMENT. Describes Practical Devices for Grinding Balls and Handwheels, E. Viall. Abrasive Industry, vol. 9, no. 1, Jan. 1928, pp. 1-3, 5 figs. Emergency mountings for odd jobs in lathe or drilling machine; production methods on radial grinder; attachment for ball-end work on universal toolroom grinding machine; ball-end production on Cincinnati centreless grinder; handwheel grinding on special machine and by means of attachment for old-style machine.

SURFACE. New Surface Grinder. Iron Age, vol. 120, no. 26, Dec. 29, 1927, p. 1788, 3 figs. Hydraulic machine is recent addition to line of Norton Co., Worcester, Mass., and replaces open-side model previously marketed; designed to carry two lengths of tables, one for grinding work up to 36 in. in length, other for work not exceeding 48 in.

Surface Grinding Machine. Abrasive Industry, vol. 9, no. 1, Jan. 1928, p. 25, 2 figs. Hydraulic table traverse and two lengths of table for grinding work up to 36 in. and 48 in. in length are new features of Norton Co. model; table movement controlled by two levers; table speeds varied from 30 to 90 ft. per minute.

H

HEAT-TREATING EQUIPMENT

ELECTRIC. Selecting Electric Heat-Treating Equipment. Machy. (Lond.), vol. 31, nos. 790 and 791, Dec. 1 and 8, 1927, pp. 257-259 and 313-315, 11 figs. Two articles explaining points to consider in planning installations; heating elements, terminals, terminal connections, furnace voltage and furnace control discussed; heating elements as weakest parts of electric furnace; charts for determining worth of heating-element designs; furnaces for temperatures in excess of 1,850 deg. Fahr.; necessity for conservatism in rating heating units; factors limiting total radiation of coils; automatic control of temperature essential.

HOUSE. How Reduced Night Temperature Cut Fuel Bills, T. H. Smoot. Fuel Oil, vol. 6, no. 7, pp. 27-32, 2 figs. Shows exactly what economy can be derived from careful regulation of night temperature; if advantage is taken of reduced temperature operation at night over entire heating season, savings corresponding to system which develops average seasonal heating load of 33 per cent are respectively 5½, 10 and 14 per cent for night temperatures of 65, 60 and 55 deg.

HEATING, STEAM

CENTRAL. Urban Distribution of Heat. Project of Paris Distribution System (La distribution urbaine de la chaleur. Projet de réseau de distribution parisien), M. Baudot. Génie Civil, vol. 91, no. 25, Dec. 17, 1927, pp. 618-621, 5 figs. Description of installation to provide steam heat in Paris from central station; terms of concession granted for Paris distribution of steam; scale of prices and participation of city in profits.

EXHAUST STEAM. Improvements in Heating System Save Four Times Their Cost, J. C. Evans. Power, vol. 67, no. 1, Jan. 3, 1928, pp. 27-28. Exhaust steam for industrial processes used for building heating, instead of high-pressure steam, in factory engaged in manufacture of rubber products; operations of heaters made automatic.

HYDRAULIC DREDGES

INSTALLATIONS. Hydraulicking and Dredging During 1927, G. B. Massey. Pit and Quarry, vol. 15, no. 6, Dec. 21, 1927, pp. 83-89, 9 figs. Numerous hydraulic dredge installations have been made; very few steam hydraulic dredges are being constructed except in case of those for export to locations where timber is available for fuel and where fuel oil, gasoline or electricity are not to be had; most marked improvement in situation at present time is made possible by builders of Diesel engines.

HYDRAULIC PRESSES

WHEEL-FORCING. Hydraulic Wheel-Forcing Presses. Mech. Wld., vol. 82, no. 2135, Dec. 2, 1927, pp. 411-412, 2 figs. Describes machine capable of exerting a total load of 200 tons which will accommodate wheels up to 3 ft. 9 in. over tread and axles 7 ft. long; employed for mounting and demounting wheels of locomotives, railway and street cars, mine cars, etc.

VERTICAL. Defiance No. 717 Vertical 60-Ton Hydraulic Press. Am. Mach., vol. 67, no. 26, Dec. 29, 1927, p. 1031, 1 fig. For use in pressing objects together in automobile plants and wheel plants; stroke of ram does not exceed 8 in.; hydraulic pump of double-acting type; adjusted safety valve attached to pump set to release force at any desired pressure; working surface of table top 28 in. in diameter.

HYDRAULIC VALVES

INSTALLATION. How Gate Valve Chambers Are Installed in Cleveland. Water Wks. Eng., vol. 80, no. 26, Dec. 21, 1927, pp. 1797-1798, 5 figs. Detailed drawings of methods adopted; information on large valve installations, including designs of chambers, drains and drain connections for 24-inch, 30-inch and 36-inch valves; also typical section of chamber wall when depth exceeds 12 feet.

I

ICE MANUFACTURE

RAW-WATER SYSTEM. Design Features of a Raw-Water Ice-Making System, T. Mitchell. Power, vol. 67, no. 2, Jan. 10, 1928, pp. 63-65, 5 figs. Author discusses merits of various designs of agitating tubes; he claims that medium pressures are best and recommends drawing of air from over tank.

INDICATORS

STEAM ENGINE. Measurements on Steam Engines and Turbines. Power Plant Eng., vol. 32, no. 1, Jan. 1, 1928, pp. 52-54, 5 figs. Determination of pounds of steam per kw.-hr. and per indicated horse power-hour; use of indicator; tests by weighing condensed steam; use of dynamometers; measurement on steam turbines.

INDUSTRIAL RESEARCH

APPLICATION OF. Application of Research to Sales, Production and Employment Problems in New England. Textile World, vol. 72, no. 25, Dec. 17, 1927, pp. 35-36. Results of investigation made by Metropolitan Life Insurance Co. of research which has been employed in New England industries dealing with sales, production and employment; covers package sizes, labour saving, customer contact, special machines, employment co-operation, team work and research.

INSULATING MATERIALS

BRITTLENESS. Brittleness Tests for Rubber and Gutta-Percha Compounds, G. T. Kohman and R. L. Peck, Jr. Indus. and Eng. Chem., vol. 20, no. 1, Jan. 1928, pp. 81-83, 2 figs. Insulating material compounded of rubber, gutta-percha or similar substances becomes brittle at temperature characteristic of material, below which it may not be used if liable to mechanical stress; apparatus was designed for determining this temperature; highest temperature at which fracture occurs in this test (brittle temperature) has been found to be nearly independent of bending angle and sample's dimensions, provided rate of bending is maintained at nearly constant (high) rate.

INTERNAL-COMBUSTION ENGINES

EXHAUST GAS, TESTING. Interpretation of Exhaust Gas, C. C. Minter. Soc. Automotive Engrs.—Jl., vol. 22, no. 1, Jan. 1928, pp. 19-23, 3 figs. Physiochemical aspects of exhaust gas of internal-combustion engines; composition of non-homogeneous charge pictured as manifestation of law of probabilities; ideal volumes of combustion products; probability law applied to full distribution; development of general formulas; calculations of combustion products.

See also Diesel Engines.

IRON-CARBON ALLOYS

METALLURGY OF. The Metastable Nature of Iron Carbide, A. Hayes. Ohio State College of Agriculture and Mechanic Arts—Official Pub., vol. 26, no. 1, June 1, 1927, 51 pp., 21 figs. Free energy and heat of formation of iron carbide for temperature interval 650-700 deg. cent.; calorimetric determination of heat formation of iron carbide at room temperatures; graphitizing behaviour of pure iron carbon alloys in critical range.

IRON CASTINGS

DIRTY. What Causes Dirty Castings? W. F. Prince. Foundry, vol. 56, no. 1, Jan. 1, 1928, pp. 19-20.

PROPERTIES. Castings of High Resistance (Pearlitic Cast Iron) [Les fontes à resistance élélée (fontes perilitiques)], A. Le Thomas. Revue Industrielle, vol. 58, no. 2222, Jan. 1928, pp. 16-20, 6 figs. Increase in mechanical properties of high-resistance cast iron; methods of making chemical and metallographic tests; various methods of making high-resistance castings, viz., Lang, Emmel, Schuez are given; evolution of cast-iron testing.

Centrifugal Castings for Diesel Engines, J. E. Hurst. Foundry Trade Jl., vol. 37, no. 591, Dec. 15, 1927, pp. 199-201, 5 figs. Chemical composition and properties of centrifugal castings; resistance to wear and heat conditions; spun-sorbitic centrifugal castings; two most important advantages of centrifugal over vertical sand-casting processes for production of cylindrical castings are soundness and freedom from internal defects and extreme closeness and uniformity of grain size which is reflected in mechanical strength properties of this material.

IRON

CORROSION. The Action of Water, Air, Oxygen and Carbon Dioxide on the Corrosion of Iron, K. Inamura. Tohoku Imperial University—Sci. Reports, vol. 16, no. 8, Dec. 1927, pp. 979-986, 1 fig. Investigation to determine essential factor of corrosion; using Armo iron, action of distilled water, city water and sodium-chloride solution upon iron was studied; also action of air, oxygen and CO_2 was studied and it was shown that action of CO_2 is weaker than that of oxygen, while CO_2 accelerates rate of corrosion by oxygen. (In English.)

PURE. The Direct Production of Pure Iron. P. Longmuir. Iron and Steel of Can., vol. 10, no. 12, Dec. 1927, pp. 370-371. Historical sketch of various methods of making iron directly in furnaces; discusses possibilities of direct reduction and its commercial advantages; touches Thomas Rowland's proposals for production of high-purity metallic iron.

IRON METALLURGY

DEVELOPMENTS. Metallurgical Developments of 1927, S. Goodale. Blast Furnace and Steel Plant, vol. 16, no. 1, Jan. 1928, pp. 46-48. Important new advances made during year in blast-furnace and foundry practice and in steel-plant equipment and operations and rolling-mill design; electric melting, treating and welding; developments of Knowles tube that made it possible for Judge Gary, sitting in his office in New York City, to start newly electrified Homestead structural mills with mere waving of his hand over bulb on his desk.

L

LATHES

AUTOMATIC, OPERATION OF. Auto-lathe Production. Machy. (Lond.), vol. 31, no. 790, Dec. 1, 1927, pp. 283-284, 4 figs. Brief article giving examples of practice on new Herbert No. 3 machine; completely machining Whittle-type belt pulley in 20 min.; first operation described with special mounting and tools used; second operation in finishing work; two line cuts showing details of Whittle Belt pulley and friction ring carrier also machined on auto-lathe.

TURRET, CAM DESIGN. Dwell Cams and Auxiliary Slides. Machy. (Lond.), vol. 31, nos. 791 and 793, Dec. 8 and 22, 1927, pp. 292-295 and 399-401, 16 figs. Dec. 8: Development of dwell cams and auxiliary slides for automatic turret lathes; most needed on larger machines where work consists mainly of castings or forgings; two drum cams for moving turret slide and cross-slides; development of drum; auxiliary slide for mounting on back or front of cross-slide; line cuts giving design and development layout. Dec. 22: Practical examples of some of many useful applications of dwell and how, given required data, to lay out cam developments; time loss resulting from roller working around peak of cam; timing of cams to cause desired relative movements; layout for taper turning; layout for turning bevel pinion blank; case in which turret dwell was required but cross-slide dwell unnecessary; line cuts showing layout for different operations.

LEAD ALLOYS

TERNARY. Ternary Systems of Lead-Antimony and a Third Constituent, R. A. Morgen, L. G. Swenson, F. C. Nix and E. H. Roberts. Am. Inst. Min. and Met. Engrs.—Tech. Pub., no. 43, Dec 1927, 33 pp., 23 figs.

LOCOMOTIVE BOILERS

WATER-TUBE. Proposed High-Pressure Water-Tube Locomotive Boiler, L. A. Rehfuss. Boiler Maker, vol. 22, no. 12, Dec. 1927, pp. 339-342, 349, 6 figs. Boiler designed for 500-lb. pressure indicates lines along which steam locomotives of greater efficiency and higher powers may be developed; advantages are: high pressure, superior combustion efficiency, superior circulation, quick steaming, compound superheating, safety from crown or other extensive explosions.

LOCOMOTIVES

DESIGN. Development and Design of Modern Steam Locomotives, F. J. Carty. Steam Coal Buyer, vol. 8, no. 6, Dec. 1927, pp. 24-25, 35 and 43. Historical development, increase of weight; provision for American curves; introduction of link motion; high-speed passenger and freight locomotives; introduction of stokers; thermic system; latest mechanical improvements; turbine and 3-cylinder engines; advantages.

ELECTRIC. *See Electric Locomotives.*

FIREBOXES, WELDING. Repairing Copper Fireboxes by Welding (Réparation par soudure autogène des foyers en cuivre), M. Houlet. Revue Générale des Chemins de Fer, vol. 46, no. 12, Dec. 1927, pp. 552-564, 24 figs. Practice of Eastern Railway Co.; acetylene and oxygen are used at same time by two welders; various types of repairs are noted.

MAINTENANCE. Engine Handling at Terminals, H. E. Bergstrom. Ry. Jl., vol. 34, no. 1, Jan. 1928, pp. 24-26, 1 fig. Treats of process of handling engines at Northern Pacific R.R. terminals, such as inspection, cleaning, coaling, sanding, etc.; organization of forces at terminals; time occupied by engine in mechanical department and economy of quick handling in terminal.

OPERATION. Importance of Locomotive Assignment, H. J. Titus. Railway Age, vol. 83, no. 27, pp. 1323-1326. Treats of most economical methods of handling locomotives, as affected by their design, on various divisions on varying classes of service; costs of types are studied; locomotive service other than freight and factor of investment costs.

TESTING. Locomotive Tests at Purdue. Ry. Jl., vol. 34. no. 1, Jan. 1928, pp. 18-19, 4 figs. Tests being made by Am. Ry. Assn. & Purdue Univ. at Lafayette, Ind., on efficiency of air brakes; half of tests completed; brake equipment for 100-car train with trainagraph which records braking time and air pressure; 30 men are carrying on tests which will be finished in a year and a half.

THERMIC SIPHONS. Thermic Siphons on Locomotives. Ry. Jl., vol. 34, no. 1, Jan. 1928, pp. 34-36, 13 figs. Describes Nicholson siphon applied to fireboxes of locomotives; it acts to keep crown sheet covered with water and aids steaming by increasing firebox surface, increases water circulation and efficiency of locomotive.

THREE-CYLINDER COMPOUND. Some Experimental Results from a Three-Cylinder Compound Locomotive, L. H. Fry. Engineer, vol. 144, nos. 3754 and 3755, Dec. 23 and 30, 1927, pp. 718-720 and 731-734, 17 figs. Also Ry. Gaz., Dec. 23, pp. 792-793.

TRENDS, UNITED STATES. Recent American Locomotive Practice, E. C. Poultney. Ry. Engr., vol. 49, no. 576, Jan. 1928, pp. 19-23, 7 figs. Comprehensive surlocomotive features from 1892 to date giving principal dimensions of Pacific type and New York Central Hudson type; feed heating, smoke-box regulators.

LUBRICATING OILS

TESTING. Consumers' Oil Tests, A. F. Evans. Diesel Engine Users' Assn.—Paper, read at meeting, June 10, 1927, 27 pp., including discussion, 6 figs. Specification and description of lubricating-oil test and specification of apparatus; viscosity of oils at high temperatures of Diesel engine a most important characteristic of good oil; sample test sheet given.

M

MACHINE SHOPS

EQUIPMENT REPLACEMENT. What Modern Equipment Has Done—The Treadwell Eng. Co., A. A. Neave. Am. Mach., vol. 68, no. 1, Jan. 5, 1928, pp. 1-4, 9 figs. First of series of articles giving actual results achieved by replacing obsolete with up-to-date equipment; rolling-mill equipment, tube-mill machinery and hot metal and cinder cars are principal products; nine line drawings of parts with comparison of old and new operations and time saved in per cent.

MAINTENANCE COSTS. Efficient Effort by Machine-Shop and Section Men Essential for Lowered Maintenance Costs, H. H. Her. Textile World, vol. 73, no. 1, Jan. 7, 1928, pp. 71-73. Discusses maintenance of high productions and low expenses; intelligent salvaging of broken and worn machine parts, together with careful and correct installation and adjustment of both new and repaired parts from viewpoint of master mechanic.

POWER EQUIPMENT. Source of Energy in Shops (La fourniture de l'energie dans les ateliers), C. R. Dartevelle. Technique Moderne, vol. 20, no. 1, Jan. 1, 1928, pp. 63-65. Machines should be controlled individually and preferably electric; various systems of power are treated and their economical value discussed; steam, electricity and Diesel motor; and batteries are treated.

PRACTICE, PROGRESS IN. Progress in Machine-Shop Practice. Mech. Eng., vol. 50, no. 1, Jan. 1928, pp. 56-60, 3 figs. Report contributed by Machine-Shop Practice Division of A.S.M.E. Economic factors influencing metal-working industries; changes in machine tools; machine drives; advances in grinding practice; development of machine tools for use in automotive industry; advances in grinding practice; process and machines of year; standardization.

TOOL EQUIPMENT. Modern Machinery of Mechanical Industries (Le matériel moderne des industries mécanique), M. Dalbouze. Technique Moderne, vol. 20, no. 1, Jan. 1, 1928, pp. 1-40, 114 figs.

MACHINE TOOLS

DESIGN TREND, ENGLAND. The Trend of Machine Tool Design. Machy. Lond.), vol. 31, no. 792, Dec. 15, 1927, pp. 321-328, 17 figs.

ENGLAND, MODELS OF 1927. Production Machines of the Year. Machy. (Lond.), vol. 31, no. 792, Dec. 15, 1927, pp. 331-348, 40 figs. Detailed account of features that make for high output and cost reduction and samples of their application.

MATERIALS HANDLING

PROGRESS IN. Progress in Materials Handling. Mech. Eng., vol. 50, no. 1, Jan. 1928, pp. 13-18, 6 figs. Report contributed by Materials-Handling Division of A.S.M.E. Developments in cranes, hoist and tramrail equipment, elevators, electric industrial-transportation equipment, hand lift trucks, skid shipment of materials, gasoline truck and tractor equipment, conveyors and pneumatic equipment; layout in paper industry; foundry practice; construction and railway field; marine handling; ceramic industries.

METAL MINING GEOLOGY

GEOPHYSICAL EXPLORATION. Exploration for Ore by Potential Methods, E. G. Leonardon and S. F. Kelly. Can. Min. and Met. Bul., no. 189, Jan. 1928, pp. 157-158, 15 figs. From discussion of potential method and examples given, one salient feature of this method is put in evidence: this is its great flexibility; many other geophysical methods do not possess such a flexibility.

Exploring for Ore by Potential Methods, E. G. Leonardon and S. F. Kelly. Eng. and Min. Jl., vol. 125, no. 2, Jan. 14, 1928, pp. 46-49, 7 figs. Surface phenomenon; determining continuity of mineralization; field work; phenomena show permanence; some practical points. (To be concluded.)

METALLURGY

REVIEW. The Behaviour of Metals at High Temperatures, P. Henry. Metallurgist (Supp. to Engineer), Dec. 30, 1927, pp. 180-181. Review of paper published in Revue de Métallurgie, Aug. 1927, describing work carried out on rate of deformation during prolonged loading of materials in plastic state; materials used were steel and electrolytic copper in form of cylindrical test pieces; results show that, whereas mechanical strain at proportional limit decreases with temperature, total strain increases; decrease in modulus of elasticity with temperature shows that stress required to produce given spacing decreases with temperature.

METALS

COHESION. Cohesion. Metallurgist (Supp. to Engineer), Dec. 30, 1927, pp. 177-178. Refers to recent discussion on cohesion organized by Faraday Society which served to show how much still remains unknown in regard to atom and its means of attachment to its neighbours; when it is known why and how cohesion is developed to such widely varying degrees in different materials, metallurgists will have key to selection of those best suited for given purpose, and to production of new combinations of matter, but understanding of fundamental phenomena of cohesion is still very remote.

FATIGUE. Fatigue Phenomena with Relation to Cohesion Problems, H. J. Gough. Metal Industry (Lond.), vol. 31, no. 24, Dec. 16, 1927, pp. 557-561.

NITROGEN IN. Gases in Metals: III The Determination of Nitrogen in Metals by Fusion in Vacuum, L. Jordan and J. R. Eckman. U.S. Bur. Standards—Scientific Papers, no. 563, Oct. 18, 1927, pp. 468-485, 2 figs. Complete vacuum-fusion procedure was applied to analysis of several synthetic nitrides (silicon, aluminum, titanium, zirconium, chromium, vanadium) and a few irons and steels; fusion method has precision equal to that of solution method and gives higher values for nitrogen than solution method in analysis of nitrides of silicon, titanium and vanadium and in certain iron and steel samples.

MILLING MACHINES

ATTACHMENTS. Increasing the Usefulness of Milling Machines, H. Rowland. Can. Machy., vol. 38, no. 25, Dec. 22, 1927, pp. 13-14, 5 figs. Describes attachments to use on milling machines to increase variety of work done; heavy vertical milling attachment; rack milling attachment, universal spiral and circular milling attachment.

Standard Attachments for Standard Milling Machines, H. Rowland. West. Machy. Wld., vol. 18, no. 12, Dec. 1927, pp. 575-577 and 588, 8 figs.

MINE TIMBER

TREATMENT. Mine Timber, W. D. Haley. Can. Min. and Met. Bul., no. 188, Dec. 1927, pp. 1495-1505 and (discussion), 1505-1514. Discusses care after cutting, peeling, seasoning, storing; methods of treatment, and preservatives used.

MINES AND MINING

EQUIPMENT, AUTOMATIC CONTROL. Automatic Control of Mine Equipment, C. R. Seem. Engrs. Soc. Northeastern Pa., no. 5, May 1927, 12 pp. Brings out facts in regard to use of automatic equipment and savings engendered thereby, and shows that such equipment has advantages over non-automatic or manually-operated devices.

VENTILATION. Commercial Air Conditioning, E. G. Lawford. Eng. and Min. Jl., vol. 125, no. 1, Jan. 7, 1928, pp. 5-10, 5 figs. Conditions in some mines indicate that question of assisting fans by artificial changing of physical quality of circulating air is problem that will have to be faced soon.

MOULDING

CENTRE PLATE. Manufacture of a Bronze Centre Plate for a Briquetting Machine (Mémoire sur la fabrication d'un centre de plateau bronze d'appareil à fabriquer les briquettes), F. Simorre. Fonderie Moderne, vol. 21, Dec. 10, 1927, pp. 488-496, 8 figs. Details of making moulds and core boxes; sand micture; methods of pouring; charging furnaces; mixtures to use and time taken for different operations in foundry when making bronze centre plate weighing about 900 kg.

COSTS. Short-Cut Method to Find Moulding Costs, M. R. Lott. Mfg. Industries, vol. 14, no. 6, Dec. 1927, pp. 443-446, 6 figs. Author has worked out simple and satisfactory solution for moulding cost of brass and aluminum castings which are variable items.

MOULDS

WATER-COOLED. Water-Cooled Chill Moulds. Metal Industry (Lond.), vol. 31, no. 24, Dec. 16, 1927, pp. 560-561. Criticisms on article entitled "Water-Cooled Chill Moulds in Brass Foundries," in same journal for Nov. 18; author claims that for casting rolled plates, only one kind of water-cooled chill mould is recognized practically and widely adopted in brass industry, namely, cooling form made by Junker, of Solberg, Rhineland; claim can be emphatically maintained that such moulds never wear down.

MOTION STUDY

MACHINING METAL. Time Losses in Machining Practice. Mech. Wld., vol. 82, no. 2137, Dec. 16, 1927, pp. 450-451, 3 figs. Methods of speeding-up movements at specific periods, reducing non-cutting motions to briefest time, stopping drives or feeds instantly, varying either of these frequently to get best output, and using rapid-power mechanism for adjustments and clampings.

MOTOR BUSES

EXHIBITION, LONDON. International Commercial Motor Transport Exhibition. Tramway and Ry. World, vol. 62, no. 30, Dec. 15, 1927, pp. 343-357, 30 figs. Shows many photos and gives description of buses from 30 makers; many 6-wheel buses were shown; 4-wheel brakes were fitted in many cases and two types of power brakes; one vacuum servo and one compressed air.

OPERATION. Montreal Tramways Company's Bus and Coach Operations. Can. Ry. and Mar. Wld., no. 359, Jan. 1928, pp. 42-45, 7 figs. Describes buses used on city and suburban service in Montreal; a truck-mounted gas-electric coach is shown and that and others listed as to type and capacity; 70 buses in operation, 28 ordered; operating results for 1926 are given.

Pacific Coast Fleet-Maintenance Practice, E. C. Wood. Soc. Automotive Engrs.—Jl., vol. 22, no. 1, Jan. 1928, pp. 27-39. Report of West Coast Subcommittee presented at Transportation Meeting in Chicago; provisions of state laws; standardization to reduce costs; equilibrium-distillation basis for carburetors; valves and other parts; cooling and fuel systems; reconditioning bearings; changes wanted in power-transmitting parts; brakes and brake-lining failures; tires and tire trouble; maintenance of springs and lighting equipment; air-cleaner bibliography; use of governors to lessen maintenance.

SPECIFICATIONS. Condensed Specifications of Motor-Vehicle Chassis for Bus Service. Bus Transportation, vol. 7, no. 1, Jan. 1928, pp. 44-45. Two-page table giving trade name and model, chassis list price, seating capacity, weights, main dimensions, engine details, electrical equipment, transmission, axles, steering gear, brakes, wheels, tires.

MUNICIPAL ENGINEERING

PROBLEMS. Municipal Engineering Problems, E. G. Kaltenbach. Professional Engr., vol. 13, no. 1, Jan. 1928, pp. 13-17. Glimpse of engineering problems and activities of Pittsburgh Metropolitan District; department of public works, bridges, tunnels, summary of funds for municipal improvements under Pittsburgh Metropolitan District.

N

NON-FERROUS METALLURGY

PROGRESS. Marked Progress in Non-Ferrous Metallurgy Last Year. W. M. Corse. Iron Age, vol. 120. no. 1, Jan. 5, 1928, pp. 69-71. Copper—advantages broadcast; lead—no spectacular progress; zinc—new processes and alloys; zinc-base magnesium-bearing alloy designed for die casting; nickel—new outlets developed; monel metal has new fields; solid nickel-silver plumbing fixtures; aluminum and magnesium—Alclad, new aluminum sheet. has strength and corrosion resistance; trend in lighter weight in transportation; magnesium expansion; chromium and chromium plating expands.

NON-FERROUS METALS

CANADA. The Miscellaneous Non-Ferrous Metal Products Industry in Canada, 1926. Metal Industry (Lond.), vol. 31, no. 26, Dec. 30, 1927, p. 603. Production amounted, according to Dominion Bureau of Statistics, to $998,512 in value, as compared with $999,277 reported for previous year.

NON-METALLIC MINERALS

RESEARCH. Non-Metallic Minerals Station, Bureau of Mines, in Many Activities, O. Bowles. Rock Products, vol. 30. no. 26, Dec. 24, 1927, pp. 169-170. Work covered investigations in lime, gypsum, potash, metallurgical limestone, mica and slate industries: effect of steam in lime kiln; anhydrite in cement retardation; metallurgical limestone; wire saw in slate.

O

ORE TREATMENT

FLOTATION. Gas Sorption in Flotation. A. S. Adams. Am. Inst. Min. and Met. Engrs., no. 41, Dec. 1927, 10 pp., 5 figs. Contact angle and oil attraction; sorption power of solids for gas; experiments on connection between absorption and flotation; floatability if mineral depends on nature of gas in bubble, and it is therefore concluded that solid-gas sorption is factor in flotation process.

The Flotation of Oxidized Ores, T. Varley. Min. Jl., vol. 11, no. 16, Jan. 15, 1928, pp. 5-6. Paper brings up-to-date literature on flotation of oxidized ores and describes methods in use at various flotation plants; flotation of oxidized and carbonate copper ores at Ajo, Arizona. (Concluded.)

OXY-ACETYLENE CUTTING

ACETYLENE VS. CITY GAS. Acetylene and City Gas, J. K. Mabbs. Acetylene Jl., vol. 29. no. 7, Jan. 1928. pp. 275-278, 2 figs. Some laboratory studies which were made to show their relative values as fuel gases for cutting metals by oxidation; highest possible preheating temperature and ability to start cut quickly under all conditions are always of advantage, and these desirable characteristics can be obtained only through use of acetylene.

P

PAINTING

MECHANICAL. Paint Application by Mechanical Means, R. C. Sheeler. Indus. Power, vol. 14. no. 1. Jan. 1928, pp. 49-54. 8 figs. Advantages of spray painting and proper method of using equipment to gain best results are pointed out.

PAVEMENTS

ASPHALT. Sheet Asphalt Maintenance Requirements, G. F. Fisk. Can. Engr., vol. 53, no. 25. Dec. 20, 1927, pp. 617-619. Methods employed in laying and maintaining sheet-asphalt pavements in Buffalo since 1878 described in paper presented at sixth annual Asphalt Paving Conference, Atlanta. Ga.; repair costs for ten-year periods.

Sheet Asphalt Pavement Designed for Stability, V. Nicholson. Highway Engr. and Contractor, vol. 18, no. 1, Jan. 1928, pp. 67-69. 2 figs. Stability test for use in design and control of asphalt paving mixture is rapidly becoming popular because of close results obtained; tells of street designed and built following certain control methods; in effort to produce maximum-density sand from materials easily obtained in Chicago, series of stability and density tests were run on ordinary lake and torpedo sand, separately and in mixtures with each other, with results as shown in chart.

Stability of Asphalt Paving Mixtures, F. P. Smith. Can. Engr., vol. 53, no. 26. Dec. 27. 1927. pp. 647-649. Design and proportioning of mixtures discussed in paper presented at sixth annual Asphalt Paving Conference, Atlanta. Ga.; durability, manufacture and laying are also important factors; various types of filler; lack of compression is probably greatest factor of all in decreasing stability.

MAINTENANCE AND REPAIRS. Chicago's Method of Repairing Pavements. Earth Mover. vol. 15, no. 1. Jan. 1928. pp. 10-11. 5 figs. Practical and economical to use comparatively small portable road-repair machines built under original Adresen patents but now known as "Western Hot Patch Outfit."

BITUMINOUS. Bituminous Types of Pavements for Streets and Roads, H. W. Skidmore. Purdue Univ.—Bul., vol. 21. no. 3, May 1927. pp. 146-165. Discussing broad, general subject of bituminous pavements proceeding from most simple form of construction to most complex; penetration types; premixed types; hot application and plant for it; construction details.

BRICK. The Recent Study of Thin Brick Pavements by the U.S. Bureau of Public Roads, L. W. Teller. Purdue Univ.—Bul., vol. 21, no. 3, May 1927, pp. 12-22, 4 figs. Field survey was made of several million square yards of thin brick pavements which had been in use for length of time sufficient to demonstrate their serviceability; accelerated traffic test was run on series of brick wearing surfaces of different thicknesses; 2-in. and 2½-in. bricks used from one manufacture; accelerated traffic tests were carried on at Arlington, Virginia.

CONCRETE. Concrete Pavement Opened to Heavy Traffic at Age of 46 Hours. Concrete, vol. 32, no. 1. Jan. 1928. pp. 31-33. 5 figs. Description of methods used to secure high early strengths with standard portland cement on cold-weather pavement construction job; pavement at Wyandotte, Mich.; slab is 10 in. thick at edges, tapering to 8 in. at 2 ft. from edges; concrete kept at 50 deg. Fahr. during curing; concrete proportions given.

Design and Construction of Concrete Pavements. C. Older. Am. Soc. Civ. Engrs. Proc., vol. 54, no. 1. Jan. 1928, pp. 147-154, 1 fig. Computation of stresses and their application to practical design and construction practice recommended; construction details to follow.

COST. Cost and Technique of Opening Concrete Street Pavements. Concrete Products. vol. 33, no. 6. Dec. 1927, pp. 53-54, 8 figs. Rates used in various cities; method of patching described; curing; if these suggestions are followed carefully and proper materials used, patch will be produced which will unite perfectly with old concrete; temporary repairs.

PETROLEUM GEOLOGY

ALBERTA. Natural Gas Its Production and Use in the Province of Alberta, C. J. Yorath. Natural Gas, vol. 9, no. 1, Jan. 1928, pp. 20-23 and 50, 1 fig. Alberta may be divided into four major structures, extending as belts northward from international boundary; new transmission line; may recharge sands.

PIPE, CAST-IRON

JOINTS. Bronze Joints in Cast-Iron Pipe, T. C. Fetherston. Iron Age, vol. 120, no. 26. Dec. 29, 1927, pp. 1782-1784, 4 figs. Four years' service experience indicates weaknesses in butt joints with collar welds; new "shear-vee" design proves cheaper and twice as strong.

New Bronze Joint Has High Strength, T. W. Greene. Acetylene Jl., vol. 29. no. 6. Dec. 1927, pp. 246-248, 5 figs. Comparison of three types of welded pipe joints; collar-type joint failures analyzed; advantages of Shear-Vee joint in giving 100 per cent more strength than collar-joint and developing full strength of pipe, cheaper and easier to make, graphical stress transfer shown for both types of joint.

WELDING. Developments in Cast-Iron Pipe, H. Y. Carson. Am. Water Wks. Assn. —Jl., vol. 18, no. 6, Dec. 1927, pp. 721-727, 4 figs. Eliminating joints by welding; bronze-welding; one table of practical bronze-welding data; large pipe with welded tees; cement-lined cast-iron pipe.

PILE DRIVING

FORMULAS. A Critical Examination of Pile-Driving Formulas, A. J. Hunter. New Zealand Soc. Civ. Engrs.—Proc., no. 13, 1926-27, pp. 44-45 and (discussion) 55-83. Treatment of theory of pile driving with application to special cases and comparison of practice with theory; many charts are given showing bearing power of piles according to various formulas.

STRUCTURAL ENGINEERING. Piling in the Service of Structural Engineering, M. J. McCarthy. Structural Engr., vol. 5, no. 12, Dec. 1927, pp. 369-380, 17 figs. Treats of sheet piling and independent piles; methods of sinking; types of pile drives and power hammers. The advantage of hammers over drop drivers; American and English hammers described.

PIPE, WATER

RUST REMOVAL. Removal of Rust from Pipe Systems by an Acid Solvent, F. N. Speller, E. L. Chappell and R. P. Russell. Mass. Inst. Technology—Pub., vol. 63, no. 53. Oct. 1927, 7 pp., 3 figs. New method of removing rust from cold-water piping of large New York office building; method is thought to be equally applicable to removal of rust from condensers, boilers, heaters and other fabricated systems which would be expensive to take down and clean by ordinary methods; removal is accomplished by dissolving rust in acid rendered inert toward metal by addition of inhibitors. Paper presented at Am. Inst. Chem. Engrs.

POWER PLANTS

DESIGN. The Role of the Civil Engineer in Power Development, I. W. McConnell. Am. Soc. Civ. Engrs.—Proc., vol. 54. no. 1, Jan. 1928, pp. 155-164, 1 fig. Argues and demonstrates with examples from practice that civil engineer has more opportunity to effect economies in construction of works for production and distribution of power than any other type of engineer connected with design.

EQUIPMENT. Choosing Power Equipment, J. N. Landis. Elec. World, vol. 90, no. 25, Dec. 17, 1927, pp. 1237-1241, 19 figs. Method of evaluating bids based on curves plotted from operating conditions and guaranteed performance; examples of application to specific cases; basis for calculating annual carrying charges; development of load-duration curves; determination of installation costs.

MANAGEMENT. Eleven Fundamentals of Management Save Money in the Boiler Room, H. L. Griffin. Mfg. Industries, vol. 14, no. 7, Dec. 1927, pp. 461-463. Discusses fundamentals which have been successfully applied in a dozen or more factory power plants.

ELECTRIC SUBSTATIONS. Substation Construction of Los Angeles Gas & Electric Corporation, W. R. Shettel. West. Constr. News, vol. 2, no. 24, Dec. 25, 1927, pp. 54-55, 4 figs. Architectural design of Pico street substation in keeping with better type of buildings along boulevard; switch regulator, transformer cells and bus troughs of reinforced concrete; supervisory control system; brief description of Palo Alto street and Western avenue substations.

STEAM VS. WATER POWER. Relation of Steam to Water Power, A. H. Markwart. Power, vol. 67. no. 1. Jan. 3, 1928. pp. 39-41. 4 figs. With hydro equipment nearing maximum efficiency and development costs increasing and marked improvement in steam-plant economies, it would appear that ultimate development of water power must involve use of proportion of steam power; it is quite probable that combination system will generate at lower cost than either steam or hydro alone; economic study of factors involved in these two power sources.

STEAM, HIGH-PRESSURE. Experiences with 1,300-Lb. Steam Pressure. J. Anderson. Eng. and Boiler House Rev., vol. 41. no. 6. Dec. 1927, pp. 266-270, 4 figs. Though high-pressure installation at Lakeside Station, Milwaukee, has been in service 57 per cent of 11-months' period since starting, operating one continuous period at full capacity for 50 days and improving overall plant efficiency 4 per cent. major troubles have been experienced which are discussed in detail; condenser leakage; boiler-tube failure. (To be continued.)

STEAM, MANAGEMENT OF. Fundamentals of Management Save Money in the Boiler Room, L. H. Friggin. Paper Trade Jl.. vol. 85, no. 26, Dec. 29, 1927, pp. 47-49. Eleven major principles are given for boiler-room management and these are discussed; kind of equipment to add and importance of power-plant instruments and keeping of records emphasized.

PRESSURE VESSELS

WELDING. Procedure Control in Pressure Vessel Welding, H. E. Rockefeller. Boiler Maker, vol. 22, no. 12, Dec. 1927. pp. 346-348, 4 figs. Design of vessel for 300-lb. pressure; selection and preparation of material; oxy-acetylene welding of longitudinal seams and reinforcing rings. Paper presented at Int. Acetylene Assn.

PULVERIZED COAL

BURNERS. A New Pulverized Fuel Burner. Eng. and Boiler House Rev., vol. 41 no. 6. Dec. 1927, pp. 288-289, 1 fig. In new Lopulco design, fuel and air within burner are deliberately segregated; design is not influenced by any arrangement of external piping, and it operates with low air pressure; suitable for every type of boiler and also for general furnace work.

UTILIZATION. Pulverized Coal in a Large Power System, T. E. Purcell. Combustion, vol. 18. no. 1, Jan. 1928, pp. 41-45, 5 figs. Discussion of successive developments in use of pulverized fuel in plants of Duquesne Light Co., and of results obtained with this method of firing; interesting comparison is made between service hours available with pulverized fuel and stoker units.

Survey of the Present Use of Pulverized Fuel, P. Junkersfeld. Combustion, vol. 18, no. 1, Jan. 1928, pp. 31-35. Survey of growth in use of pulverized fuel for power plant work; what has been accomplished and probable future tendencies; author feels that there will be increasing use of this method of burning fuel, and that further improvements may be looked for as result of studies now being made.

PUMPS

AIR LIFT IN OIL FIELDS. Principles of Air Lift as Applied to Oil Production, H. R. Pierce and J. O. Lewis. Oil Weekly, vol. 47, no. 6, Oct. 28, 1927, pp. 43-46 and 56-60. Reviews theory of air lift, elements of mechanical efficiency, collecting and analyzing evidence, pressure and volume of air, surface flow lines, gas-oil ratio, estimating compressor capacity.

PUMPS, CENTRIFUGAL

Axial-Flow and. Low-Lift, Axial-Flow and Centrifugal Pumps, H. R. Lupton and J. H. W. Gill. Water and Water Eng., vol. 29, no. 347, Nov. 21, 1927, pp. 435-445, 17 figs. Construction and characteristics of axial and axial-radial pumps; development of method pursued in determining characteristics and losses, contrasting axial with ordinary centrifugal type; description of experimental plant being installed at Ferrybridge, Eng., and of tests it is hoped to carry out. Abstract of paper read before Brit. Assn.

Selection. Selection of Centrifugal Pumps. Can. Min. Jl., vol. 48, no. 52, Dec. 30, 1927, pp. 1054-1057, 6 figs. Selection for or application particularly to mining and milling industries; characteristics of pump suitable for drawing from Crowe tank and delivering to precipitation press; characteristics of pump suitable for mine drainage and unwatering.

R

RADIATORS

Steam, Performance of. Effect of Enclosures on Direct Steam Radiator Performance. Univ. of Ill.—Bul., vol. 25, no. 8, Oct. 25, 1927, pp. 5-37, 21 figs. Investigation to determine effect of various types of present-day commercial radiator enclosures, shields and covers on steam-condensing capacity of direct cast-iron radiator; factors studied were air inlets, air outlets, heights and grilles.

RADIO

Apparatus. Rectifiers and Smoothing Circuits, F. Record and I. N. Holmes. Wireless Wld., vol. 21, no. 26, Dec. 28, 1927, pp. 841-843, 5 figs. An experimental study of input and output wave forms by means of Duddell oscillograph; tests described were made on experimental unit employing a U.5 tube which is a full-wave rectifier.

Wavemeters. The Accuracy and Calibration Permanence of Variable Air Condensers for Precision Wavemeters, W. H. F. Griffiths. Experimental Wireless, vol. 5, no. 52, Jan. 1928, pp. 17-24, 8 figs. Capacity uncertainties are discussed in first part of article and in second part is described entirely new design of variable-air condenser by use of which it is hoped to fill, more effectively, gap which exists between good commercial heterodyne wavemeters having overall accuracy of, say, 2 parts in 1,000 and modern multi-vibrator standard of radio frequencies.

Waves. Experiments and Observations Concerning the Ionized Regions of the Atmosphere, R. A. Heising. Inst. Radio Engrs.—Proc., vol. 16, no. 1, Jan. 1928, pp. 75-99, 12 figs. Experiments are described in which virtual height of reflecting ionized region was measured, using time lag between impulses arriving over direct and reflected path; measurements were made on 57 and 111 meters; height was ascertained only at night and daylight hour before sunset; experiments and curves are mentioned that show absorption to be one of important factors causing poor daylight transmission in wavelength region contiguous to 214 meters.

RAILROADS

Curves—Surveying. String Lining of Curves Made Easy, C. H. Bartlett. Ry. Eng. and Maintenance, vol. 24, no. 1, Jan. 1928, pp. 4-6. Method of correcting alignment which is quicker and more convenient than use of engineering instruments; proposed method points out exactly what correction is needed at each point in order to make true curve; no elaborate equipment is necessary; no complicated mathematical expressions to use; several trials are required to line curve which is badly out of shape; work can be inspected in advance.

Electrification. Electric Traction Development During 1927, A. G. Oehler. Ry. Age, vol. 84, no. 1, Jan. 7, 1928, pp. 41-42, 2 figs. Treats of electrification of railroads during 1927; kind of cars and locomotives ordered; recent developments in electric locomotives, operating data and projects for railroad electrification in 1928.

Electrification, Virginian Railway. The Virginian Railway Electrification, G. Gibbs. Am. Soc. Civ. Engrs.—Proc., vol. 54, no. 1, Jan. 1928, pp. 3-59, 26 figs. Presents broad engineering features of recent electric-traction installation for long-distance freight service of heaviest character, in manner which will make clear to railway engineers generally its essentials in design, construction and operation; general description of main elements of electric-traction system and inspection and repair facilities provided for locomotives.

Roadbeds. Will a Concrete Roadbed Stand Up? Ry. Eng. and Maintenance, vol. 24, no. 1, Jan. 1928, pp. 12-13, 2 figs. Describes 1,326-ft. section for double-track main line of Pere Marquette near Detroit; conditions of concrete; improvements can be made; first year's service of Pere Marquette installation developed no serious defects.

Signals and Signalling. A New Method of Operating Semaphore Signals. Engineer, vol. 144, no. 3755, Dec. 30, 1927, pp. 745-746, 5 figs. Although system of operating semaphore signals was invented to meet and defeated predatory habits of Chinese bandits, it should prove interesting and useful under variety of normal conditions which will readily suggest themselves to railway signal engineers; system is invention of J. H. Williams.

Terminals. Canadian Roads Open Impressive Union Station at Toronto. Ry. Age, vol. 83, no. 26, Dec. 24 (Section 1) 1927, pp. 1243-1250, 10 figs. Plans and description of new Union Station containing post office, railroad offices, train concourse, waiting room, dining room, baggage room, etc.; front, 850 ft. long, 7 stories high, with two wings 250 ft. long, 4 storeys high; Bedford limestone used.

Ties, Concrete. Reinforced Concrete Sleepers, H. Stringer. Ry. Engr., vol. 49, no. 576, Jan. 1928, pp. 32-33, 4 figs. Ties used in China; tests made on 60-lb. rails with 6-coupled locomotive having 12-ton axle load, running at 15 m.p.h.; test on ties reinforced by boiler tubes or solid rod; former has shown cracks, latter none; in all cases tubes employed for reinforcement were scrap.

Train Despatching. A New Train Despatching System, New York Central Lines, B. J. Schwendt. Ry. Gaz., vol. 47, no. 25, Dec. 16, 1927, pp. 753-762, 19 figs.

RAILWAY MOTOR CARS

Diesel-Electric. Pioneering the Diesel Railcar. Oil Engine Power, vol. 6, no. 1, Jan. 1928, pp. 26-28, 4 figs. Diesel-electric railcar built jointly by New York Central Railroad and McIntosh and Seymour Corporation represents important American development in utilization of oil-electric drive for propulsion of self-contained passenger coach.

RAIN AND RAINFALL

Influence of Forests. Influence of Forests on Rainfall. Can. Engr., vol. 53, no. 26, Dec. 27, 1927, pp. 637-639. Effect of varying conditions on amount of rainfall and resultant run-off; causes of precipitation; water vapour from sea largely responsible for rainfall; forests increase local rainfall and cause more regular run-off; subject treated from European standpoint with fundamental conditions as basis.

RECTIFIERS

Mercury-Arc. Operation and Performance of Mercury-Arc Rectifier on the Chicago, North Shore and Milwaukee Railroad Company, C. Antoniono. Am. Inst. Elec. Engrs.—Jl., vol. 47, no. 1, Jan. 1928, pp. 3-7, 4 figs. Actual operating results and experiences with rectifier feeding railroad; rectifier is compared with synchronous converters in regard to efficiency, troubles, maintenance, etc.; advantages are: high efficiency over whole working range, high capacity to absorb momentary loads, insensibility to short circuits, no synchronizing, simple operation and minimum attention, noiseless operation and no vibration, low maintenance cost, reliability of service.

REFRACTORY MATERIALS

Properties. Properties of Refractories in Zinc Metallurgy, E. S. Wheeler, A. H. Kuechler and H. M. Lawrence. Univ. Missouri School of Mines and Met., vol. 10, no. 2, Feb. 1927, pp. 11-137, 94 figs. Study made of physical properties of bodies containing varying percentages of old retort material and zinc oxide as grog; preliminary tests seemed to indicate that retorts decrease in refractoriness in service, as several samples of old retort material showed very low deformation values.

REFRIGERATING MACHINERY

Corrosion. Corrosion in the Refrigerating Industry, J. K. Roberts, H. O. Forrest and R. P. Russell. Refrig. Eng., vol. 14, no. 6, Dec. 1927, pp. 173-182 and 187, 17 figs. A.S.R.E. corrosion committee presents draught of its final report; corrosion of iron, steel and galvanized steel in brine systems may be greatly reduced by addition of sodium dichromate to brine; disodium phosphate as corrosion retarder; comparison of dichromate and phosphate treatments; other materials as retarders in brine; corrosion in condenser systems and in salt water; heat-transfer measurements for paint coatings and rust films; recommendations for treatments and instructions for application.

REFRIGERATING MACHINES

Mercury-Compressor. A Hermetically Sealed Refrigerating Machine Using the Mercury Compressor, J. G. DeRemer and R. W. Ayres. Refrig. Eng., vol. 14, no. 6, Dec. 1927, pp. 169-172, 7 figs. Refers to paper published in Nov. 1926 issue of this journal and Mid-Nov. 1926 issue of Mech. Eng. (see reference in Eng. Index 1926, p. 633), in which reference was made to application of mercury compressor to refrigeration in form of sealed rigid element having no internal moving parts, requiring no internal lubricant and possessing other interesting features; present paper records recent advance made in this type of refrigerating machine.

REFRIGERATING PLANTS

Piping. Piping for Cold Storage Rooms, W. S. Huntington. Refrigeration, vol. 42, no. 6, Dec. 1927, pp. 54-56. Describes and tabulates sizes of piping used for brine and ammonia in cold-storage rooms.

REFRIGERATORS

Standardization. Engineering Standards for the Refrigerator Box. Refrig. Eng., vol. 14, no. 6, Dec. 1927, p. 183. Further steps toward standardization of refrigerators were discussed and planned at conference for this purpose held in Engineering Societies Building, New York, through offices of American Engineering Standards Committee.

RESERVOIRS

Protection. Storage of Water in Large Population Centre Requires Unusual Protection, C. Wilson. Hydraulic Eng. (West. Waterworks Section), vol. 3, no. 12, Dec. 1927, pp. 26-27 and 38. Fencing of reservoirs and elaborate by-passing system for storm waters have been installed by Los Angeles; storm-wall converts street into storm drain and prevents surface run-off from reaching lake; chlorination house at outlet of Lake Hollywood.

ROADS

Asphalt. Bases for Asphalt Wearing Courses, E. N. Seymour. Can. Engr., vol. 53, no. 26, Dec. 27, 1927, pp. 641-642. Construction of gravel- and stone-base courses on Georgia highways discussed in paper presented at sixth annual Asphalt Paving Conference, Atlanta, Ga.; type of base governed by location of project with respect to supply of base material.

Concrete. An Outstanding Concrete Paving Job, J. M. Breen. Contract Rec., vol. 41, no. 52, Dec. 28, 1927, pp. 229-232, 10 figs. Ten-mile stretch on Ontario provincial highway No. 3; completeness of mechanical equipment an important factor in success of job; work was carried on at rate of about 1,000 ft. per day.

Concrete Roads—Present Trend in Design and Construction, W. E. Barker. Contract Rec., vol. 41, no. 52, Dec. 28, 1927, pp. 1332-1335, 7 figs. Growth of thickened-edge design; safety measures; loads may be increased by adding wheels of vehicles; construction; better batch measurement; accurate water measurement; high early-strength concrete; changes in curing methods; resurfacing; core tests.

Construction. Paving Methods on an Illinois Super-Highway. Roads and Streets, vol. 67, no. 11, Nov. 1927, pp. 477-480, 9 figs. How state paved road in co-operation with villages and Federal Government after removal of old pavement; batching plant; subgrading; design of slab; paving operation; finishing, curing, inspection; forces used; road 40 ft. wide plus 4 ft. shoulder on each side.

Construction Equipment. Building the Nation's Roads with Oil Engine Power. Oil Engine Power, vol. 6, no. 1, Jan. 1928, pp. 19-25, 9 figs. Oil-engine economy and reliability establish it as standard power for road builder's equipment; Diesel shovels and draglines; road rollers, Diesel tractors and trucks; logging equipment; Diesel locomotives; air compressors and rock crushers.

Construction, Quebec. Record Year in Road Construction and Maintenance in Quebec, J. L. Boulanger. Contract Rec., vol. 42, no. 2, Jan. 11, 1928, pp. 30-32. 1,301 miles of new highways built and 7,801 maintained by Quebec Roads Department; programme of 1,000 miles of high-class pavements; large increase in traffic; progress of maintenance at Government's expense; permanent pavements, widening and other improvements; increase in tourist traffic.

Design. Structural Design of Roads. Am. Highways, vol. 7, no. 1, Jan. 1928, pp. 4-8. Report covers variety of subjects as motor-truck impact; subgrade studies; gravel, top-soil and sand-clay road material; top-dressing or dry maintenance roads; bituminous macadam; premixed types of bituminous pavement; concrete-pavement design.

Earth—Alberta. Earth and Sand-Clay Roads in Alberta, C. A. Dividson. Roads and Streets, vol. 67, no. 11, Nov. 1927, pp. 481-482. Describes roads in Alberta, problems met in their construction, cost; how divided; types of roads and kind used.

Gravel, Construction. Construction of Gravel Roads in B.C., E. R. Hoffman. Can. Engr., vol. 53, no. 23, Dec. 6, 1927, pp. 591-592. Fundamental features to be considered in construction and maintenance work; each section of highway presents distinctive problem; cost of preparing material for maintenance; principles of continuous maintenance.

Maintenance and Repairs. Recent Developments in Road Maintenance Methods, A. H. Hinkle. Purdue Univ. Bul., vol. 21, no. 3, May 1927, pp. 76-80. Indiana road methods described; treating protecting slopes against erosion by temporary use of straw followed by growing vines; spring treatment of shoulders and ditch slopes, and standard shoulder maintenance; repairing concrete pavements with quick-hardening concrete; use of penetration base for rock asphalt and bituminous concrete tops; method of smoothing rock-asphalt surface by use of long-base steel drag or planer; pulverizing rock asphalt and other bituminous mixtures; bituminous concrete top for traffic-bound gravel and stone roads.

The Development and Care of Light Asphaltic Oil Road Surfaces. Good Roads, vol. 70, no. 11, Nov. 1927, pp. 470-473. Costs of untreated roads; advantages and disadvantages of fine crushed rock and gravel roads; resistance to vehicles; surface oiling of roads in Oregon and cost of such treatment and maintenance. (To be continued.)

MAINTENANCE COSTS. A Cost Keeping System for Effecting Maintenance Economies. J. A. Edwards. Highway Mag., vol. 19, no. 1, Jan. 1928, pp. 11-13, 4 figs. Before type of construction can be called most economical, cost of maintenance entailed, as well as first cost, must be recorded systematically and comparison made with other types; only in this way can maintenance leads be avoided and lowest year-to-year cost of highway improvements be secured.

SURFACE TREATMENT. Survey of the Surface Treatment Fields, C. N. Conner. Can. Engr., vol. 53, no. 25, Dec. 20, 1927, pp. 630-632. (See also Roads and Streets, vol. 68, no. 1, Jan. 1928, pp. 5-7.) Era of low-cost road construction; principal methods of bituminous surface treatment discussed in paper presented at sixth annual Asphalt Paving Conference, Atlanta, Ga.; construction and maintenance methods.

SURFACES. The Evolution of Modern Road Surfaces. R. G. H. Clements. Surveyor (Lond.), vol. 72, no. 1874, Dec. 23, 1927, pp. 623-624. Engineering features and characteristics of perfect road surface with preliminary consideration; mechanical problems of actual construction, materials to be combined; block systems of paving are treated. (To be continued.)

ROCK PRODUCTS

RESEARCH. Cement, Lime, Gypsum and Stone at the Bureau of Standards in 1927. Rock Products, vol. 31, no. 1, Jan. 7, 1928, pp. 57-61. Control of fabricating and curing conditions for concrete and cement testing; durability of concrete aggregates; standard methods of physical tests for cements; terra-cotta wall investigation; hollow-tile and concrete floor slabs; composition of chemical lime; manufacture of lime; expansion of calcined gypsum on setting; limestone research; weathering tests on building stones.

ROOF TRUSSES

WELDED. Design for Welded Roof Trusses, W. Dalton. Welding Engr., vol. 12, no. 12, Dec. 1927, pp. 27-28, 5 figs. One-piece construction using arc-welded joint produces lighter member without loss of strength or serviceability; tests of welded joints in roof truss, made by Rensellaer Polytechnic laboratory; welds were fillet welds and tests were compressive and tensile.

S

SAND

PAVEMENT. Sands for Sheet Asphalt Pavements, P. Hubbard and F. C. Field. Can. Engr., vol. 53, no. 26, Dec. 27, 1927, pp. 643-646, 3 figs. Method of determining quality of sand discussed in paper presented at sixth Asphalt Paving Conference, Atlanta, Ga.; determination of percentage of voids in various sands; evaluation of sand by stability test; New York sand, sand from Potomac river, lake Erie, lake Michigan, Platte river; beach sands from Florida and Long Island, and others were tested.

SCREWS

WOOD, SPECIFICATIONS FOR. United States Government Master Specifications for Screws, Wood. U.S. Bur. Standards—Circular, no. 140, Oct. 8, 1927, 8 pp., 1 fig. Material and workmanship; general requirements; detail requirements.

SEWAGE

CHLORINATION. Chlorination in Sewage Treatment, L. N. Enslow. Contract Rec., vol. 42, no. 2, Jan. 11, 1928, pp. 32-34. How liquid chlorine is used in correcting odor nuisances at sewage plants; main causes of odors; prevention chief objective; pump station collecting wells and their relationship to odor control.

Three Studies of Sewage Chlorination. Eng. News-Rec., vol. 99, no. 26, Dec. 29, 1927, pp. 1030-1031. Laboratory tests of digestion at Harvard University and field studies at Independence, Kan., and Bridgeport, Conn., on odor control and on effect of chlorination on screened sewage.

SEWAGE DISPOSAL

ACTIVATED SLUDGE METHOD. Operation of Milwaukee Sewage Treatment Plant. Pub. Wks., vol. 59, no. 1, Jan. 1928, pp. 20-23. Largest activated-sludge plant in operation in world; only sewage-disposal plant that manufactures commercial fertilizer in large quantities and actually markets it successfully.

Scientific Sewage Disposal at Milwaukee, R. Cramer and J. A. Wilson. Indus. and Eng. Chem., vol. 20, no. 1, Jan. 1928, pp. 4-9, 13 figs. New activated-sludge plant is capable of separating 100,000,000 gal. of sewage per day into practically pure water and dry powder of high fertilizer value, and with no offense to surrounding community; description of plant and its operation and of some of chemical principles involved.

SLUDGE DIGESTION. Hydrogen-Ion Control of Sludge Digestion, G. M. Fair and C. L. Carlson. Eng. News-Rec., vol. 99, no. 22, Dec. 1, 1927, pp. 881-883, 4 figs. Optimum reaction of digestive sludge seems to vary with digestion and nature of sewage; use of adjusting chemical suggested; studies of variation in hydrogen-ion concentration of digesting sewage solids have resulted in discovery that pH control can be made to produce marked acceleration and improvement of digestion.

TREATMENT. Developments in Sewage Treatment, G. G. Nasmith. Contract Rec., vol. 41, no. 52, Dec. 28, 1927, pp. 1343-1345 and 1350. New knowledge during past year on activated sludge process, continuous flow vs. fill and draw system, activated sludge vs. mechanical aeration, colloiders, fine screens, removal of oil, sludge digestion in separate tanks, sludge treatment, storm water tanks, use of chlorine in sewage treatment, sewage treatment mechanisms, pollution of water supplies.

SNOW REMOVAL

EQUIPMENT. The Proper Selection of Snow Removal Equipment, G. E. Wallis. Good Roads, vol. 71, no. 1, Jan. 1928, pp. 18-19, 2 figs. New problem; use of straight blade; "V"-shaped plows; snow fencing for drift prevention; rotary-plow type; best selection.

ROADS. Snow Removal and Snow Problems, H. G. McKelvey. Highway Engr. and Contractor, vol. 17, no. 6, Dec. 1927, pp. 35-39, 7 figs. Methods of caring for snowfall by plows and tractors, trained men needed, snowfall data; effect of snow removal on spring maintenance; design that facilitates snow removal and relative costs. (Concluded.)

SOAPSTONE QUARRIES AND QUARRYING

QUEBEC. Soapstone Mining in the Province of Quebec, R. C. Rowe. Can. Min. Jl., vol. 48, no. 50, Dec. 16, 1927, pp. 1003-1004, 4 figs. From very small beginnings this company has worked up business on soapstone blocks for lining furnaces in sulphite-pulp mills; deposit in question occurs in same great serpentine belt that produces asbestos mine.

STANDARDS

ENGINEERING. Report of Divisions to Standards Committee. Soc. Automotive Engrs.—Jl., vol. 22, no. 1, Jan. 1928, pp. 113-128, 23 figs. Ball bearing radii, roller bearings, motor-coach batteries, storage-battery terminals, engine-testing forms, fan belts and pulleys, hood-ledge lacings, new S.A.E. steel heat-treatment definitions, headlamp laboratory tests, vacuum-brake manifold connection, passenger-car bumper mountings, Woodruff key specifications, oil- and grease-cup threads, rivet-cap specifications, taper-fitting tolerances, steering-gear connecting roads, round unslotted-head bolts, rims for low-pressure tires.

STAYBOLTS

MATERIALS. Staybolt Material Compared. Iron Age, vol. 120, no. 26, Dec. 29, 1927, pp. 1785 and 1829, 2 figs. Two independent investigations on wrought iron, steel and alloy steels; conditions under which staybolts are used.

STEAM ACCUMULATORS

RUTHS. Accumulators for Electric Power Station Overloads. Eng. and Boiler House Rev., vol. 41, no. 6, Dec. 1927, pp. 290-291, 2 figs. Some 330 of these accumulators are in operation, mainly in industries; by utilizing accumulator to cope with overloads in any projected extension of electric generating station, capital outlay necessary might be estimated at $30 to $35 per new kw. installed. Review of paper by Dr. Ruths before Soc. of German Elec. Engrs.

STEAM PIPE

DESIGN. Notes on the Design of the Steam Pipe Network in a Power Station, W. Eccles. Metropolitan-Vickers Gaz., vol. 10, no. 176, Nov. 1927, pp. 259-263, 3 figs. Similarity of piping and electric cable systems; provision for increase in steam pressure, space required, different systems, auxiliary steam supply; economical layout, steam velocity and pressure drop effect on design.

STEEL HIGH-PRESSURE. High-Pressure Steam: Its Demands on Piping, A. L. Walker. Mech. Wld., vol. 82, no. 2137, Dec. 16, 1927, p. 448.

STEAM POWER

HEAT LOSSES. Heat Losses from Fuel to Machine, R. E. Light. Eng. and Boiler House Rev., vol. 41, no. 6, Dec. 1927, pp. 278-280, 3 figs. Points out that only very small fraction of fuel-heat contents supplied to factory boiler is utilized as "work done" at machines; ultimate ratio of energy output at machines to input at grates is seldom moro than 6 per cent; detailed losses for three classes of installation are considered.

STEEL

ALLOY. *See Alloy Steels.*

DENSITY. Density of Hot-Rolled and Heat-Treated Carbon Steels, H. C. Cross and E. E. Hill. U.S. Bur. Standards—Sci. Papers, no. 562, Oct. 11, 1927, pp. 451-466, 7 figs. Density values for commercially pure and electrolytic iron and series of carbon steels, varying from 0.09 to 1.29 per cent carbon; values are given for these steels when hot-rolled, when annealed, when quenched and when quenched and tempered. Bibliography.

FATIGUE. On the Fatigue of Steels for Springs, Axles and Rails, S. Ikeda. (Japan) Dept. of Railways—Bul., vol. 15, no. 11, Nov. 1927, pp. 1745-1774, 32 figs. (In Japanese.)

HEAT TREATMENT. On a New Method of Quenching Steels in a High Temperature Bath, K. Honda and K. Tamuru., Am. Soc. Steel Treat.—Trans., vol. 13, no. 1, Jan. 1928, pp. 95-104, 7 figs.

STAINLESS. Stainless Iron and Steels, J. B. Green. Welding Engr., vol. 12, no. 12, Dec. 1927, pp. 34-36, 2 figs. Study of corrosion-resistant steel alloys and how changes in composition affect working qualities; scope of this article is confined to description of stainless steels from standpoint of using them in welded articles of manufacture; analyses of various brands of stainless steels.

STELLITE

USES. Two Metals Better Than One. Acetylene Jl., vol. 29, no. 6, Dec. 1927, pp. 241-243, 2 figs. Methods employed to weld stellite to oil-well drills by oxy-acetylene process; advantages in oil-drilling work; reports of bits in practice and stelliting in oil-field shops; the wearing qualities of stellite and its fitness for this kind of work. Shows how saving is made by use of stellite bits.

STOKERS

LOCOMOTIVE. How the Mechanical Locomotive Stoker Has Been Developed, W. Sperflage. Steam Coal Buyer, vol. 8, no. 6, Dec. 1927, pp. 40-42. Description of mechanical stoker operations such as crushing and distributing; economical limit of locomotive size justifying installation, maintenance charge and economy of operation cited in two cases; recent construction.

MECHANICAL. Some Characteristics of Modern Stokers and How the Requirements of To-day Can Be Met to Advantage, F. H. Daniels. Steam Coal Buyer, vol. 8, no. 5, Nov. 1927, pp. 17-20, 5 figs. Kinds of mechanical stokers and what is required of stokers; capacity to respond to sudden demands; multiple-retort and duplex firing stokers described and advantages enumerated.

STREAM FLOW

METHOD OF ANALYSIS. Stream Flow in General Terms, M. D. Casler. Am. Soc. Civ. Engrs.—Proc., vol. 54, no. 1, Jan. 1928, pp. 97-122, 8 figs. General method for analysis of stream flow in channels in which invert slope and channel cross-section are not constant and Chezy formula is not properly applicable; demonstrations of applicability of analysis to weirs, orifices and siphons; evaluation of friction factor; critical sections.

EFFECT OF. The Effect of Agricultural Drainage Upon Flood Run-Off, S. M. Woodward. Am. Soc. Civ. Engrs.—Proc., vol. 54, no. 1, Jan. 1928, pp. 164-183, 10 figs. Comparison of stream-flow conditions prior and subsequent to extensive drainage upon Des Moines river and Iowa river watersheds; shows that during flood periods there has been no significant change in their behaviour which may be attributed to drainage.

STREET LIGHTING

NEW DEVELOPMENTS. New Street Lighting Developments. Elec. West, vol. 60, no. 1, Jan. 1, 1928, pp. 9-13, 11 figs. In this article some of installations in cities in California involving new technique or novel practices are described.

PREDETERMINATION. Predetermining Illumination in Street Lighting, M. S. Gilbert. Elec. World. vol. 90, no. 26, Dec. 24, 1927, pp. 1301-1304, 7 figs. Method of making calculations for average conditions; use of data for fixing lighting-unit locations and magnitude of illumination; sample calculations.

T

TAPS AND DIES

EFFICIENT USE OF. Securing Best Results in Tapping, A. L. Valentine. Machy. (N.Y.), vol. 34, no. 5, Jan. 1928, pp. 353-358, 10 figs. One of series of articles; table of tapping speeds for machine tapping of nuts with carbon-steel taps; method of holding taps and nuts while tapping; tapping with acme and square-thread taps; friction tap holders described with diagram; die chasers and threading dies; relation between root diameter of taps and tap-drill sizes explained with diagrams.

TELEPHONE LINES

LONG DISTANCE. Telephonic Transmission Over Long Lines, F. J. Dommerque. Telephone Engr., vol. 32, no. 1, Jan. 1928, pp. 17-19. In any telephonic transmission, resistance, inductance, capacity and leakance determine attenuation of sound power entering line; for measure of attenuation in circuit, factor can be calculated which expresses losses of talking current per mile or kilometer of circuit, as case may be; gives list of transmission equivalents of various lines and pieces of apparatus, that is, mileage which gives transmission equal to that given by one mile of standard cable and equal to one transmission unit.

THERMODYNAMICS

INTEGRATING FACTORS. Thermodynamic Integrating Factors, A. Press. Lond., Edinburgh and Dublin Philosophical Mag. and Jl. of Science, vol. 4, no. 26, Dec. 1927, pp. 1245-1249. Integrating factor and its consequent equation of state; gamma-ratio and adiabatic expansion; integrating factor for adiabatic expansion; results tending to show that to each particular path thermodynamically pursued by substance there corresponds distinguishing thermodynamic integrating factor.

TINNING

CASTINGS. Tinning Cast and Malleable Iron Products, A. Eyles. Sheet Metal Worker, vol. 18, no. 24, Dec. 30, 1927, pp. 915 and 928.

TRACTORS

VARIED USES OF. Tractor Meeting Deals with Uses. Soc. Automotive Engrs.—Jl., vol. 22, no. 1, Jan. 1928, pp. 108-112, 5 figs. Brief review of papers presented at Annual Tractor Meeting in Chicago.

TUBES, STEEL

HEAT TREATMENT. The Effect of Heat Treatment on Cold-Drawn Steel Tubes, F. C. Lea. Engineering, vol. 124, no. 3232, Dec. 23, 1927, pp. 797-800, 16 figs. Experiments to determine effect of annealing at various temperatures on properties of cold-worked steel tubes and their relationship to fatigue range; compression and torsion tests; change of density by heat treatment; effect of repetition stresses; effect of gradually raising repeated stress.

TUNNELS

CONSTRUCTION. Driving the New Cascade Tunnel, H. J. King. Explosives Engr., vol. 6, no. 1, Jan. 1928, pp. 17-24, 15 figs. New Cascade tunnel, now under construction for Great Northern Railway Co. between Scenic and Berne, in state of Washington, is single-track bore 7.78 mi. in length.

W

WATER CHLORINATION

DRINKING SUPPLIES. Chlorinating Drinking Water Supplies, R. V. Donelly. Can. Engr., vol. 53, no. 25, Dec. 20, 1927, pp. 621-625, 4 figs. What every engineer and water-works superintendent should know about chlorination discussed in paper presented at annual convention of New England Water Works Association; operation of chlorinating equipment described; uses of chlorine.

WATER FILTRATION

SUGGESTED RATE. What Is the Best Rate of Filtration? R. B. Simms. Water Wks. Eng., vol. 81, no. 1, Jan. 4, 1928, pp. 19-20. Author suggests rate of 125,000,000 gal. per acre per day, and, where raw water is only slightly polluted and is of low turbidity, 150 million gal. per acre per day; loss of head; wash water; rate of flow in wash-water line.

RAPID GRAVEL. Modern Rapid Filters, A. Graumann. Eng. Progress, vol. 9, no. 1, Jan. 1928, pp. 12-14, 3 figs. Term of filtering, as used in discussion, implies work of removing suspended matter and of simultaneously destroying considerable part of bacteria contained in water; details of Bollmann rapid vertical gravel filters.

RAPID SAND. Five Years' Operation of a Rapid Sand Filtration Plant, M. C. Whipple and H. C. Chandler. Am. City, vol. 38, no. 1, Jan. 1928, pp. 133-138, 4 figs. Quality of raw water to be filtered, water sources, purification process at present time; coagulation filter operation; special treatment of beds.

PLANTS. Efficiency in Filter Plant Operation, J. L. Barron. Contract Rec., vol. 41, no. 50, Dec. 14, 1927, pp. 1257-1259. What successful operator should know about his duties; takes up continuous vs. intermittent operation, cleaning settling basin and beds; washing; chemical control; tests and records; use of control instruments.

PLANTS, CANADA. New Waterworks at Merritton, Ontario, E. H. Darling. Contract Rec. and Eng. Rev., vol. 41, no. 52, Dec. 28, 1927, pp. 242-245, 8 figs. Unusual layout for filter plant as result of necessity for speedy construction; new intake to overcome ice trouble; plant operated in open, design of sedimentation tank, pump and piping arrangements; cost of plant.

WATER PIPE LINES

DESIGN. Design of Pipe Lines, R. J. Roberts. New Zealand Soc. Civ. Engrs.—Proc., no. 13, 1926-27, pp. 147-154. It is shown that design of lines for water works, where total head may not exceed 300 ft., does not permit of great elaboration, and lines chiefly considered are those so much used in New Zealand in recent years for hydro-electric works.

WATER POWER

CANADA. Water Power for Canadian Industries. Can. Min. Jl., vol. 48, no. 50, Dec. 16, 1927, pp. 1010-1014, 2 figs. Adequate supply of low-cost power is one of two essential bases of pulp and paper industry; it is of almost equal importance to mining industry; year signalized completion of first high-tension electric power-transmission system in Canada and incidentally in British Empire.

Developing St. Lawrence River Power. Can. Engr., vol. 53, no. 23, Dec. 6, 1927, pp. 583-585. International feature of proposed power and navigation project; advantages of two-stage development; formation of ice and its effect in river; artificial control of lake Ontario; canals between lake St. Francis and Montreal.

Water Powers of Canada. Dept. of Interior, Canada—Water Resources Paper, no. 60, Nov. 1927, 90 pp., 40 figs. Review of general conditions in Canada; amount of power utilized and by what industries; review of provinces taking up developments by hydro-electric plants for central stations and pulp and paper industries and transmission of power; part played by government in investigating and administering, also legislation affecting water power.

WATER PURIFICATION

LOCOMOTIVES. The Treatment of Water for Locomotives, W. Barr and R. W. Savidge. Am. Water Wks. Assn.—Jl., vol. 18, no. 6, Dec. 1927, pp. 728-736. Discusses softening to remove scale-forming salts; boiler compounds; use of soda ash; zeolite treatment; lime-soda softener; use of sodium aluminate; methods of applying chemicals; Excelsior filter; horizontal-type water softeners; pitting corrosion and foaming.

WATER SUPPLY

BACTERIOLOGY. The Correlation Between Differential Tests for Colon Bacteria and Sanitary Quality of Water, I. M. Lewis and E. E. Pittman. Am. Water Wks. Assn.—Jl., vol. 19, no. 1, Jan. 1928, pp. 78-92. Investigation for determining which method correlates best with sanitary quality of water from fissure springs along Balcones Escarpment from Austin, Texas, to Del Rio; following methods were tested: methyl red and Voges-Proskauer reactions, indol production, ability to use sodium and ferric ammonium citrates and fermentation of cellobiose; citrate test gives better correlation than methyl red and Voges-Proskauer reactions.

WATER TREATMENT

ALUM FLOC. Effect of Salts on the Rate of Coagulation and the Optimum Precipitation of Alum Floc, H. Peterson and E. Bartow. Indus. and Eng. Chem., vol. 20, no. 1, Jan. 1928, pp. 51-55, 3 figs. Alum floc is gelatinous substance, highly absorptive, amphoteric and relatively insoluble over wide range of hydrogen-ion concentration.

SODIUM ALUMINATE. Coagulation Studies at the Washington Suburban Sanitary District, R. B. Morse, C. A. Hechmer and S. T. Powell. Indus. and Eng. Chem., vol. 20, no. 1, Jan. 1928, pp. 56-59. Experience gained at two plants during past few months has indicated clearly that combined treatment of small quantities of sodium aluminate with alum has specific value in treatment of water, especially during periods when raw water contains much colloidal clay

WATER WORKS

CHICAGO. The Distribution System of the Chicago Water Works, J. B. Eddy. Am. Water Wks. Assn.—Jl., vol. 19, no. 1, Jan. 1928, pp. 1-35, 21 figs. History of system since 1834; description of original wooden and cast-iron pipes; growth of population, increase in consumption and development of system; function and design of pumping station and distribution from it; evolution of pumping-station header pipes; operation of distribution system; underground street leakage; dye-tank apparatus used in underground-leakage surveys; meter testing and control; results of changing from 3-in. to 1½-in. meters.

WATERSHEDS

PROBLEMS. Protecting a Water Supply Where Watershed Is Used as Playground of Large City, J. Burt. Hydraulic Eng. (West. Waterworks Section). vol. 3, no. 12, Dec. 1927, pp. 25 and 35. Unusual problems of Marin Water District to maintain clean water; providing fireplaces, picnic tables, convenience stations and water taps; take samples of water, both before and after chlorination, and these samples are tested.

WATERWAYS

ST. LAWRENCE RIVER. Great Lakes to Ocean Waterways. Minn. Federation of Arch. and Eng. Soc.—Bul., vol. 12, no. 12, Dec. 1927, pp. 11-18. Considers costs and relative economic advantages of St. Lawrence route, lake Ontario-Hudson river route, all-American route; description of St. Lawrence route; present navigation; St. Lawrence river; present power developments; ice conditions; improvement proposed.

WELDING

AIRCRAFT. Principles of Aircraft Welding, P. N. Jansen. Acetylene Jl., vol. 29, no. 6, Dec. 1927, pp. 238-240, 5 figs. Methods used by Curtiss Airplane and Motor Co. are described with types of joints and personnel of welders. Strength of welded joints discussed and welding tools used. How uniformity and close limits are obtained.

Welding in Airplanes. Aviation, vol. 23, no. 26, Dec. 26, 1927, pp. 1522-1525, 9 figs. Abstracts from paper presented by R. M. Mock at 1927 International Acetylene Assn. Convention; wing with welded steel spars; welded steel tail surfaces; fuselages welded; future possibilities.

See also Airplanes, Welding.

ELECTRIC. *See Electric Welding Machines.*

PROCESSES AND USES. Welding in Mechanical Construction (La soudre autogène dans la construction mécanique), E. Delamarre. Technique Moderne, vol. 20, no. 1, Jan. 1, 1928, pp. 41-48, 27 figs. Treats of various processes of welding and their application; blowpipe, electric-arc, electric resistance; material necessary for various processes; net cost of welding; charts giving costs of various welding methods.

WIRE

MANUFACTURE. The Manufacture of Steel Wire, G. A. Alder. Iron and Coal Trades Rev., vol. 115, no. 3120, Dec. 16, 1927, pp. 891-892. Patenting; prevention of decarburization in patenting process; passage of wire through galvanizing bath; overdrawing not usually cause of failure. (Continued from Dec. 9.) Paper read before Cleveland Instn. Engrs.

Z

ZINC INDUSTRY

REVIEW OF. The Zinc Mining Industry in 1927, J. D. Conover. Min. Congress Jl., vol. 13, no. 1, Jan. 1928, pp. 34-36 and 56, 2 figs. With many forced closings, overproduction in zinc industry persists; world production for year increased 3 per cent, with tri-state district production off 20 per cent; association activities, legal restrictions, metallurgical progress and tariff necessity discussed.

ZINC ORE

LEACHING. Recent Developments in Ammonia Leaching for Zinc Ores. Chem. Age, vol. 17, no. 440, Dec. 3, 1927, pp. 41-42. Conclusions are that ammonia leaching as process for extraction of zinc from complex ores or other zinc-bearing materials has possibilities.

Engineering Index

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A

AIR BRAKES

Design. Improvements in Air Brakes, C. C. Farmer. Ry. Age (Section I), vol. 84, no. 4, Jan. 28, 1928, pp. 239-241. Discusses improvements that have been made to air brakes on steam locomotive; number of improvements that have been made to air valves and cages with object of obtaining more rugged designs and reduced leakage; discusses at considerable length operation and advantages of quick-service function incorporated in passenger-car brakes; freight-car brakes; air brakes for electric locomotives.

Maintenance and Repairs. Modernization of Air Brake Maintenance, E. F. Wentworth. Ry. Age (Section I), vol. 84, no. 4, Jan. 28, 1928, pp. 241-242. Considerable number of roads handling heavy passenger traffic of freight trains on heavy grades have for years been forced by necessity to follow satisfactory system of air-brake maintenance for locomotive and car equipment; outlines what has been done in last two years to bring about practically satisfactory air-brake maintenance conditions by establishment of brake-pipe and cylinder-leakage limits.

AIR PREHEATERS

Types. Air Preheaters for Boiler Furnaces (Les réchauffeurs d'air pour foyers de chaudières). Génie Civil, vol. 92, no. 3, Jan. 21, 1928, pp. 63-67, 12 figs. Classifies air heaters and describes and discusses values of each; comparison of three different types showing preference for heaters with parallel plates instead of tubes.

Preheated Air for Boiler Furnaces, P. H. N. Ulander. Eng. and Boiler House Rev., vol. 41, no. 7, Jan. 1928, pp. 332-335, 3 figs. Relative cost of preheater installation designed for an efficiency varying between 30 to 70 per cent, and cost per 1 per cent of fuel saving effected by preheater; presents curves referring to regenerative type of preheater; temperature of preheated air. (Continuation of serial.)

AIRPLANE ENGINES

Fuel Sprays, Testing. The N.A.C.A. Photographic Apparatus for Studying Fuel Sprays from Oil Engine Injection Valves and Test Results from Several Researches, E. G. Beardsley. Nat. Advisory Com. for Aeronautics—Report, no. 274, 1927, 14 pp., 12 figs.

Manufacture. Machining Operations in Aero-Engine Production. Machy. (Lond.), vol. 31 and vol. 32, nos. 794 and 795, Dec. 29, 1927, and Jan. 5, 1928, pp. 409-412, 13 figs., and 441-445, 5 figs.

Water-Cooled. Water-Cooled Aero Engines, A. A. Rubbra. Royal Aeronautical Soc.—Jl., vol. 32, no. 205, Jan. 1928, pp. 77-85, 9 figs. Water-cooled Rolls-Royce engines and constructional details; power and weight; increasing loading factor on bearings; reduction gears; auxiliaries; cooling systems; 3-point engine suspension; simplified controls; fuel system; starting systems; supercharging; gear-driven blower.

AIRPLANE PROPELLERS

Testing. A New Type of Combined Airscrew Hub Dynamometer and Thrust Meter, F. E. Hellyer. Royal Aeronautical Soc.—Jl., vol. 31, no. 204, Dec. 1927, pp. 1150-1168, 19 figs. Designed to measure resultant force upon its hub forces due to airscrew's torque and thrust; measurement of airscrew efficiency and engine horse power method of applying force; experiments with model; friction between propeller boss and shaft on which it slides; friction between driving faces and rollers; experiments with model torque-thrust meter; finding brake horse power.

AIRPLANES

Design. In the Drawing Office—Some Notes on the Assembly of Wings, W. S. Hollyhock. Flight (Aircraft Engr.), vol. 19, no. 52, Dec. 29, 1927, pp. 880d-880e, 1 fig. Importance of combination of angles due to sweepback, dihedral, airfoil incidence and spar incidence briefly dealt with; errors small, but might cause structural failure; in case of sweepback, effect of spar incidence if neglected may upset fore-and-aft trim of machine, by giving incorrect amount of sweepback when erected; formula arranged to correct effects.

Materials, Mechanical Properties of. Mechanical Properties of Some Materials Used in Airplane Construction, E. B. Wolff and L. J. G. Van Ewijk. Nat. Advisory Com. for Aeronautics—Tech. Memorandum, no. 448, Jan. 1928, 17 pp. Results of test to determine mechanical properties of aircraft materials; aluminum and its alloys, steel, wood and fabrics tested; tables of strength ratios; ratio between allowable stress (tensile or compressive) and specific gravity; figures for spruce, pine and 3-ply wood, merawan, Carolina pine, walnut and mahogany; exceptionally low specific gravity and favourable D/S. G. ratio of balsa. Translated from Ingenieur, Aug. 7, 1926.

Performance Requirements. Notes on the Guggenheim Safety Competition, A. Klemin. Aviation, vol. 24, no. 5, Jan. 30, 1928, pp. 246-254, 13 figs, 3 tables.

ALLOY STEELS

Heat-Resisting. Heat-Resisting and Non-Corrodible Steels, S. A. Main. Fuel, vol. 7, no. 1, Jan. 1928, pp. 4-20, 17 figs. Account of progress which has taken place lately, including development and practical application of heat-resisting and non-corroding steels; deals particularly with products resulting from research carried out by author's firm, Handfields, Ltd., Sheffield, England. Reprinted from Jl. of Instn. of Aeronautical Engrs., Aug. 1927.

ALLOYS

Magnesium. *See Magnesium Alloys.*

Temperature Effect. On the Influence of Temperature on the Properties of Alloys, J. Cournot. Information on Refrigeration (Institut Int. du Froid)—Monthly Bul., no. 9-10, Sept.-Oct. and Oct.-Nov. 1927, pp. 873-874. Author summarizes present state of knowledge on variations of properties of alloys and practical consequences therefrom; study of these variations is made by means of test tubes of alloys considered, by bringing these tubes to temperatures required and determining by appropriate tests values of properties sought for. Translated from Revue Scientifique, no. 19, 1927, pp. 589-595.

AMMONIA COMPRESSORS

Control Valves. Automatic Ammonia Control Valves, H. C. Venemann. Power, vol. 67, no. 4, Jan. 24, 1928, pp. 148-151, 3 figs. Discusses shortcomings of existing automatic control valves and outlines plant conditions that influence operation of such expansion valves; there are four types of automatic control valves in common use: Stop valves, to open and close quickly; constant-pressure valves, to maintain definite suction pressure; constant liquid-level valves, to keep liquid in evaporators at definite level; and load-demand valves, to control liquid supply in proportion to load demands upon evaporator.

Rotary. The Most Powerful Refrigerating Machine in the World (La plus puissante machine frigorifique du monde), R. Villers. Nature (Paris), no. 2777, Jan. 15, 1928, pp. 66-68, 5 figs. Describes rotary ammonia compressor; scheme of operation; built by Brown-Boveri for Kaiseroda works in Germany; delivers 8 million frigories per hour if temperature of liquefaction falls to 25 deg. cent.

Volumetric Efficiency. Is Volumetric Efficiency Important? T. M. Gunn. Power, vol. 67, no. 6, Feb. 7, 1928, pp. 255-257, 2 figs.

AMMONIA CONDENSERS

Heat Transfer in. Heat Transfer in Ammonia Condensers, A. P. Kratz, H. J. MacIntire and R. E. Gould. Univ. of Ill.—Bul., vol. 25, no. 15, Dec. 13, 1927, 56 pp., 30 figs. Also (conclusions) Refrig. Eng., vol. 15, no. 2, Feb. 1928, p. 56, 1 fig. Investigation to determine coefficient of heat transfer for various types of condensers, regarding total surface exposed to saturated ammonia vapour as whole; it was also desired to obtain information on relative effectiveness of different portions of cooling surface and to develop both optimum and limiting conditions of operation for types considered.

AMPLIFIERS

Vacuum Tube. Vacuum Tube Synchronizing Equipment, T. A. E. Belt and N. Hoard. Am. Inst. Elec. Engrs.—Jl., vol. 47, no. 2, Feb. 1928, pp. 113-117, 11 figs. Points out that vacuum tube synchronizing equipment makes unnecessary costly high-voltage transformers which have been almost universally used for synchronizing in past; describes commercial apparatus, gives equations pertaining to vacuum tube amplifier and shows calculated and measured characteristic curves.

ARCHES, CIRCULAR

Stresses. A Graphic Method for Determining the Stresses in Circular Arches Under Normal Loads by the Cain Formulas, W. Cain, W. L. Huber and G. E. Edgerton. Am. Soc. Civ. Engrs.—vol. 54, no. 2, Jan. 1928, pp. 333-337. Discussion of paper by F. H. Fowler, continued from Dec. 1927 issue of Proceedings

AUTOMOBILE ENGINES

Cylinders, Casting. Aluminum Cylinder Blocks Cast in Permanent Moulds, J. A. Lucas. Am. Mach., vol. 68, no. 4, Jan. 26, 1928, pp. 173-174, 6 figs. Method used in Lancia plant for casting cylinder blocks around cylinder sleeves and other inserts; cylinders staggered, and have iron sleeves cast into aluminum block by use of permanent metal moulds; oiling tubes welded into complete unit and placed in mould; sleeves, rough bored, turned, then sand blasted and copper plated before being set in moulds, are temporarily located on pilots and handled by insides; cores located accurately by dowels.

Design. Increase in Engine Power Among Chief Trends of Year, P. M. Heldt. Automotive Industries, vol. 58, no. 2, Jan. 14, 1928, pp. 45-49, 8 figs.

Detonation. Mechanical Design and Detonation, H. R. Ricardo. Automobile Engr., vol. 18, no. 237, Jan. 1928, pp. 23-24. Question of detonation in its relation to engine design; what could be done in way of performance considered if detonation were non-existent; advantages and disadvantages of raising compression ratio; tendency to detonate depends upon four design factors; influence of turbulence upon detonation; effect of cylinder size on detonation. Paper presented to Instn. Petroleum Technologists.

Diesel. *See Diesel Engines, Automotive.*

AUTOMOBILE PLANTS

Heat-Treating Department. Heat-Treating at the Fordson Plant. Soc. Automotive Engrs.—Jl., vol. 22, no. 2, Feb. 1928, pp. 166-167, 2 figs.

Heat-Treatment Plant. Machy. (Lond.), vol. 31, no. 796, Jan. 12, 1928, pp. 485-486, 2 figs. Layout and operation of heat-treatment plant of Associated Daimler Co. at Southall; carburizing and heat-treatment of parts; 15 August muffle furnaces fired by oil fuel, and 5 quenching tanks, 3 for oil and 2 for water quenching; 9 furnaces for heat treatment; description of carburizing furnaces; each of quenching tanks connected to Heenan patent cooling machines housed outside main factory in special buildings.

AUTOMOBILES

Headlights, Specifications for. Draught of Specifications for Laboratory Tests of Optical Characteristics of Electric Headlamps for Motor Vehicles. Illum. Eng. Soc.—Trans., vol. 23, no. 1, Jan. 1928, pp. 17-22. Definitions; samples for test; incandescent lamps; set-up for testing; photometric test points; focal adjustments of incandescent lamps; dual-beam headlamps designed for 21-22 candlepower incandescent lamps; fixed-beam headlamps designed for 21 candlepower incandescent lamps.

Manufacture, Ford. Ford Production Methods. Machy. (Lond.), vol. 31, no. 794, Dec. 29, 1927, pp. 413-415, 7 figs. Commutator roller head produced by series of press operations from 14 B.W.G. sheet steel; three forming operations to give roller head its shape; first bending tools for roller head; blanking tools; press operations; after forming, roller head swaged; operations on roller clevis; punching and piercing operations.

Operations on the New Ford Car—Progressive Assembly in the Fordson Plant. Machy. (N.Y.), vol. 34, no. 6, Feb. 1928, pp. 464-465, 8 figs. Eight halftones illustrating assembling operations on new Ford car, each accompanied by brief description; individual units separately assembled and tested, ready for final assembly; assembling of clutch; engine assembly; gas-fired annealing furnace with automatic timing control for differential ring gears; fitting pistons to engine; all operations performed along assembly line as chassis proceeds; chassis completely assembled.

Manufacture, Inspection. Ford Inspection Methods. Machy. (Lond.), vol. 31, no. 796, Jan. 12, 1928, pp. 473-475, 7 figs.

B

BEARING METALS

Lead-Base. A Discussion of Lead-Base Bearing Metal, G. A. Nelson. West. Machy. Wld., vol. 19, no. 1, Jan. 1928, pp. 12 and 25, 3 figs. Lead-base bearing metals as substitute for tin-base babbitt metal, but at much lower price; use in line shaftings and parts of machines that do not receive shocks; heated up to 1,000 deg. Fahr.; at definite intervals of time, temperature readings taken; time plotted against temperature; care to prevent segregation in pouring box of this metal; use of tin bearing for lower half of box and lead bearing for upper half.

BEARINGS

Alloy-Steel. Alloy Bearings Applied to Trains, F. C. Langenberg and C. McKnight. Iron Age, vol. 121, no. 2, Jan. 12, 1928, pp. 130-131, 3 figs. Very hard wearing surface after proper treatment and strength of core result in high resistance to shock and impact; possibility of obtaining fine core and hard case after single quench; heat-treated, it is applicable for high temperatures; alloys in scrap recoverable; chart showing physical properties of core of case-hardened nickel-molybdenum steel; single treatment; table of properties of heat-treated specimens tested at 74,600 and 1,000 deg. Fahr.

White-Metal. White-Metal Bearings. Automobile Engr., vol. 18, no. 237, Jan. 1928, pp. 25-26, 1 fig. Investigation regarding adhesion between white metal and bearing shells; thorough cleaning and tinning absolutely essential for all types of surfaces and materials; adhesion between white metal and cast-iron assisted by natural roughness and porosity of surface; efficiency of joint of 50 per cent obtained between white metal and gun metal; results with mild-steel test pieces; temperature of mandrel and back plate important; sand blasting and pickling; design of bearing bushes.

BEARINGS, ROLLER

Steel Mills. Roller Bearings Cut Down Power Waste, S. M. Weckstein. Iron Age, vol. 121, no. 4, Jan. 26, 1928, pp. 259-262, 8 figs. Application of roller bearings to roll necks, pinion stands and hot saws in steel mills; roller bearings suited to roll necks, simple in construction and compact; advantages claimed; conditions for hot saws hard to meet; high speed of saw and sudden heavy-peak loads; high operating temperatures; bearing arrangements for various types of auxiliaries; hot-bed table rolls for strip mills.

BELT DRIVE

Design. Modern Theory and Practice Involved in Belt Drives, W. D. Hamerstadt. Purdue Eng. Rev., vol. 23, no. 2, Jan. 1928, pp. 11-12 and 22, 24 and 26, 5 figs. Design of belt drives; pull equal to product of pressure between driving and driven surfaces times their coefficient of friction; values of coefficient of friction; transmitting capacities; correction for different arcs of contact of belt on pulley; belt, not pulley, limiting factor; belt increased in width because greater cross-section is necessary to stand tension to which belt is to be subjected; questions and answers on belt drives.

BELTS AND BELTING

Quality Factors. Quality Factors of Leather Belts, R. C. Moore. Indus. Engr., vol. 86, no. 1, Jan. 1928, pp. 29-31, 4 figs. Life and operating reliability of leather belt depends to large extent upon selection and matching of leather strips used, as well as care exercised in its manufacture.

BLAST FURNACES

Blast Drying. The Silica Gel Blast-Drying Plant at Wishaw. Engineering, vol. 124, no. 3233, Dec. 30, 1927, pp. 836-837, 3 figs. Description of the silica gel blast-drying plant as installed at Wishaw works of Glasgow Iron & Steel Co.; method of manufacture and properties of silica gel.

Practice. Blast Furnace Developments in 1927, H. A. Berg. Blast Furnace and Steel Plant, vol. 16, no. 1, Jan. 1928, pp. 15-17. Although there have been no radical departures in furnace construction or in manner of handling furnaces, nevertheless many minor advances have been made; preparation, selection and handling of materials; thorough gas cleaning; hot-blast stoves; boiler installations.

Low-Cost Pig Iron Means Highest Output Per Furnace, W. A. Haven. Iron Age, vol. 121, no. 5, Feb. 2, 1928, pp. 334-335, 2 figs.

BOILER FEEDWATER

Regulators. Feedwater Control Equipment. Power Plant Eng., vol. 32, no. 2, Jan. 15, 1928, pp. 117-120, 6 figs. Present-day demands require quicker response from feedwater regulators; types of regulators, their application and operation.

Softening. Sodium Aluminate as an Aid to Water Softening. Am. Ry. Eng. Assn.—Bul., vol. 29, no. 300, Oct. 1927, pp. 138-142. Use of sodium aluminate on the Rock Island lines; table showing additional savings resulting from use of sodium aluminate in lime and soda plants.

BOILER FURNACES

Linings. How to Avoid Failure in Monolithic Furnace Linings, J. L. Cummings. Power, vol. 67, no. 5, Jan. 31, 1928, pp. 175-177, 4 figs. Résumé of practical experience telling why same materials cannot be used for furnace linings and baffles, importance of thoroughly mixing and proportioning refractory and bonding material, with comments on compacting, drying and use of wooden forms and reinforcing metal.

Pulverized Coal in. Heating of Steam Boilers with Pulverized Coal (La chauffe des générateurs de vapeur au charbon pulverisé), M. Emanaud. Technique Moderne, vol. 19, no. 24, Dec. 15, 1927, pp. 781-783, 7 figs. Treats of smoke-dust separators and ash arresters.

The Disposal of Grit from Boilers Fed by Pulverized Fuel, W. A. Smith. Elecn., vol. 99, no. 2587, Dec. 30, 1927, pp. 803-805, 5 figs. Station engineer's problem; soot blowers; pneumatic-dust extraction plants; grit catchers; installations for Lancashire boilers; dealing with existing plants; alternative to permanent extraction system; pneuconex; combined gravity and induction advantages; principal features of grit catchers.

Turbulence vs. Volume. Turbulence vs. Large Furnace Volume, L. W. Hayward. Power, vol. 67, no. 6, Feb. 7, 1928, p. 240. To obtain both time element for burning fixed carbon and turbulence for rapid mixing of products of conduction, furnaces should be large enough to provide necessary time element for burning fixed carbon, and burner should provide necessary turbulence for rapid mixing of gases; experience obtained in burning coal in pulverized form has demonstrated that turbulence is of importance, but that time element of combustion, which is determined by furnace volume, is of greater importance.

BOILER TUBES

Heat Transmission Through. Heat Transmission Through Boiler Tubes, H. O. Croft. Univ. of Ill.—Bul., vol. 25, no. 5, Oct. 4, 1927, 55 pp., 17 figs. Investigation to obtain heat transmission data under conditions similar to those existing in actual water-tube boiler and to study phenomena of water circulation under same conditions; conclusions drawn are that coefficient of heat transmission of apparatus is affected by: rate of gas flow, temperature difference between flue gas and water; pressure at which steam is generated; temperature of gas stream; water velocity in tube has slight effect on overall coefficient of heat transmission.

BOILERS

Design. Steam Generators at Morgan & Wright Plant, G. Burgess. Power Plant Eng., vol. 32, no. 3, Feb. 1, 1928, pp. 171-173, 2 figs.

The Characteristics of Modern Boilers, E. R. Fish. Machy. Market, no. 1419, Jan. 13, 1928, pp. 21-22. Changes in shape and design due to use of higher pressures; more powerful fabricating equipment and greater care in methods of workmanship; moderate-size moderate-pressure boilers in majority; furnace improvements; modern fuel-burning apparatus designed to use small amount of excess air; water walls must be carefully and properly designed and arranged; draught problems; details of boiler design considerably modified to accommodate superheaters sufficiently large to give desired temperatures; furnace-controlling systems.

Efficiency Diagrams. The Reflex-Ordinate Boiler-Efficiency Diagram. Power Engr., vol. 23, no. 262, Jan. 1928, p. 8. Presents diagram on supplementary plate based on Callendar's enlarged steam tables; drawn and designed by H. C. Golder and R. B. Page.

Locomotive. *See Locomotive Boilers.*

Steam Generators. *See Steam Generators.*

Steam-Heating, Testing. The Testing of Low-Pressure Steam Heating Boilers, L. S. O'Bannon. Am. Soc. Heating and Ventilating Engrs.—Jl., vol. 34, no. 2, Feb. 1928, pp. 103-115, 4 figs. Gives results of few experiments conducted at University of Kentucky, designed to furnish information bearing on several important features of tentative code for rating of low-pressure solid-fuel steam boilers; description of boiler-testing laboratory.

BORESCOPES

Holz. Holz "Borescopes." Am. Mach., vol. 68, no. 2, Jan. 12, 1928, pp. 73-74, 3 figs. Device for examining inside surfaces of gun and rifle barrels, compressed-gas steel cylinders, metal tubes, hollow shafts and axles and long borings in castings; long metal tube carries source of electric illumination and contains optical system, usually consisting of lenses, prisms, light filters and focusing eyepiece; slight structural difference clearly brought out; various types and applications.

BRIDGES

Construction Progress. Bridge Construction Gained 70 Per Cent, A. W. Welch. Iron Age, vol. 120, no. 1, Jan. 5, 1928, p. 44. Very brief discussion giving principally statistics for steel construction; total for all classes of work exceeded $7,000,000,000, as it did in 1926; outlook is for continuance of high rate of building; latter half showed greater activity than first half; reflected in domain of public works and in private work other than buildings; gain in every class except water-works; greatest gain in bridges explained; coincident with rapid increase in construction volume, strong increase in credits.

Design. Bridge Design for Various Conditions, J. A. L. Waddell. Can. Engr., vol. 54, no. 3, Jan. 17, 1928, pp. 138-140. Treats of steel arches, cantilever arches, suspension bridges, continuous-truss spans, swing spans, bascule spans, vertical-lift spans, toll bridges; also treats of studies preliminary to design of bridge such as borings for foundations and right of way. (Conclusion.)

Lift, Bascule. Railway and Vehicular Bridge Across Vancouver Harbour, B.C. (Canada), A. Don Swan. Instn. Civil Engrs.—Proc., paper no. 4638, 1928, 15 pp., 4 figs. on supp. plate. Describes sinking of piers and construction of concrete piers and caissons; erection of steel work; operating mechanisms; signals; bridge carries single-track standard-gauge railway between main trusses, with two 10-ft. highways, one on either side, outside of truss, and one 3½-ft. sidewalk; provided with 185-ft. bascule span between piers Nos. 2 and 3.

Skew Arch, Design. Crown Stresses in a Skew Arch, J. C. Rathbun. Am. Soc. Civ. Engrs.—Proc., vol. 54, no. 2, Feb. 1928, pp. 485-504, 12 figs. Purpose of investigation was to devise method of finding stresses at crown of ring of cast skew-arch model and to check results obtained by laboratory experiments with those obtained by theoretical calculations; investigation has grown out of study made by writer in 1923-24; study of effect of horizontal loads is of especial interest as brought out by A. H. Beyer.

Suspension, Eye-Bar Cable. The Eye-Bar Cable Suspension Bridge at Florianopolis, Brazil, H. Cross. Am. Soc. Civ. Engrs.—Proc., vol. 54, nos. 1 and 2, Feb. 1928, pp. 579-580. Discussion on paper by D. B. Steinman and W. G. Grove, continued from Dec. 1927 issue of Proceedings.

Suspension, Stiffening Girder. The Stiffening Girder with Variable Moment of Inertia. Engineering, vol. 125, no. 3234, Jan. 6, 1928, pp. 1-2. Refers to article by L. S. Moisseiff (Jl. Franklin Inst., Oct. 1925); it was shown that, when moment of inertia of girder varies from point to point, solution becomes very difficult, and in general can only be effected arithmetically; repeats calculation given in article cited, taking into account fact that moment of inertia of girder embodied in Delaware river bridge varies considerably from its average value; method of solving linear differential equations devised by author of this article some 35 years ago.

BUFFING

Automatic Machine for. Buffing Odd-Shaped Parts Automatically. Machy. (N.Y.), vol. 34, no. 6, Feb. 1928, pp. 429-431, 3 figs. Design of three mechanisms for buffing odd-shaped parts on type H model built by Automatic Buffing Machine Co.; mechanism for buffing automobile lamp doors; automobile rear-lamp doors pressed from brass; rotated past buffing wheel; automobile radiator shells polished and buffed; in polishing and copper buffing, production of 10 shells per hour averaged.

BUILDING CONSTRUCTION

Canada. A Phenomenal Year for Canada's Building Industries, A. R. R. Jones. Can. Machy., vol. 38, no. 26, Dec. 29, 1927, pp. 166-167, 3 figs. High value of contracts; work contemplated; residential contracts higher; industrial contracts much lower; great year for business-building construction; increase in construction well spread all over country; tables for 1924-1927 showing contracts awarded; industrial-construction awards; engineering-construction contracts.

REINFORCED-CONCRETE. The Application of Reinforced-Concrete to Structures, W. F. Zabriskie. Concrete, vol. 32, no. 2, Feb. 1928, pp. 39-42, 3 figs. Discussion of present-day trends in uses of reinforced concrete in structures; concrete in competition with other building materials; developments in construction methods; discussion of scope of usefulness of reinforced concrete; combination steel and concrete structures.

BUILDINGS

CONCRETE, FORMWORK. Form Details on a Monolithic Concrete Building, N. L. Protheroe. Concrete, vol. 32, no. 2, Feb. 1928, pp. 17-21, 8 figs. Monolithic concrete walls require careful formwork; methods used to obtain attractive bush-hammered exterior concrete surface; economical scaffolding designed; form details that secure true concrete surfaces; preventing surface irregularities caused when concrete shrinks from forms; construction methods; working drawings of form details.

REINFORCED-CONCRETE. America's Tallest Reinforced-Concrete Building, W. W. Hay. Concrete, vol. 32, no. 2, Feb. 1928, pp. 33-34, 3 figs. Design of Master Printers' Building in New York involves many interesting features; is 301 ft. high; flat-slab construction used; combination of reinforced concrete and steel in columns.

STEEL, DESIGN. Column Deflection Method for Designing Lateral Bracing, J. C. Van der Mey and F. H. Spitzer. Eng. News-Rec., vol. 100, no. 3, Jan. 19, 1928, pp. 106-108, 3 figs. Authors submit means of determining necessary lateral bracing for any assumed loadings, using method that is based on deflection of columns; claim is made for this method that it is workable, economical and more consistent with conditions that actually obtain in building submitted to lateral loadings which cause deflection in columns than in three methods of designing against horizontal loadings that are in common use.

C

CAMS

MACHINING. Machining a Cam Surface in a Drill Press, J. E. Fenno. Machy. (N.Y.), vol. 34, no. 6, Feb. 1928, pp. 447-448, 3 figs. Problems in machining switch box-control pad; two operations performed with fixtures of unique design; machining of cam surface and drilling and tapping of hole; to machine cam face, pad is placed in base of fixture bolted to drill-press table, concentric with drill-press spindle; short; hub of pad on which cam surface is to be formed first rough-faced with standard counterbore, drilling and tapping jig; jig used in machining cam surface; design of jig that can be quickly loaded and unloaded.

CANALS

SHIP. The Lake Washington Ship Canal, Washington, L. C. Sabin. Am. Soc. Civ. Engrs.—Proc., vol. 54, no. 1, Jan. 1928, pp. 273-277. Discussion on paper by W. J. Barden and A. W. Sargent, continued from Dec. 1927 Proceedings.

The Lake Washington Ship Canal, Washington, W. J. Barden and A. W. Sargent. Am. Soc. Civ. Engrs.—Proc., vol. 54, no. 2, Feb. 1928, pp. 585-586. Discussion of paper by W. J. Bardon and A. W. Sargent, continued from Jan. 1928 issue of Proceedings.

SPILLWAYS. Side Spillways for Regulating Diversion Canals, E. S. Lindley. Am. Soc. Civ. Engrs.—Proc., vol. 54, no. 2, Feb. 1928, pp. 641-642. Discussion of paper by W. H. R. Nimmo, published in Oct. 1927 issue of Proceedings.

WELLAND, CANADA. Welland Ship Canal Project Nears Completion. Can. Machy., vol. 38, no. 26, Dec. 29, 1927, pp. 217-221, 6 figs. General article dealing with history of first four canals and construction of present canal; curves eliminated; table of dimensions and notable features of canal; has eight sections; Port Weller artificial harbour; twin locks in flight; work from Port Robinson to Welland of very involved nature; western breakwater; new station erected.

CAR RETARDERS

G.R.S. SYSTEM. Car Retarders at Mechanicville. Ry. Age, vol. 84, no. 5, Feb. 4, 1928, pp. 295-298, 6 figs. Boston & Maine installs G.R.S. system in eastbound yard; 10 retarders serve 36 tracks; layout of this yard differs in many features from other yards previously equipped with car retarders; principal difference is in arrangement of ladders, whereby each group of six tracks is served by one group of retarders, yard having 36 classification tracks; description of yard; ladder arrangement; grades; car retarders; control towers; traffic economies.

CARS, DYNAMOMETER

NEW. New Dynamometer Car, South African Railways. Ry. Engr., vol. 49, no. 576, Jan. 1928, pp. 27-29, 5 figs. Description of this car and its equipment recently introduced on South African Railways; car is 3-ft. 6-in gauge; underframes and body details; mechanism of instruments; measurement of car speed; ascertaining amount of work performed; other equipment.

CARS, FREIGHT

REPAIRING. Progressive Repairs to Hopper Cars. Ry. Mech. Engr., vol. 102, no. 1. Jan. 1928, pp. 27-29, 7 figs. Reclaimed material important factor in rebuilding cars; article describes operations in connection with overhauling of series of 750 composite hopper cars of 110,000-lb. capacity at Frankfort, Ind., shops of New York, Chicago & St. Louis Co.

Rebuilding Redesigned Box Cars on the New Haven. Ry. Mech. Engr., vol. 102, no. 2, Feb. 1928, pp. 89-94, 14 figs.

CARS, PASSENGER

RECONSTRUCTION. Passenger Car Reconstruction of the D. & H. Ry. Mech. Engr., vol. 102, no. 1, Jan. 1928, pp. 23-26, 8 figs. Delaware & Hudson has incorporated number of new and unusual features of construction in design of two types of passenger cars which it has recently constructed and placed in service; two most prominent features are modified turtle-back roof, which has been adopted as standard for all passenger cars on system, and unusual interior arrangements planned to meet needs of travellers.

CARS, STREET

GEARS AND GEARING, REDUCTION. Double-Reduction Motor Drive with Spring Suspension, C. Bethel. Elec. Ry. Jl., vol. 71, no. 4, Jan. 28, 1928, pp. 152-154, 5 figs. Description of suspension of motors and double-reduction gear drive; lightening of motors; European experience proves valuable aid to design; quietness of operation of motors obtained; demands for more rapid and attractive street-car service led to development of double-reduction gear drive with spring-supported motors; oil-tight gear case is additional advantage.

CASE HARDENING

NITRIDING PROCESS. Nitralloy and the Nitriding Process, H. A. DeFries. Machy. (Lond.), vol. 31, no. 796, Jan. 12, 1928, pp. 478-479. Special alloy steels which can be surface-hardened by being subjected to action of ammonia gas while material is heated to approximately 875 deg. Fahr. without subsequent quenching; remarkable resistance to metal-to-metal wear; excellent forging properties; machined satisfactorily in both annealed and heat-treated conditions; composition and uses; heat treatment previous to nitriding; nitriding process and equipment used for it; depth and hardness of case.

Surface-Hardening by Nitrogen. Iron and Steel of Can., vol. 11, no. 1, Jan. 1928, pp. 19-21. Invention of Dr. Fry, of research laboratories of Friedrich Krupp, of Essen; process consists of subjecting parts to be hardened to action of ammonia gas at temperature of approximately 500 deg. cent. for period of time varying from 40 to 120 hr.

CAST IRON

ALLOY. Production and Uses of Nickel-Chromium-Iron and Cobalt-Chromium-Iron Castings, J. F. Kayser. Iron and Steel World, vol. 1, no. 10, Nov. 1927, pp. 717-718. Description of Ni-Cr-Fe and Co-Cr-Fe alloys suitable for castings; properties and uses of such alloy castings; "stainless" alloys. Abstract from paper read before Belgian Foundrymen's Assn.

ALUMINUM. Aluminum Cast Irons, A. B. Everest. Foundry Trade Jl., vol. 37, no. 592, Dec. 22, 1927, pp. 208-210, 1 fig. Discusses grey cast iron formed by addition of aluminum to low-silicon irons; mechanical tests were made on alloys formed by adding aluminum to American washed iron; results indicate that at moment there is no definite future for aluminum cast iron for normal purposes; no special properties have been shown which cannot be obtained by other simpler and better methods of treating cast iron.

PROPERTIES. The Influence of Nickel and Chromium on Cast Iron, A. B. Everest. Brit. Cast Iron Research Assn.—Bul., no. 19, Jan. 1928, pp. 7-9. Supplement to Bulletin No. 16, April 1927, giving details of papers on influence of nickel and chromium on cast iron; gives bibliography of recently published works.

WEAR. The Wear of Cast Iron. Brit. Cast Iron Research Assn.—Bul., no. 19, Jan. 1928, pp. 9-13. Review of recent experimental work, covering automobile pistons and cylinders; brake blocks; locomotive valve rings and work hardening.

CEMENT

PORTLAND, INTERNATIONAL STANDARDS. International Standards for Cement, D. R. Platzmann. Concrete, vol. 32, no. 2, Feb. 1928, pp. 103-108. Analysis of cement specifications of various nations, pointing out advantages and disadvantages of international standardization of cement specifications.

CHIMNEYS

REINFORCED-CONCRETE, STRESSES. Stress in Reinforced-Concrete Chimneys, P. Gillespie and W. K. Irwin. Can. Engr., vol. 54, no. 3, Jan. 24, 1928, pp. 153-156, 4 figs. Charts for approximate stress determination prepared for rapid, though approximate, determination of stress in both steel and concrete, and reinforced-concrete chimneys, due to weight, wind and temperature changes; based on studies conducted at Toronto Univ.

CHROMIUM

ALUMINUM STEEL. Physical Properties of Several Chromium-Aluminum and Chromium-Nickel-Aluminum Steels, V. O. Homerberg and I. N. Zavarine. Am. Soc. Steel Treating—Trans., vol. 8, no. 2, Feb. 1928, pp. 297-301 and (discussion) 301-304, 3 figs. Affinity of aluminum for nitrogen in ammonia case-hardening process has resulted in manufacture of special alloy steels containing aluminum with chromium or with chromium and nickel; subjection of steels to action of ammonia gas at comparatively low temperature results in production of hard surface without deformation of material and without subsequent heat treatment; curves and tables showing physical properties of steel.

CHROMIUM-VANADIUM STEEL

HEAT-TREATED. Correlating Test Data on Heat-Treated Chromium-Vanadium Steels, E. J. Janitzky. Soc. Automotive Engrs.—Jl., vol. 22, no. 1, Jan. 1928, pp. 55-59 and (discussion) 59-64, 6 figs. Work performed and procedure followed in correlating test results on specimens of heat-treated S.A.E. chromium-vanadium steel 6130, as basis for revision of physical-property charts for certain automotive steels; 115 tests, including complete chemical analysis, tensile strength and Brinell, scleroscope and Rockwell hardness tests; results given in frequency or probability curves.

CITIES AND TOWNS

PLANNING. Basic Information Needed for a Regional Plan, D. M. Baker and H. J. March. Am. Soc. Civ. Engrs.—Proc., vol. 54, no. 2, Feb. 1928, pp. 597-600. Discussion on paper by H. M. Lewis, continued from Jan 1928 issue of Proceedings

Basic Information Needed for a Regional Plan, H. Bartholomew. Am. Soc. Civ. Engrs.—Proc., vol. 54, no. 2, Jan. 1928, pp. 289-290. Discussion on paper by H. M. Lewis, continued from Dec. 1927 issued of Proceedings.

PLANNING, TORONTO. University Avenue Extension Scheme, A. G. Dalzell. Can. Engr., vol. 54, no. 3, Jan. 24, 1928, pp. 169-171, 3 figs. Proposal for extension of University avenue, Toronto, to Front street, to relieve traffic on Yonge and Bay streets; elevated roadway 100 ft. wide with eight traffic lanes suggested; straight and spiral ramps at Queen street.

COAL

CARBONIZATION, LOW-TEMPERATURE. The Dvorkovitz Low-Temperature Carbonization System. Engineering, vol. 125, no. 3236, Jan. 20, 1928, pp. 72-73, 6 figs. Method developed for minimizing extent of cracking, preventing inconvenient cohesion in charge and removing oil vapours almost immediately after they have been formed; consists in supplementing external heating of retort with producer gas by introducing into upper parts of retort, and of its downward extension, supply of gas superheated to moderate temperature.

COAL HANDLING

PLANT. Coal-Handling Plant at the Stourport Generating Station. Engineering, vol. 125, no. 3234, Ja. 6, 1928, pp. 11-13, 2 figs. Coal-handling plant installed is designed for unloading barges in canal basin and transferring coal unloaded either to store in front of boiler house or to boiler house bunkers; alternatively, it can be used for reclaiming stored coal and transferring it to bunkers; describes quay cranes, hopper, conveyors, weighing apparatus, rolling stock; capacity of plant, 50 tons per hr.

COAL MINES AND MINING

ACCIDENT PREVENTION. Safety Practices in the Swastika Mine, J. R. Barber. Min. Congress Jl., vol. 14, no. 2, Feb. 1928, pp. 89-91, 6 figs. Problem of mine safety means unceasing vigilance and alertness in spotting dangerous practices and exacting drastic penalties for violations of safety rules; safety system of St. Louis, Rocky Mountain and Pacific Co. presented.

COLD STORAGE

AIR COOLING. Notes on Cooling Air in Storage Rooms, O. Henckel. Refrig. Eng., vol. 15, no. 2, Feb. 1928, pp. 52-54, 8 figs. Author, who is chief engineer of Swiss firm of Sulzer Bros., discusses brine-spray cooling, flooded evaporator systems, defrosting of coils and air purity, covering interesting points connected with general subject of cooling air for storage and handling of foods; presents culture slides taken from air passing to and from brine-shower air cooler.

CONCRETE

AGGREGATES. Economy in the Use of Local Materials for Concrete, G. W. Hutchinson. Concrete, vol. 32, no. 2, Feb. 1928, pp. 43-44. Discussion of possible use of more easily obtained local materials in some localities; their effect on cost of concrete; their probable influence on quality of concrete; local aggregates tested in Miami paving project.

MIXTURES. Control and Special Mixtures for Road Concrete, J. H. Chubb. Eng. News-Rec., vol. 100, no. 1, Jan. 5, 1928, pp. 19-21, 2 figs. Early-strength concrete gives quick service; marked effect of volume of water in batch on strength of concrete is clearly shown by results of tests on eight batches of concrete identical in every respect except amount of mixing water; data presented show that it is practicable to obtain and to use high-early-strength concrete for paving work; test results are tabulated.

CONCRETE BLOCKS

MANUFACTURE. Distinctive Block Made with Own Design of Equipment, V. Ey. Concrete, vol. 32, no. 2, Feb. 1928, pp. 35-38, 10 figs. "Eyblock" is trade name of wet cast block made in New York plant; products manufacturer designed his own equipment and method of manufacture; wide variety of facings possible; types of block made; manufacturing methods; interesting plant layout; yard-storage methods; costs; merchandizing methods used.

CONVEYORS

BELT. Belt Conveyors Handle Materials for Chicago Sewage Works. Construction Methods, vol. 10, no. 2, Feb. 1928, pp. 10-11, 7 figs. Describes belt conveyors used in building West Side sewage treatment plant in Chicago; mostly to handle cement and aggregates.

Belt Conveyor's Part in Handling Economies. Can. Machy., vol. 38, no. 26, Dec. 29, 1927, pp. 237-238, 4 figs. Design and selection of parts that compose belt conveyor application of proper type of drive and four types in common use; effect of pulleys; hugger drive preferable for conveyors too long to be driven by lagged pulley with snub; variety of materials; in handling materials rubber belts have their limitations; troughed belts work successfully at inclination; differential band brake; spacing idlers; each belt conveyor installation constitutes separate problem.

COPPER DEPOSITS

QUEBEC. Origin of the Copper Ores of Rouyn District, Quebec, H. C. Cooke. Min. Jl., vol. 160, no. 4821, Jan. 14, 1928, p. 24. Facts all suggest that there is close connection existing between sulphite bodies and granodiorite-quartz diorite masses, but it is equally evident that much yet remains to be done toward working out exact nature of this connection and conditions under which different sulphides, pyrites, pyrrhotite, chalcopyrite and sphalerite, respectively, are formed.

CORES

OIL-SAND, MAKING. Oil-Sand Cores in the Jobbing Foundry, J. Masters. Foundry Trade Jl., vol. 37, no. 592, Dec. 22, 1927, p. 217. Notes on baking cores, avoiding unsightly markings, blacking and venting of cores, core irons, turbine-end casting, cylinder casting mould made in loam.

COTTON MILLS

POWER EQUIPMENTS. Power Requirements of Machinery Used in Cotton Mills, H. H. Bodge. Elec. Wld., vol. 91, no. 2, Jan. 14, 1928, pp. 97-99. Trends in motor-drive practice; average data on typical applications; plant-load distribution analysis offered in connection with estimate basis; presents table of horse power requirements of cotton machinery.

CRANES

ELECTRIC. Material-Handling Crane Saves Time and Labour. Elec. World, vol. 91, no. 4, Jan. 28, 1928, p. 205, 1 fig. 5-ton monorail electric crane installed at distribution headquarters of Los Angeles Gas & Electric Corporation has been found great aid in loading and unloading distribution transformers and handling other heavy material used in overhead and underground construction work.

CRANKSHAFTS

HONING. Exteral Cylindrical Honing. Soc. Automotive Engrs.—Jl., vol. 22, no. 1, Jan. 1928, p. 73. Short résumé and discussion of L. A. Becker's Production-Meeting paper printed in The Journal for Oct. 1927; machine for honing bearing surfaces of crankshafts; honing said to produce bearing surface smoother and more true to form than produced by grinding alone or by grinding and polishing; no appreciable wear on any surface that has been honed; friction reduction of 25 per cent in block tests; lubricant for honing.

DAMS

DESIGN. The Design and Construction of Dams. Eng. News-Record, vol. 100, no. 3, Jan. 19, 1928, pp. 123-124. Review of work by E. Wegmann; notable addition is section of nearly 100 pages on multiple-arch dams by F. A. Noetzli; also contains description of number of items not included in earlier edition.

EMERGENCY, NEW ORLEANS. Emergency Dam on Inner Navigation Canal at New Orleans, Louisiana, F. R. Harris and R. H. Whitehead. Am. Soc. Civ. Engrs.—Proc., vol. 54, no. 2, Feb. 1928, pp. 673-676. Discussion of paper by H. Goldmark, published in Dec. 1927 issue of Proceedings.

FAILURES. Failure of Non-State-Inspected Dam Under Construction, H. T. Critchlow. Eng. News-Rec., vol. 100, no. 3, Jan. 19, 1928, p. 116. Recent failure of small dam under construction in New Jersey illustrates need of state supervision of dams, even those impounding water from small collecting areas; dam failed during severe storm of rain, lightning and wind; experience emphasizes desirability of having more complete supervision over construction of dams than is now provided by law.

GRAVITY. Uplift Pressure in Gravity Dams, A. Floris. West. Constr. News, vol. 3, no. 2, Jan. 25, 1928, pp. 58-62, 7 figs. Study of various assumptions made on distribution of uplift pressure, and investigation of methods used for calculation of stress as regards their correctness and validity; annotes many authorities and gives graphical stress analysis of triangular profile; several examples are worked out.

MASONRY. The O'Shaughnessy Dam and Reservoir, J. H. Gregory, C. B. Hoover and C. B. Cornell. Am. Soc. Civ. Engrs.—Proc., vol. 54, no. 2, Feb. 1928, pp. 405-469, 24 figs. Design and construction of masonry dam and reservoir built to increase storage of raw water for water supply in city of Columbus, Ohio; masonry portion of dam is of overflow gravity type, spillway section, 879 ft. in length between end abutments, being spanned by a 12-arch reinforced concrete bridge; reservoir, formed by construction of dam, is 8 miles in length, has maximum width of 1,900 ft., and total available storage capacity of 5,341,000,000 gal.

MULTIPLE-ARCH. Construction of Multiple-Arch Dam in Arizona. Eng. News-Rec., vol. 100, no. 5, Feb. 2, 1928, pp. 180-183, 5 figs. Concrete multiple-arch dam 2,146 ft. long creates storage reservoir for irrigation and power purposes to serve 40,000-acre project of Maricopa County Municipal Water Conservation District No. 1; design of dam, methods of flood protection of construction work, general methods of construction and concrete pouring, spillway, power plans and water distribution.

D

DEPRECIATION

ACCOUNTING. Factors Affecting Accumulation of Depreciation Reserve, W. G. Cross. Elec. World, vol. 91, no. 4, Jan. 28, 1928, pp. 203-205. Deals with two factors pertaining to depreciation and accumulation of reserve, namely, salvage value to be obtained from unit at its expiration of life and cost of physically removing or retiring item; reserve is usually designed to take care of both, that is, to reimburse original "wearing value" or cost of item, less its salvage, and to provide sum of money sufficient to pay cost of removal.

DIE CASTING

MACHINES FOR. Die-Casting Equipment with Automatic Features. Iron Age, vol. 121, no. 6, Feb. 9, 1928, p. 407, 1 fig. Madison-Kipp Corp., Madison, Wis., has placed on market die-casting machine, operation of which is entirely automatic; feature stressed is that in no case is more than one operator necessary; molten metal delivered to die by air pressure.

NON-FERROUS METALS. The General Aspects of Die-Casting, T. P. Russell. Metal Industry (Lond.), vol. 32, no. 1, Jan. 6, 1928, pp. 5-7. Discusses history and future prospects of die-casting industry, with special reference to non-ferrous die-casting; such processes have of late years made marked progress and are among those most favoured by metal founders for machine parts and small casting. Paper read originally before Sheffield Metallurgical Assn., but revised for this journal.

DIES

QUENCHING. High-Temperature Quenching Treatment Applied to Cold Heading Ball Dies of Plain Carbon Tool Steel, F. L. Wright. Am. Soc. Steel Treating—Trans., vol. 8, no. 2, Feb. 1928, pp. 282-293 and (discussion) 293-296, 5 figs. Describes quenching treatment for cold-forming dies and submerged water-spray quenching fixture used for quenching double-end ball-heading dies; increase in quenching temperature from 1,470 to 1,620 deg. Fahr. followed by suitable tempering treatment has doubled life of dies; results of endurance tests compared to variations in chemical analysis, to normality of tool steel as determined by McQuaid-Ehn carburizing test, and to hardness penetration.

DIESEL ENGINES

AUTOMOTIVE. The Acro Diesel Engine with Air Storage (le moteur Diesel "ACRO" à emmagasinage d'air), Sribeck. Technique Automobile et Aérienne, vol. 18, no. 139, 1927, pp. 105-118, 25 figs. Describes principal characteristics of this new engine and treats of its points relative to its use as automobile or aviation engine; describes parts of engine and tests to determine cylinder-pressure variations and temperature in cylinder which are shown in several charts; influence of speed, form of compression chamber and its effect on efficiency.

The Automotive Full-Diesel Engine, R. J. Broege. Soc. Automotive Engrs.—Jl., vol. 22, no. 2, Feb. 1928, pp. 177-182, 8 figs. Description of tests with compressorless, solid-injection, full-Diesel engine of 4-cycle operation, as developed by M.A.N. of Germany, for application in all industrial automotive installations; 50-h.p. engine installed in 4-ton truck; performed as well as gasoline engine of same bore in same truck, but with greater fuel economy and more lugging ability; American-built 4-cycle engine tested; similar to heavy-duty automotive-type gasoline engine; engine started by electric starters or by two-cylinder air-cooled gasoline engine; controlled by two levers regulating fuel pump, replaces magneto.

CENTRIFUGAL CASTINGS FOR. Centrifugal Castings for Diesel Engines, J. E. Hurst Diesel Engine Users' Assn.—Paper, Nov. 25, 1927, 20 pp., 14 figs. Describes kind of castings needed for Diesel engines; behaviour of cast iron when in molten state and when cooling and treats of centrifugal casting process, chemical composition and properties of centrifugal castings, their resistance to wear and heat conditions; also spun-sorbitic centrifugal castings as used by author.

DOUBLE-ACTING. Where is the Power in a Double-Acting Diesel? W. C. Baker. Power, vol. 67, no. 5, Jan. 31, 1928, p. 199. Reply to article by D. McFee in Dec. 27, 1927, issue of this journal, pointing out that this article is misleading concerning relative merits single- and double-acting Diesel; present writer maintains that double-acting 2-stroke-cycle Diesel will undoubtedly be developed beyond all others in future; effect of gravity is of no account, except that it causes still greater amount of power to be transformed into flywheel energy, to be given up during up-stroke, in single-acting, vertical engine.

POWER PLANTS, USE IN. The Use of Diesel Engines for Peak Load Supply. Engineer, vol. 145, no. 3758, Jan. 20, 1928, pp. 78-79. Whereas writer's immediate plea is for continued use of existing oil engines, general question of use of steam turbines for basic load for which they are eminently fitted and use of oil engines for peak load should not be overlooked; oil engine costs only half as much for fuel for peak-load units and less for labour, while it is very questionable whether, when new peak-load stations have to be put up, their capital cost would be any less with steam turbines than with oil engines.

SUPERIOR-OTTO. Heavy Duty Diesels Designed for Continuous Service. Oil Engine Power, vol. 6, no. 2, Feb. 1928, pp. 94-97, 5 figs. Detailed description of Superior-Otto series of vertical, four-stroke-cycle engines; available in sizes from 60-b.h.p. to 360 b.h.p. with one, two, three, four or six cylinders; base casting; main bearings; crankshaft construction; cylinder and valve assembly; piston and connecting rod; fuel supplied from cam-actuated fuel pump; combined oil filter and cooler mounted at rear end of engine; control gear.

DROP FORGING

PRACTICE. Drop Forging Industry and Equipment, M. S. Reed. Heat Treating and Forging, vol. 14, no. 1, Jan. 1928, pp. 32-33 and 40. Present status of industry and improvements in methods and equipment to meet changed conditions; four-roll board-drop hammer; speed and accuracy of hammer operation; withdrawal of obsolete equipment; new uses found for drop forgings.

E

ELECTRIC APPARATUS AND APPLIANCES

LOAD VALUES. Utility Research Indicates Appliance Load Values, H. A. Snow. Elec. World, vol. 91, no. 3, Jan. 21, 1928, pp. 143-147, 10 figs. Tests show electric ranges, refrigerators and oil burners of great potential importance in raising average annual consumption; special metering has made it possible to determine annual consumption, daily and yearly load curves, maximum demands, load factors and diversity factors for these appliances.

ELECTRIC CABLES

HIGH-TENSION. High-Voltage Cable Problems, T. N. Riley. Elec. World, vol. 91, no. 3, Jan. 21, 1928, pp. 137-140, 8 figs. Heating and cooling stresses must be considered as well as electric stresses; loss tests should be based on load cycles; further data obtained regarding ionization phenomena; effect of insulation oil.

132,000-Volt, Single Conductor, Lead Covered Cable. Am. Inst. Elec. Egrs.—Jl., vol. 47, no. 2, Feb. 1928, pp. 118-125, 9 figs. Describes development of oil-filled type of cable; paper is divided into four parts, as follows: Introduction, Economics and Commercial Demand, P. Torchio; Theory, Design and Development of the 132,000-Volt Cable, L. Emanueli; Manufacture, Inspection and Testing of the 132,000-Volt Cable, W. S. Clark; Installation of the 132,000-Volt Cable, A. H. Kehoe, C. H. Shaw, J. B. Noe and D. W. Roper.

UNDERGROUND, TESTING. Insuring Good Performance Underground Cable Work, H. Halperin. Elec. Light and Power, vol. 6, no. 2, Feb. 1928, pp. 26-27 and 84 and 86, 2 figs. Describes methods of testing underground electric cables, especially at joints; instruments used are noted; tapes are described and their characteristics; methods of making joints and materials used.

ELECTRIC FURNACES

Annealing. Electric-Elevator Furnace Anneals Steel Castings, L. M. Bassini. Am. Mach., vol. 68, no. 4, Jan. 26, 1928, pp. 161-163, 4 figs. Construction and operation of electrically operated car-type furnace of Burnside Steel Foundry Co.; heating chamber above floor; work piled on annealing racks placed on car; car wheeled under furnace and lifted into heating chamber; special sand seals provide airtight joint between car and furnace; elevator operated by 3-cylinder pump driven by electric motor; output one ton per hour; 1,650 deg. Fahr. obtained by four Nichrome ribbons.

Control. Automatic Control of Electric Furnaces, L. G. Bean. Elec. Light and Power, vol. 6, no. 2, Feb. 1928, pp. 64-70 and 91, 10 figs. Tells what automatic control accomplishes, how it operates, what instruments are used for it and how they are connected to various kinds of furnaces; advantages of automatic control are generally conceded to be more even product; lower labour charges; longer life of furnaces due to not overheating; saving of fuel.

High-Frequency. A New Electric Steel Furnace. Elec. Rev., vol. 101, no. 2612, Dec. 16, 1927, pp. 1029-1031, 4 figs. High-frequency Ajax-Northrup furnace installed at Sheffield, England; steel produced under crucible conditions; eddy currents induced in steel itself, before and during melting; no heat is passed from exterior of crucible to metal within; supply frequency 2,200 cycles per sec. and pressure 1,200 volts; small space occupied. See description in Elec. Times, vol. 72, no. 1886, Dec. 15, 1927, pp. 780-782, 5 figs.

Melting. Presents Cost Data on Electric Furnace Melting, J. B. Meier. Foundry, vol. 56, no. 3, Feb. 1, 1928, pp. 93-98, 5 figs. Author presents unbiased and accurate continuous record of actual conditions as encountered in foundry with which he is associated, dealing solely in rough castings; includes graphic representation of electric-furnace operation over period of 8 months; résumé of cost per ton.

Miguet. New Miguet Electric Furnace with Continuous Electrodes (Le nouveau four électrique Miguet à électrode continue), R. Sevin. Jl. du Four Electrique (Supp.), vol. 37, no. 1, Jan. 1928, pp. 5-8, 5 figs. Description of electric furnace at Montricher using single-phase current; incoming current at 5,000 volts transformed by 5 transformers; operation also described and complete installation.

ELECTRIC LINES

Grounding. Protective Grounding, S. W. Bordon. Elec. World, vol. 91, no. 5, Feb. 4, 1928, pp. 255-257, 2 figs. Discussion of recommended practices of Nat. Elec. Mfrs'. Assn.; presents drawings of typical industrial-plant installation in accordance with N.E.M.A. recommendations, and ground conditions which may occur on system.

High-Tension. 1926 Lightning Experience on 132-Kv. Transmission Lines, P. Sporn. Am. Inst. Elec. Engrs.—Jl., vol. 47, no. 2, Feb. 1928, pp. 105-109, 3 figs. Transmission network in question comprises 910 mi. of actual line, about one-third of which is double-circuit; tabular data describing lines and 1926 performance; design developments during 1927; summation of experience and its application to tower-line design.

Interconnected. Advantages and Possibilities of Electric Power Line Interconnections, H. Markle. Pub. Service Mgmt., vol. 44, no. 2, Feb. 1928, pp. 62-63. Water powers of South are linked with steam stations of North in such a way that over a million kilowatts of existing generating capacity is released for future growth; benefits of interconnection; value demonstrated; public benefits; to-day, big, efficient steam plants carry base load and hydros are auxiliaries.

Theory. Some Transmission Line Fundamentals, C. A. Boddie. Elec. Jl., vol. 25, no. 1, Jan. 1928, pp. 32-35, 5 figs. In transmission of power over short lines at power frequencies, resistance and inductance of line are only factors which need to be taken into account in determining performance of line; any given line will act on sending end generator as resistance, inductance or capacity, depending on length of line and frequency applied. (To be continued.)

Sag. Calculation of Sags in a Transmission Line with a Broken Conductor, J. P. Den Hartog. Elec. Jl., vol. 25, no. 1, Jan. 1928, pp. 24-26, 5 figs. When transmission line crosses railroad or highway it is necessary to maintain sufficient clearance between level of road and overhead conductors; often definite clearance is specified, and in such cases it is important to know sag of span just above road when conductor breaks in one of neighbouring spans; gives method for calculating such sags.

Underground. Thirteen Kv. Underground Construction, E. R. Pelster. Elec. Light and Power, vol. 6, no. 2, Feb. 1928, pp. 28-34 and 90-91, 10 figs. Description of methods used by Dallas Power & Light Co. to increase and change character of their distribution system; 5-year job; all overhead wires removed and put underground; feeders and mains, vaults and transformers; transformer connections, service connections and underground services are treated and allocation of costs to consumers and power company.

ELECTRIC LOCOMOTIVES

Maintenance and Repairs. Electric Locomotive Maintenance, A. McLanahan. Ry. Mech. Engr., vol. 102, no. 2, Feb. 1928, pp. 109-112, 5 figs.

Operation. Some Points Regarding Electric Locomotive Operation, T. Rich. Elec. Times, vol. 73, no. 1891, Jan. 19, 1928, pp. 78-79, 3 figs. Describes method used on electric locomotives to keep centre of gravity from being too low and to minimize unsprung weight; how motors are geared to driving axles; advantage of electric hauling over steam.

ELECTRIC METERS

Four-Wire. Four-Wire Metering, E. A. Corum and F. L. Christenberry. Elec. Wld., vol. 91, no. 2, Jan. 14, 1928, pp. 95-97, 12 figs. Various methods available discussed, with data showing comparative accuracies obtained; 3-phase, 4-wire, 3-element meter adopted by Memphis Power & Light Co.

ELECTRIC MOTORS

Alternating-Current, Protective Relays. Phase-Balance Relays Protect Polyphase Motors, E. H. Stivender. Power, vol. 67, no. 4, Jan. 24, 1928, pp. 145-146, 2 figs. Phase-balance relays represent one of latest types of protective relays and are coming into general use for protection of important auxiliaries in power plants and other installations where continuity of service is essential; describes General Electric and Westinghouse Company types of phase-balance relays.

Rolling Mills. Synchronous Motors for Driving Steel Rolling Mills, W. T. Berkshire and H. A. Winne. Am. Inst. Elec. Engrs.—Jl., vol. 47, no. 2, Feb 1928, pp. 136-142, 14 figs. Discusses, from practical standpoint, application and design of synchronous motors for steel-mill main-roll drives, in effort to show what their advantages and disadvantages are; where they should and where they should not be used; and what special precautions must be taken in design of motors for this service.

Starting Currents. Motor Starting Current vs. Lighting Flicker, H. L. Wallau. Elec. World, vol. 91, no. 4, Jan. 28, 1928, p. 198. Discusses question of maximum draught of current which may be allowed to be suddenly imposed upon any portion of system of combined light and power underground; low-voltage networks; values of current draught are determined, from which allowable ratings of motors of different types may be determined.

Starters. The Motor Starter Is Just as Important as the Motor, B. Candlish. Power House, vol. 22, no. 1, Jan. 5, 1928, pp. 30-32 and 44. Describes types of motor starters, good and bad points; application of various types of motors, why accidents occur; motor starter or controller is just as important as motor itself, and operation of motor should not be jeopardized by poor starting and controlling equipment.

ELECTRIC POWER

National Defence. Power in National Defence, E. C. Kelton. Elec. World, vol. 91, no. 5, Feb. 4, 1928, pp. 239-242. Points out that 10 years ago there were serious power shortages in several parts of country; discusses plan, presented by Secretary of War D. F. Davis in June 1927 before Nat. Elec. Light Assn., calling for selection of executive assistant to be known as emergency power director who would be responsible for effective utilization of power facilities of country.

ELECTRIC RAILROADS

Chicago. Illinois Central Suburban Service, W. M. Vandersluis. Am. Inst. Elec. Engrs.—Jl., vol. 47, no. 2, Feb. 1928, pp. 133-135, 4 figs. Gives operating records of first year of electrical operation of suburban service of Illinois Central Railroad; it shows monthly curves of load, kw.-hr. per car-mile, maximum demand, load factor and temperature; also monthly curves for last 4 years of passengers, car-miles, seat-miles and operating income; improvements in service are enumerated and general results at this date are discussed.

ELECTRIC RELAYS

Protection of. The Application of Relays for the Protection of Power System Interconnections, L. N. Crichton and H. C. Graves, Jr. Am. Inst. Elec. Engrs.—Jl., vol. 47, no. 2, Feb. 1928, pp. 143-151, 15 figs. Compilation of many new methods for relay protection required by superpower interconnections; ideas have been obtained from various sources and represent good present-day practice; indicates usefulness of certain inverse time-limit relays on systems having dead grounded power-transformer neutrals at all switching stations; bus protection and "back-up" methods; new relays and improvements made to older types illustrate typical relay installation similar to that being placed in service on 220-kv. interconnection.

ELECTRIC TRANSFORMERS

Cooling. Emergency Cooling of Transformers, H. C. Klingenschmitt. Power, vol. 67, no. 4, Jan. 24, 1928, p. 147, 1 fig. Describes use of fire-hose sprayer for cooling overloaded transformers, as applied on single-phase transformer which suddenly failed.

ELECTRIC WELDING

Methods. Electrical Welding and Hardening Processes. AEG Progress, vol. 3, no. 12, Dec. 1927, pp. 379-384, 20 figs. Electric equipment and methods for hardening and welding; electric salt-bath furnaces for hardening cutting tools; electric hardening furnaces for hardening carbon steels; electric annealing and tempering furnaces; arc welding and resistance welding; electric fusion butt welding employed in manufacture of highly stressed machine parts; sheets of metal welded together by spot welding; elasticity depreciated by electric arc welding; atomic arc-welding process.

ELECTRIC WELDING, ARC

Cutting and. Arc Welding and Cutting. Am. Welding Soc.—Jl., vol. 6, no. 12, Dec. 1927, pp. 1-76, 61 figs. Information and instructions for making of arc welds compiled by Educational Committee of Am. Welding Soc. as source of reference of fundamentals of arc welding; comprehensive and detailed treatise on welding of all kinds of metals, apparatus and equipment and qualifications for arc welders.

Equipment. Some Considerations on Arc Welding and Choice of Equipment (Quelques considérations sur la soudure à l'arc électrique et sur le choix d'un équipement), F. Lorne. Electricité de Mécanique, no. 21, Nov.-Dec. 1927, pp. 23-30, 9 figs. Suggestions to act as guide on choice of equipment and information on method of utilizing current and electrodes for particular case at hand; application to different metals and different kinds of welding.

Rolled-Steel Parts. Welded Rolled-Steel in Machine Construction, R. H. Rogers. Can. Machy., vol. 39, no. 2, Jan. 26, 1928, pp. 33, 34, 36, 38, 39, 8 figs. Parts formerly made from pig iron now made by fabrication from finished products of steel rolling mills; application of fabricated steel made possible only by metallic arc welding; ready-finished character reduces machine work; smaller revolving weights and smaller diameters; welding on feet; stator frame containing 2,000 ft. of weld; bearing pedestals; stator frame procedure.

ELECTRIC WIRING

National Electric Code. Analysis of Proposed 1928 Code Revisions, A. L. Abbott. Electragist, vol. 27, no. 4, Feb. 1928, pp. 28-30. Proposed changes in National Electrical Code; Article 5 on Wiring Methods is perhaps most important of proposed changes; preceding installation rules for each type with clear statement of location where and conditions under which this type of wiring is approved for use; interior electrical systems; branch circuits; demand-factor data; outlet boxes; grounding; grounding portable equipment; control circuits; storage-battery rooms; low-voltage circuits.

Protective Grounding. Hazard of Grounding to Circuit Wiring, S. W. Bowden. Electragist, vol. 27, no. 4, Feb. 1928, pp. 21-24, 2 figs. Discussion of recommended practices of Nat. Elec. Manufacturers' Assn. on protective grounding; cause of shock hazard; schematic wiring diagram of industrial-plant installations; rise of potential kept within safe limits by keeping resistance of secondary ground circuit sufficiently low; artificial grounds; single-electrode grounding; grounding motor frame; objections to using grounded circuit wire for grounding metallic enclosures even where water-piping systems of known low resistance are utilized for earth electrode.

Standardization. How Standardization Procedure Affects the Industry, A. P. Denton. Elec. World, vol. 91, no. 3, Jan. 21, 1928, p. 151. Points out that standardization procedure from this time on must protect each type of wiring according to its merits and at same time permit of new developments and progress of art; basic factor underlying standards for wiring installations of code is safety from standpoint of fire and life hazards.

ELECTRICITY SUPPLY, RURAL

Ontario. Ontario Active in Rural Distribution. Elec. News, vol. 37, no. 1, Jan. 1, 1928, pp. 31-34, 5 figs. Nearly 40,000 farm and rural customers supplied with electric service; over 875 miles of primary lines built in 1927 and 1,000 expected for 1928; difficulties of rural distribution; rural financing; design of rural feeders; overhead wood pole-line construction; transformers with very low exciting current; classification of service; supplied at cost to consumer; estimated costs of electrical service by Hydro-Electric Power Commission of Ontario in rural power districts.

ELEVATORS

Electric, Door Operators for. An Elevator-Door Operator That Splits Seconds. Power, vol. 67, no. 6, Feb. 7, 1928, pp. 251-252, 4 figs. Details of new door-opening equipment developed by F. A. Boedtcher, New York City; instead of one operating door as has been previously used on elevator doors, in this equipment there are two, purpose of which is to overcome tendency that single door has to tip door and cause them to bind and in some cases break door hangers.

EROSION

Niagara Falls. Preservation of Niagara Falls. Contract Rec., vol. 42, no. 5, Feb. 1, 1928, pp. 102-105, 3 figs. Comparatively simple and inexpensive engineering works recommended by joint board; interim report of special International Niagara Board suggests measures to preserve beauty of Falls and possibly permit greater water diversion for power purposes; initial works recommended; cost estimates.

Preservation. Niagara Falls. Preservation of Horseshoe Falls, Niagara. Can. Engr., vol. 54, no. 5, Jan. 31, 1928, pp. 175-180, 5 figs. Conclusions and recommendations of special board with respect to initial remedial measures; conditions at falls; recession of horseshoe; power diversions; remedial works; submerged weir proposed; results antcipated; sequence of construction; cost estimates.

F

FLOOD CONTROL

Miami River, Ohio. Maintenance of Flood-Control Works of Miami District, C. S. Bennett. Eng. News-Rec., vol. 100, no. 5, Feb. 2, 1928, pp. 186-188, 4 figs. Current upkeep operations conducted to give improved appearance as well as maintained efficiency; describes methods of treating banks of Miami river in towns of Dayton, Hamilton and Middletown, and use of retarding dams; prohibition of dumping of refuse on river banks; uses of banks for camping and recreation purposes.

Mississippi River. Col. Potter Comments on Difference in Cost Estimate of Two Mississippi Flood Plans. Eng. News-Rec., vol. 100, no. 1, Jan. 5, 1928, p. 27. Reasons for differences between cost figure given in Chief of Engincer's flood-control plan and that given in Mississippi River Commission plan, outlined by president of commission.

Model Study. Flood Study in Europe, M. P. O'Brien. Purdue Eng. Rev., vol. 23, no. 2, Jan. 1928, pp. 9-10 and 32 and 34, 2 figs. Use of models in study of large hydraulic structures; models of canals, shiplocks and hydraulic power plants; hydraulic engineering of this sort much better known and more widely employed in Europe than in America; development and equation forms of theory governing use of models; value of model experiments; reliability of model tests; investigation of flow conditions by means of models in United States.

FLOOD DISCHARGE

Discussion on. Maximum Flood Discharge in San Joaquin Valley, California, R. Bollansbee and H. K. Fox. Am. Soc. Civ. Engrs.—Proc., vol. 54, no. 2, Feb. 1928, pp. 651-653. Discussion of paper by O. Reed published in Nov. 1927 issue of Proceedings.

FOREMAN

Qualifications. Qualifications of a Foreman, E. H. Fish. Machy. (N.Y.), vol. 34, no. 6, Feb. 1928, pp. 413-416. Qualities most valuable in foreman; limiting foreman's responsibility; how foremen themselves rate personality, character and leadership; submerging foremen in red tape; judgment and loyalty; knowledge of men not as much appreciated; health as important factor; resourcefulness and tact; what co-operation means; importance of study and technical books; sympathetic personality as asset; qualities at top of list; ways in which shop profits by better foremanship.

FORGE-SHOP PRACTICE

Methods. Forging Machine Practice, W. S. Dewell. Machy. (Lond.), vol. 31, no. 797, Jan. 19, 1928, pp. 5 3-516, 5 figs.

Forging Methods and Heating to Forge, W. M. Hepburn. Heat Treating and Forging, vol. 14, no. 1, Jan. 1928, pp. 41-43, 6 figs. Classification of forging methods; relation of proper heating to good results and certain types of furnaces that have been used to advantage; describes continuous-type furnace; end heating for upsetting. Abstract of paper presented before Am. Gas Assn.

FOUNDATIONS

Theory. The Science of Foundations—Its Present and Future, G. Paaswell, C. C. Williams and H. Chatley. Am. Soc. Civ. Engrs.—Proc., vol. 54, no. 2, Feb. 1928, pp. 655-665, 3 figs. Discussion of principles of foundations in soils of various kinds. Discussion on paper by C. Terzaghi, continued from Nov. 1927 issue of Proceedings.

FOUNDRIES

Non-Ferrous. New Plant Widens Scope of Output. Iron Age, vol. 121, no. 5, Feb. 2, 1928, pp. 328 and 329, 3 figs. New foundry and machine shop of Hills McCanna Co. described; larger sizes of individual castings and heats from wider range of non-ferrous metals obtained; 11 oil-fired furnaces; moulding machines; Pridmore stripper, 2 electrically operated sand riddles and sand mixer; small moulds made in steel flasks; core room, core ovens, gate and riser cutting-off machines and sand-blast equipment; duorail and monorail systems for handling materials; fuel oil from central pumping station.

FOUNDRY COST ACCOUNTING

Group Costs. Group Foundry Costs, D. McDanields. Am. Foundrymen's Assn. —Reprint, no. 27-28, June 7, 1927, pp. 38-42 and (discussion) 43-44. Tells of operation of particular group with which author's foundry is connected and discusses some of benefits derived from it; idea back of formation of costs groups is to make dependable cost data so easy to obtain and so low in price that no one operating foundry will consider being without it.

Runge System. Seven Years of Foundry Cost Accounting, A. Wessling. Am. Foundrymen's Assn.—Reprint, no. 27-28, June 7, 1927, pp. 32-36 and (discussion) 36-37. Experiences of jobbing foundrymen of Cincinnati with adoption of Runge system of cost accounting.

FOUNDRY PRACTICE

Developments in. Recent Developments in Cast Iron and Foundry Practice. Brit. Cast Iron Research Assn.—Bul., no. 19, Jan. 1928, pp. 14-18. Reviews paper by Moore and Lyon on fatigue tests of cast iron; paper by Schwarz on tests of cast iron, results being given in tabular form; tests carried out by British Oxygen Company on strength of cast iron at very low temperatures; malleable cast iron specifications.

Economical Methods. Foundry Effects Substantial Savings, C. H. Vivian. Brass World, vol. 23, no. 12, Dec. 1927, pp. 395-400.

FOUNDRIES

Electric Power in. Electric Power in the Foundry. Foundry Trade Jl., vol. 37, no. 592, Dec. 22, 1927, p. 214. Deals with miscellaneous application of electric power in foundry, such as driving of compressors, moulding machines, fans, sand mills, hammers, etc.; preceded by details of new all-electric charging equipment in American foundry.

FREIGHT HANDLING

Containers. Road-Rail Traffic on the L.M.S.R. Ry. Gaz., vol. 47, no. 27, Dec. 30, 1927, pp. 817-818. English practice of using containers for handling and transportation of merchandise; development of container traffic; types of containers in use; service considerations; underframes and chassis; reduction of claims for goods damaged in transit; lifting tackle and crane power.

FURNACES

Annealing, Continuous. Continuous Annealing Furnaces, F. W. Manker. Heat Treating and Forging, vol. 14, no. 1, Jan. 1928, pp. 47-50 and 54, 4 figs. Abstract of paper delivered before Engrs'. Soc. of West. Penn.

Reverberatory. Study of the Flow of Gases in Reverberatory Furnaces, W. K. Thompson. Eng. Jl., vol. 11, no. 1, Jan. 1928, pp. 25-33, 25 figs. Chemistry of reverberatory smelting of copper concentrates; combustion of oil; comparison of volume of air consumed per pound of fuel, and products of combustion; reverberatory furnaces considered as hydraulic reservoirs; flow of air through ports in bridge wall and its distribution; measurement of volume of gases flowing through furnace; draught depression necessary to remove products of combustion; paper is written from standpoint of hydraulics and hydrostatics.

G

GARBAGE INCINERATORS

Description of. Garbage Disposal at Highlands, N.J. Am. City, vol. 38, no. 1, Jan. 1928, pp. 147-148, 2 figs. Describes incinerator for borough of 2,000 to 10,000 people winter and summer; average garbage collected Aug. 1 to Sept. 10 for 36 collection days was 14 tons; cost of operation of plant during this period was 80.3 cents per ton; compares cost of incinerator with former method of disposal.

GAUGES

Inspection Devices and. Inspection Devices in the Westinghouse Plant, W. H. Miller. Machy. (N.Y.), vol. 34, no. 6, Feb. 1928, pp. 409-412, 8 figs. Gauges and inspection devices required in manufacturing at East Pittsburgh plant; 8,000 different special gauging devices; testing concentricity of motor end brackets; checking parallelism of keyways; fixture for finding angles of gauges; inspecting gas-engine pistons; determining depth of counterbored hole; device employed in inspection of crankshaft; gauge for finding angle of foot castings.

GASOLINE ENGINES

High-Power. High-Power Engines (Moteurs à grande puissance spécifique), H. R. Ricardo. Technique Automobile et Aérienne, vol. 18, no. 139, 1927, pp. 125-127, 3 figs. Treats of case of modern gasoline engine having compression ratio of 5, and having cylinder filled with air or combustible mixture at atmospheric pressure at end of suction stroke; efficiency is touched upon, also cycle of operation when air is carbureted.

GEAR CUTTING

Gear Generators. A High-Speed Gear Generator. Automobile Engr., vol. 18, no. 237, Jan. 1928, pp. 21-22, 2 figs. Features of new Maag gear generator; reciprocating speed of from 180 to 200 strokes per minute; rack type of cutter with absolute minimum of overhang; separate rack-shaped backing plate; lateral adjustment ensures face of cutter is set parallel to work slide; 3 types of cutter; taking up play in lead screw and nut and, automatically, back-lash in gears; balancing mechanism for cutter slide; locating gear blank from bore; machine for planing spiral gears.

GEARS

Design. Gearing. Automotive Abstracts, vol. 6, no. 1, Jan. 20, 1928, p. 17. Review of number of articles in Maschinenbau, Nov. 17, 1927, on gearing, both toothed and hydraulic, which cover subject very completely from point of view of general arrangement and kinematics; some of articles seem to indicate that Germans, under leadership of Burmester and Kutzbach, have developed whole new science of gearing design; this science refers to general arrangement of drives, not to tooth form.

GRINDING

Automobile Parts. Abrasive Engineering Practice in Automobile Manufacturing, F. B. Jacobs. Abrasive Industry, vol. 9, no. 2, Feb. 1928, pp. 48-52, 4 figs. Describes disk grinding with hand feed and automatic feed with abrasive wheels, use of jigs, finish allowance for various classes of work, necessity for free cutting disks, maintenance of disks, their truing and setting up.

Face. Saving Material by Face Grinding. Machy. (Lond.), vol. 31, no. 797, Jan. 19, 1928, pp. 517-518, 2 figs.

GREAT LAKES

Regulation. Regulation of the Great Lakes. Eng. News-Rec., vol. 100, no. 3, Jan. 19, 1928, pp. 121-122. Review of book by J. R. Freeman, entitled "Regulation of the Great Lakes and Effect of Diversions by Chicago Sanitary District"; describes design adopted for regulating works; conditions affecting design of regulating works; evaporation studies; meteorology and hydrology conditions in connection with evaporation studies; engineer data on Great Lakes problem.

GRINDING MACHINES

Design. Achievement in Grinding Machine Design During 1927, H. Rowland. Can. Machy., vol. 39, no. 1, Jan. 12, 1928, pp. 27-37, 22 figs. Exhaustive survey of developments in grinding machines during 1927; treats of feeds and drives and products of various manufacturers with notes on features of each machine.

Internal. A New Brake Drum Grinder. Automobile Engr., vol. 18, no. 237, Jan. 1928, p. 28, 1 fig. Features of heavy-duty machine for internal grinding; Cincinnati brake-drum grinder entirely self-contained; centralized control; permanently mounted sizing indicator; wheel-truing device; 30-h.p. motor to drive grinding-wheel spindle built into machine; new tex-rope method of transmitting power to wheel spindle; spindle unusually heavy for internal grinder; water tank enclosed within main bed casting; Carborundum Aloxite wheel used.

GYPSUM MINES AND MINING

Manitoba. Mining Gypsum in Manitoba. Can. Min. Jl., vol. 49, no. 4, Jan. 27, 1928, p. 86. Although gypsum has been found at many localities in province, it has been exploited only at Gypsumville, where large deposits occur northwest of narrows of lake St. Martin; gypsum occurs in beds which vary in thickness of ¼ in. to 3 ft. and which are often separated by film of argillaceous material; quarry methods are simple.

H

HARDNESS TESTS

Methods. A Résumé of the Magnetic Methods Employed in Studying the Mechanical Properties of Matter, S. R. Williams. Instruments, vol. 1, no. 1, Jan. 1928, pp. 29-38, 9 figs.

Methods of Hardness Testing. Am. Mach., vol. 68, no. 5, Feb. 2, 1928, p. 231, 2 figs. Comparison of Brinell and Rockwell readings; table and charts for ready shop and laboratory reference; Rockwell B readings taken using 1/16-in. diameter steel ball and 500-kg. major load; C readings taken with conical diamond penetrator and 150-kg. major load.

HEAT TREATING PLANTS

Equipment. Automatic Heating and Heat Treating Units Synchronize Auto Production, J. B. Nealey. Iron Trade Rev., vol. 82, no. 5, Feb. 2, 1928, pp. 315-317, 3 figs. Describes methods and equipment of Fordson plant of Ford Motor Co., vast majority of heating and heat-treating operations are on gas; in steel-making department are 7 basic open-hearth furnaces; main heat treating department, one of largest in world, includes 40 cyanide, 19 continuous and 6 periodic furnaces.

Equipment and Operation of a Heat-Treating Plant, M. G. Jewett. Am. Mach., vol. 68, no. 4, Jan. 26, 1928, pp. 171-172, 4 figs. Heat-treating plant of Chain Belt Co. described; temperature regulated by automatic recording controllers; portable quenching tanks equipped with revolving drums and helical conveyors to carry work through water or oil; four rotary carburizing machines, two rotary drawing furnaces and one rotary, continuous heat treating machine; Greene quenching machine; gas for heating; 14 tons per 24-hr. day; operated by two furnace tenders and foreman on each 12-hr. shift.

HEATING, STEAM

Central. By-product Generation in District Heating Plant, J. H. Walker. Power, vol. 67, no. 5, Jan. 31, 1928, pp. 182-184, 3 figs. General problem of generating by-product electricity in district heating plant and how it has been worked out in Beacon street plant of Detroit Edison Co. by means of variable back-pressure turbine; installation permits generation of considerable amount of power without sacrificing great advantage of feeder method of steam distribution.

Office Buildings. Exhaust Steam Heats the Equitable Building, J. W. Degen. Power, vol. 67, no. 3, Jan. 17, 1927, pp. 102-105, 3 figs. Steam at 150 lb. per sq. in. pressure is furnished by four Heine water-tube boilers having combined heating surface of 20,000 sq. ft.; generators are driven by Corliss engnies; during heating season, engines exhaust at from one-quarter to one pound back pressure, supplying steam to two-pipe vacuum-heating system; exhaust from engines goes to oil extractor or utility tank on engine-room level in sub-basement; riser carries steam to roof.

HIGH VOLTAGES

Testing. An Easily Made Tester for High-Voltage Circuits, M. D. Smith. Power, vol. 67, no. 6, Feb. 7, 1928, pp. 252-253, 3 figs. Describes instrument, devised by superintendent of one company using 5,000 transformers of various sizes, for testing transformer cases to determine if they are alive; instrument consists of neon-gas-filled tube 13/16 in. in diam. and 4½ in. long.

HYDRO-ELECTRIC DEVELOPMENTS

California. High-Head Hydro-Electric Project on Bucks Creek. Eng. News-Rec., vol. 100, no. 4, Jan. 26, 1928, pp. 140-143, 5 figs. Variety of operations involved in California power development that will utilize record head of 2,561 ft.; will develop 70,000 h.p. in two impulse turbines; included in project are construction of 18 miles of road, 10 miles railway, 4,800-ft. incline, several dams, two tunnels, 8 miles of welded pipe, various headworks, surge chamber, penstocks and power house; résumé of statistical information on major features is appended.

HYDROMETALLURGY

Features. Hydrometallurgy. Eng. and Min. Jl., vol. 125, no. 3, Jan. 21, 1928, pp. 119-121. In field of copper leaching, one of features of 1927 was success, metallurgic and economic, of new Inspiration leaching plant, first large-scale operation for direct leaching of copper sulphide.

I

ICE PLANTS

Unusual Features in. 12-Ton Plant Employs Unusual Features, W. W. Taylor. Refrigeration, vol. 43, no. 1, Jan. 1928, pp. 69-72, 7 figs. Machinery and equipment of plant of 12 tons capacity of Mason Brown Ice Co., Huntsville, Alabama; total horse power in this plant is 51¼; vertical compressors employed.

INDUSTRIAL MANAGEMENT

Budget Control. Production and Inventory Budgets, T. R. Jones. Am. Mgmt. Assn.—Annual Convention Series, no. 67, pp. 3-9 and (discussion) 9-14. Discusses factors which production budget should determine; relation of production budget to sales budget; how purchase of raw material and supplies should be correlated with production programme; purpose of inventory budget; how raw materials and fabricated products should be budgeted; how standards should be applied to inventory budgets; forms which should be used.

Production Control. Integrated Production. Soc. Automotive Engrs.—Jl., vol. 22, no. 1, Jan. 1928, pp. 71-73, 1 fig. Brief résumé and discussion of E. P. Blanchard's Production-Meeting paper published in Journal for Oct. 1927, p. 375; progress due to "simulation" with multiple-head machines; economical production obtained in period of reduced schedule by keeping all machines in group running but reducing speed and number of operators; setting equipment for production little greater than planned quantity; critical point at which cost per piece becomes greater with simple machine than with more refined.

Production Orders. Manufacture Effectively Co-ordinated by Simple System. Iron Age, vol. 121, no. 3, Jan. 19, 1928, pp. 194-196, 9 figs. Avoidance of over-elaboration has been fundamental consideration of Landis Machine Co., Waynesboro, Pa., in developing production order system for co-ordination of its manufacturing operations; at plant production orders are issued and returns collected by central department.

Shop Management, Co-operative. A Co-operative Shop Management System That "Works." Can. Machy., vol. 39, no. 2, Jan. 26, 1928, pp. 24-25. Co-operative idea in operation at Canadian National shops at Stratford; no labour troubles; shop council composed of 14 members, 7 from management and 7 from shops, elected by men in various departments; suggestions made by men themselves that were of value; men working in Canadian National shops using their inventive genius and their powers of observation to make conditions such that work can be carried on to very best advantage; idea to take place of strikes and lockouts.

INSULATION, ELECTRIC

Testing. Testing Insulation with High Frequency, J. L. Rylander. Elec. Jl., vol. 25, no. 1, Jan. 1928, pp. 10-13, 11 figs. It has been found that by applying single-phase, high frequency current directly to winding, location and extent of any weakness may be disclosed without destroying either defective part or adjacent parts; method is applicable to any insulated circuit, be it single coil or completely wound machine, regardless of voltage.

INTERNAL-COMBUSTION ENGINES

Crankcase Scavenging. Crankcase Scavenging of a Two-Stroke-Cycle Engine, O. Holm. Nat. Advisory Committee for Aeronautics—Tech. Memorandum, no. 446, Jan. 1928, pp. 1-11, 22 figs. Experiments to find effect variation of height of scavenge and exhaust ports on scavenging efficiency as determined by gas analysis; effect of changes in shape of scavenge channel and piston openings; smaller early exhaust favourable; results confirmed on other engines; important not to dissipate kinetic energy of gases in large mufflers, but to utilize it. Translated from V.D.I. Zeit., June 11, 1927.

Supercharging. Some Aspects of Supercharging for Sea-Level Conditions, C. F. Taylor and L. M. Porter. Soc. Automotive Engrs.—Jl., vol. 22, no. 2, Feb. 1928, pp. 195-199, 5 figs. Series of tests using internal-combustion engine with variable expansion ratio; testing at normal atmospheric pressure with supercharger to increase power output; tests indicate results in horse power and efficiency attained in automobile engines by independently varying expansion ratio and total compression ratio; theoretical horse power and efficiency computed for conditions of tests; curves show results of variations in different factors and compare test results with calculated values.

Thermal Efficiency. Standards of Thermal Efficiency for Internal-Combustion Motors, D. Clerk. Engineering, vol. 125, no. 3234, Jan. 6, 1928, p. 10. Discussion of report of Heat Engine Trials Committee, discussing ideal efficiency standards for four distinct engine cycles, (1) constant-volume; (2) constant-pressure; (3) Diesel, and (4) Atkinson; points out that Atkinson cycle gives high ideal thermal efficiency, and engines built to follow it would be very economical, but no engines existing at present carry out cycle required to produce such efficiencies. Abstract of paper read before Instn. of Civ. Engrs.

Variable-Stroke. An Analysis of the Andreau Cycle, C. W. Olliver. Power Engr., vol. 23, no. 262, Jan. 1928, pp. 6-7, 7 figs. Gives general formula for motion of both piston and knuckle-joint, from which effect of various variable quantities of problem on form of curve and cycle may be readily appreciated; relates to Andreau variable-stroke internal-combustion engine.

See also Airplane Engines; Automobile Engines; Diesel Engines; Gasoline Engines; Oil Engines.

IRON CASTINGS

Cleaning. Speed Marks Cleaning Procedure in New Buick Plant, P. Dwyer. Foundry, vol. 56, no. 3, Feb. 1, 1928, pp. 99-104, 9 figs. Methods and equipment for handling and cleaning castings in Buick foundry, Flint, Mich.; equipped with 6 long and 2 short conveyors handling 500 tons of automobile engine castings daily; methods of disposing of burned core sand and scrap knocked off castings; handling débris and reclaiming metallic content; cleaning-room equipment, including tumbling barrels, sand-blast units, etc.

Cylinders. Some Further Notes on Oil-Sand and Motor Cylinders, W. West. Foundry Trade Jl., vol. 37, no. 592, Dec. 22, 1927, pp. 211-213, 5 figs. Results given represent beginning of extensive series of practical experiments to explore nature and use of all media which might be of service to foundryman in oil-sand mixture; resin as an agglomerant; effect of mixing and milling upon grain size of sand mixture.

Diesel-Engine. The Production of Diesel Engine Castings in Pearlitic Cast Iron. Foundry Trade Jl., vol. 37, no. 592, Dec. 22, 1927, pp. 215-216. Discussion of lecture by A. J. Richman before Inst. Brit. Foundrymen; points out close relationship between resistance to wear and Brinell hardness number.

Shrinkage Holes. Shrinkage Holes in Small Grey Iron Castings, P. A. Russell. Foundry Trade Jl., vol. 38, no. 597, Jan. 26, 1928, pp. 55-59, 19 figs. Points out that there is no general agreement as to root cause of shrinkage, or drawing, as author prefers to call it; definition of phosphorus; conditions during solidification; effect of composition; drawing of semi-steel cast iron; practical examples; cause of drawing is that expansion due to formation of graphite is practically all absorbed in expanding outer shell of casting, and remaining liquid shrinks.

IRON AND STEEL INDUSTRY

Canada. Steel Production in Canada Makes Big Gain in 1927. Can. Machy., vol. 38, no. 26. Dec. 29, 1927, pp. 160-163. Less iron but considerably more steel; furnace charges; ferro-alloys output; five furnaces active; increase in steel in April; six furnaces in blast; production of pig iron, steel ingots and castings fell off sharply in June; 24 per cent gain during August; eight months' total of 629,039 tons.

J

JIGS

Design. Details of Jigs and Fixtures—Design of Push Pins and Plugs, J. A. Potter. Am. Mach., vol. 68, no. 2, Jan. 12, 1928, pp. 47-49, 10 figs. Locating work in jigs and fixtures depends upon choice of cuts taken first; push pins and plugs as locators, supports and clamps; methods of locating and binding work with push pins; consideration given to parts adaptable to plug suspension. (To be continued.)

L

LATHES

Design. Lathes, E. Pull. Machy. Market, no. 1419, Jan. 13, 1928, pp. 19-20, 6 figs. Design and operations of lathes; driving arrangement for small lathe; calculations for various speeds; triple-gear 4-step cone headstock with range of 12 speeds, progressively graded with single-speed countershaft; triple-gear rapid-reduction headstock fitted for lathes of 10½-in. centres and upwards; all-geared headstocks frequently fitted to lathes of 6-in. centres and upwards.

Properties. Physical Properties of Engineering Materials. Power Engr., vol. 23, no. 262, Jan. 1928, pp. 24-26, 1 fig. Study of lead, lead ores, commercial lead, tensile and compressive strength; hardness, specific gravity and corrosion; other physical properties; alloys of lead.

LIFTING MAGNETS

Foundries. Electric Power in the Foundry. Foundry Trade Jl., vol. 36, no. 580, Sept. 29, 1927, p. 276. Deals with lifting magnet for both external and internal use; for lifting pig and scrap iron and large solid matters a circular magnet is used, while for handling long plates two or more of these magnets may be used, spaced on beam slung from crane hook.

LOCOMOTIVE BOILERS

Foaming in. Foaming of Locomotive Boilers, with Special Reference to Influence of Suspended Matter on Foaming, and Cost of Blowdown. Am. Ry. Eng. Assn.—Bul., vol. 29, no. 300, Oct. 1927, pp. 143-157, 3 figs. Problem is to determine cause of foaming in locomotive boilers and also other causes of wet steam; for foaming tests, boilers must be divided into three classes; stationary, road locomotives and switch engines; instructing enginemen as to amount of water to be blown off; charts illustrating conditions of water from locomotive boilers on Chicago & Alton R.R.

High-Pressure. Proposed High-Pressure Water Tube Boiler, L. A. Rehfuss. Ry. Mech. Engr., vol. 102, no. 2, Feb. 1928, pp. 68-73. 3 figs Greater efficiency and tractive force may be developed with boiler designed for 500 lb. pressure; stress placed on combustion efficiency; advantage of air preheater; double superheater employed; advantages of proposed boiler; judicious use of electric welding should take care of most of joints in actual construction; steam generation.

Improving. Improving the Locomotive Boiler by Research, L. H. Fry. Boiler Maker, vol. 28, no. 1, Jan. 1928, pp. 11-14, 3 figs. Shows how research can be directed to extending existing knowledge of locomotive boiler; with this in view, fundamental processes of combustion and heat transfer are surveyed; boundaries of existing knowledge are mapped out and indications given as to how these boundaries may be enlarged and benefits that might be expected.

LOCOMOTIVE REPAIR SHOPS

Wabash Ry. Wabash Enlarges Locomotive Shops. Ry. Mech. Engr., vol. 102, no. 1, Jan. 1928, pp. 41-45, 5 figs. Wabash recently completed extensive improvements at its system shops at Decatur, Ill., which embodied enlargements of locomotive repair shop in accordance with most unusual plan; study plans for enlargements; some rearrangement necessary; method routing repair work; new shop of modern design; new power plant.

LOCOMOTIVES

COMPOUND. Some Experimental Results from a Three-Cylinder Compound Locomotive, L. H. Fry. Eng., vol. 124, no. 3233, Dec. 30, 1927, pp. 855-858, 4 figs. Determination of power by measurement of steam pressures and temperatures; quality of steam at high-pressure cut-off; heat transfer to cylinder walls; actual vs. theoretical cylinder efficiency. Paper read before Institution of Mech. Engineers.

CUT-OFF ADJUSTMENT. Back-Pressure and Cut-Off Adjustment for Locomotives, T. C. McBride. Ry. and Locomotive Eng., vol. 40, no. 12, Dec. 1927, pp. 350-352, 1 fig. Question arises as to when or under what operating conditions of locomotive back-pressure can be made useful in its indication of proper adjustment of cut-off; it is evident that something better and more exact than judgment of enginemen is needed to indicate best adjustment of cut-off in order that this adjustment may be made exactly and quickly; back-pressure gauge properly used should fill this need.

DIESEL. Dieselizing Railroads, W. Arthur. Central Ry. Club—Official Proc., vol. 35, no. 5, Jan. 1928, pp. 2500-2515, 6 figs. Description of Diesel locomotives as used in Europe; how Diesel unit compares with electric and steam locomotives, and economy in fuel; Diesel cost is 1/5 that of steam; relationship of tractive effort and speed; transmission of power to wheels is great problem; kind of Diesel best adapted to railroad work.

Swedish Diesel Locomotive with Fluid Coupling, J. W. Morton. Oil Engine Power, vol. 6, no. 2, Feb. 1928, pp. 117-119, 3 figs.

ELECTRIC. *See Electric Locomotives.*

FEEDWATER HEATING. The Willans-Luard System Locomotive Superheating and Feed Water Heating (Supp. to Locomotive, Jan. 14, 1928), pp. 132-138, 9 figs. System makes use of exhaust steam, exhaust flue gases and live steam which would be wasted at safety valves.

HIGH-PRESSURE. The Schmidt-Henschel High-Pressure Locomotive. Engineer, vol. 145, no. 3758, Jan. 20, 1928, pp. 80-82, 4 figs. Details of high-pressure, two pressures, one in neighbourhood of 900 lb. and other of 200 lb.; high-of Schmidt; feature of this engine is use of boiler which generates steam at two pressures, one ni neighbourhood of 900 lb. and other of 200 lb.; high-pressure steam, which is generated by Perkins closed-circuit method, is used in single high-pressure cylinder, and, on exhausting, is mixed with low-pressure steam and admitted to two outside cylinders; includes tabulated results of road tests.

SUPERHEATER. Brief History of the Locomotive Superheater. Locomotive Superheating and Feed Water Heating (Supp. to Locomotive, Jan. 14, 1928), pp. 12-21, 16 figs. Principal attention is given to those apparatus which have been employed in actual service, including: Hawthorn, McConnell, Aspinall, Schmidt smokebox and fire-tube superheaters, Clench and other types of superheaters; Vauclain or Baldwin, Phoenix, Drummond and Buck-Jacobs or Santa Fé superheaters; progress of fire-tube superheater; Cusack-Morton superheater.

2-8-4. 2-8-4 Type Locomotives of the Chicago & North Western. Ry. and Locomotive Eng., vol. 40, no. 12, Dec. 1927, pp. 347-348, 1 fig. Develop 79,500 lb. tractive effort with booster; description of Chicago & North Western locomotives built by American Locomotive Co.; table of weights and dimensions; weight complete, 397,000 lbs.

VIBRATION. Relation Between Bearing Springs and Vertical Vibration of the Steam Locomotive, K. Musashi. (Japan) Dept. of Railways—Bul., vol. 15, no. 11, Nov. 1927, pp. 1801-1823, 15 figs. (In Japanese.)

LOOMS

WOOL. Adjusting the Eccentric Motion and the Centre Filling Stop Motion of the Wool Automatic Loom, B. F. Hayes. Textile World, vol. 73, no. 4, Jan. 28, 1928, pp. 31 and 34, 1 fig. Advice to loom fixers as to importance of eccentric motion adjustment of wool automatic looms; attention to former will reduce smashes; broken sticks and damaged boxes; false stopping.

LUBRICANTS

TAPPING. Lubricants for Tapping, A. L. Valentine. Machy. (N.Y.), vol. 34, no. 6, Feb. 1928, pp. 418-420, 2 figs. Proper lubrication for tapping and its importance to cutting qualities and length of life of tap; power required varies considerably with different lubricants; kerosene for tapping aluminum; recent experiments on lubricants; reason for chips clinging to taps; different methods of sharpening taps; tap dull when it begins to slip in holder or chuck; necessary to sharpen taps in time; rounded off corners should not be permitted to become greater than chip thickness.

M

MACHINE SHOP

EQUIPMENT REPLACEMENT. What Modern Equipment Has Done, C. R. Britten. Am. Mach., vol. 68, no. 5, Feb. 2, 1928, pp. 201-204, 9 figs. Actual results achieved at plant of Monroe Calculating Machine Co. by replacing obsolete with up-to-date equipment; policy that replacement equipment must pay for itself within year; reducing surface-grinding operations; transfer from 4-spindle drilling machine to multiple-drilling head; savings in cutting gear teeth; centreless grinding; screws made on cold-heading and thread-rolling machines; automatic cadmium-plating outfit; improvement in quality of product.

MACHINE TOOLS

AUTOMATIC. Factors Controlling Design of the Automatic Machine, H. W. Rupple. Am. Mach., vol. 68, no. 5, Feb. 2, 1928, pp. 213-214. Problem of fitting every machine to job; standardization of product in production plants has made opposite condition necessary to machine-tool builder; entire machine built around single part machine is intended to produce; synchronizing operations on different spindles of multi-spindle machines; rotating of tool positions in turret at different speeds offers saving.

BALL BEARINGS FOR. Applications of Ball Bearings to Machine Tools. West. Machy. Wld., vol. 19, no. 1, Jan. 1928, pp. 17-20, 10 figs.

DIRECT-CURRENT DRIVE. Advantages of D.C. Drive for Machine Tools, R. C. Deale. Am. Mach., vol. 68, no. 5, Feb. 2, 1928, pp. 211-212, 2 figs. Adjustable-speed d.c. motors compared with constant-speed a.c. motors having mechanical speed changes; speeds stamped on graduated dial fastened to body of field rheostat; mechanics pay little attention to actual spindle speeds but are guided by appearance of chip and finish of work; never same ease in changing speeds mechanically; complications in changing gears; advantage of adjustable speed where machine is operated any considerable portion of time.

ELECTRIC CONTROL. Modern Machine Tools with Electric Control (Les machines-outils modernes avec commande électrique incorporée), G. Weinstein. Electricité et Mécanique, no. 21, Nov.-Dec. 1927, pp. 16-21, 9 figs. General description of recent incorporation of electric control on machine tools and shoe-making machinery, citing milling machines, vertical and radial drilling machines, lathes, shoe-soling and finishing machines; principles and method of control are described and their advantages explained.

MAGNESIUM ALLOYS

PROPERTIES. Magnesium Alloys, J. A. Gann and A. W. Winston. Metallurgist (Supp. to Engineer), Jan. 27, 1928, pp. 4-6. Deals with technique of methods used by Dow Chemical Co. in manufacture of magnesium alloys and properties of these alloys; authors claim that much of corrosion trouble previously encountered in magnesium alloys has been overcome by use of purer metal and elimination of sponginess in castings by improved technique. Abstract of paper published in Indus. and Eng. Chem., Oct. 1927.

MATERIALS HANDLING

EQUIPMENT. Mechanical Handling in Industry (Les manutentions mécaniques dans l'industrie), E. Pacoret. Vie Technique et Industrielle, vol. 10, no. 100, Jan. 1928, pp. 56-61. Latest improvements affecting applications of modern materials handling; handling of coal, such as storing, unloading; mechanical handling in ports; car haulage, conveyors and transporters, belt conveyors, screw and gravity conveyors, monorails, hoist.

FACTORS IN. Eight " Slants " on the Problem of Handling Materials, F. L. Eidmann. Can. Machy., vol. 39, no. 1, Jan. 12, 1928, pp. 46-47. Author gives general review of situation and effect of certain conditions on proper handling of materials, such as weight of material, influence of design of plant, influence on inventory, selection of equipment, safety to workers, co-ordination and flexibility and return on investment.

SCHEDULING. Mechanical Scheduling, H. V. Coes. Factory, vol. 75, no. 1, Jan. 1928, pp. 52-54, 2 figs. Material handling's important part in cutting costs and speeding turnover; transferring overhead to capital account; reducing process inventory; automatic mechanical scheduling.

METAL MINES AND MINING

STATISTICS, UNITED STATES. Metal Mining in the United States in 1927. Min. Congress Jl., vol. 14, no. 2, Feb. 1928, pp. 115-122, 6 figs. Bureau of Mines makes annual report on state of metal industry; statisticians find that marked decrease in market price of silver, copper, lead and zinc seriously affected production; such increase in production as is recorded is overshadowed by price decline.

Copper, Lead and Zinc Mining in 1927. Min. Congress Jl., vol. 14, no. 2, Feb. 1928, p. 124. Copper and lead production in United States in 1927 decreased about 3 per cent each, and zinc production decreased 8 per cent; mine production of copper, lead and zinc in United States in 1926 and 1927, in terms of recovered and recoverable metal content, in short tons (1927 estimated).

METAL MINING GEOLOGY

GEOPHYSICAL EXPLORATION. Exploring for Ore by Potential Methods, E. G. Leonardon and S. F. Kelly. Eng. and Min. Jl., vol. 125, no. 4, Jan. 28, 1928, pp. 163-166, 8 figs. Potential method must be considered, not only second process of locating minerals, but also as means of checking in independent way results obtained by self-potential method; survey will usually cost about $2.50 per acre and will rarely exceed $5.00; electrical prospecting does not supplant either geologist or diamond drill in exploration work. (Concluded.)

METALLURGY

DEVELOPMENTS. Developments in Metallurgy During 1927, J. Silverstein. Heat Treating and Forging, vol. 14, no. 1, Jan. 1928, pp. 44-46. Among topics considered are: ferrous metallurgy, centrifugal casting, silicon alloys, welding, application of X-rays, chromium plating and non-ferrous metallurgy.

The Past Year in the Metallurgical Field, S. Goodale. Heat Treating and Forging, vol. 14, no. 1, Jan. 1928, pp. 60-62. Important new advances made during year in making of iron and steel, sponge iron, use of electric heat, rust preventatives, metallography and testing; blast-furnace process.

METAL SPRAYING

COATING BY. Coating by Molten-Metal Spraying. Machy. (Lond.), vol. 31, no. 797, Jan. 19, 1928, pp. 505-510, 14 figs. Developments in coating either metallic or non-metallic parts with any metal to obtain protection against atmospheric corrosion or chemical action; method of spraying molten metal on surface to be coated; how metal spraying tool is applied; coating or enlarging cylindrical parts; coating inner surfaces of tubes; coating small parts in bulk; some general applications of metal-spraying process.

METALS

FATIGUE. Repeated-Stress Endurance of Metals. Soc. Automotive Engrs.—Jl., vol. 22, no. 2, Feb. 1928, pp. 289-291. Modern viewpoint of fatigue failure pictures metal yielding first at some point of localized weakness; it is study of elastic straining and of spreading cracks, rather than of plastic straining; design of specimens for fatigue tests; effects of speed of testing on endurance limit; physical properties; threads, shoulders and fillets; welded joints; locating cracks. From Manual, by H. F. Moore, issued by Eng. Foundation.

MILLING CUTTERS

SHARPENING. Getting Greater Production Through the Proper Sharpening of Tools and Cutters, F. B. Heitkamp. West. Machy. Wld., vol. 19, no. 1, Jan. 1928, pp. 9-11, 8 figs.

MINES AND MINING

MACHINE METHODS. Progress in Mine Mechanization. Min. Congress Jl., vol. 4, no. 2, Feb. 1928, pp. 103-107. Conference at annual convention Am. Min. Congress discusses advancement; investigation indicates machines now dependable, and that problems are now those of management and engineering; mechanical loading no longer test of machines but of ability to use them effectively under existing conditions.

MOTOR TRUCKS

DESIGN TRENDS. Improvements in Truck Construction Provide More Speed and Flexibility, D. Blanchard. Operation and Maintenance, vol. 37, no. 1, Jan. 15, 1928, pp. 10-11 and 36, 10 figs.

WHEELS, MANUFACTURE OF. Methods and Equipment Used in the Manufacture of Steel Wheels. West. Machy. Wld., vol. 19, no. 1, Jan. 1928, pp. 6-8, 8 figs.

N

NOZZLES

STEAM, FLOW IN. Fifth Report of the Steam Nozzles Research Committee. Engineering, vol. 125, no. 3237, Jan. 27, 1928, pp. 116-119, 7 figs. Decision of Committee to carry out investigation into efficiency of nozzles at different pressure ranges from those covered by first four reports involved alteration in back-pressure against which nozzles discharged; superheater and rearranged pipe work; rearrangement of pressure-measurement apparatus; preliminary tests. (To be continued.) See also editorial comment, pp. 107-108.

The Dimensional Theory of Steam Nozzle Flow, J. C. Oakden. Engineering, vol. 125, no. 3236, Jan. 20, 1928, pp. 80-82.

O

OFFICE BUILDINGS

CANADA. Handsome Office Structure in London, Ont. Contract Rec., vol. 42, no. 4, Jan. 25, 1928, pp. 72-75, 4 figs. Headquarters of London Life Insurance Co., recently completed, is striking building of classical design; faced with Indiana and Queenston limestone and richly decorated inside; describes briefly boiler and coal rooms, heating and ventilating systems, electric-elevator service.

OIL ENGINES

EXPERIMENTS. Some Fuel Experiments in a Mechanical Injection Oil Engine, E. L. Bass. Diesel Engine Users' Assn.—report for mtg., Oct. 7, 1927, 25 pp., including discussion, 14 figs. Statement of fact founded upon research conducted on particular grade of residue fuel; apparatus for experiments was 32-b.h.p. Crossley cold-starting oil engine; tests were carried out with centrifuged fuel of Venezuelan origin; further similar series of tests on another fuel called light Venezuelan very similar to that previously tested, but lower asphalt content.

MARINE. The Marine Oil-Engine, C. J. Hawkes. Engineering, vol. 125, no. 3235, Jan. 13, 1928, pp. 39-41; and Engineer, vol. 145, no. 3757, Jan. 13, 1928, pp. 40-42. Author believes that much can be expected in future developments of large oil engines; he considers Still engine most efficient for marine purposes at present time; results of tests by Marine Oil Engine Trials Committee on Still and Doxford airless-injection engines and comparison of performances of these two; trunk pistons are unsuitable for high-speed 2-stroke engines; comparison of 4-stroke and 2-stroke cycles; problems of supercharging. Lecture read before Inst. Mech. Engrs.

OPEN-HEARTH FURNACES

CONTROL. The Open-Hearth Furnace in Leash, G. A. Merkt. Blast Furnace and Steel Plant, vol. 16, no. 1, Jan. 1928, pp. 41-45, 7 figs. Isley furnace control as installed by Morgan Construction Co. in number of open-hearth furnaces; patented device is ingenious arrangement of power apparatus by regulation of which supply of elements of combustion as well as removal of their products may be altered at will to any degree of activity and accuracy desired; while Isley control apparatus produces mechanical draught of definitely adjustable value, there are no moving parts exposed to high temperature.

DESIGN. Changes in Open-Hearth Design and Practice During 1927, W. J. Priestley. Iron Age, vol. 120, no. 1, Jan. 5, 1928, pp. 37-38, 1 fig. Steel operators analyzed chemistry of their melting practice and sought means to reduce their costs without sacrificing quality of their steel; research in physics of steel; advances in furnace design—preheaters for air, sloping back wall and Isley furnace; production of acid steel—experience of cable maker; residual silicon to be avoided; slag low in iron important; high-manganese pig in basic open-hearth; rigid testing reacted favourably.

IMPROVEMENTS. Outstanding Open-Hearth Improvements, C. W. Veach. Blast Furnace and Steel Plant, vol. 16, no. 1, Jan. 1928, pp. 34-37. Summary of modifications in practice and furnace design which have been established during past year as viewed by steel maker; Stevens insulated furnace; preheating air; sloping backwall; use of chrome brick; handling large scrap at River Rouge; practice in using chrome ore.

ORES

REDUCTION. A Process for the Extraction of Zinc and Other Metals from Ores, H. E. Coley. Instn. of Min. and Met.—Bul., no. 280, Jan. 1928, pp. 1-11. Number of experiments led to idea that if it were possible to obtain carbon in extremely active condition carbon would under those conditions be far better reducing agent than carbon monoxide; advantages claimed for process where it can be applied are as follows: continuity of action, small fuel costs, in case of zinc elimination of retort; complete reduction and almost complete extraction, small power charges.

TREATMENT. Ore Tests for the Small Operator, L. O. Howard. Min. Mag., vol. 38, no. 1, Jan. 1928, pp. 53-56. Necessity for more data in devising method of ore treatment than is usually available to small operator, especially when matter is left to advice of machinery supply house; plan that had advantage of simplicity and practicability would be to try to construct metallurgical flow sheet that would show travel of ore and solutions with tonnages and assays at certain key points. Abstract from Min. & Met., Dec. 1927.

OXY-ACETYLENE CUTTING

FOUNDRIES. Notes on Oxy-Acetylene Cutting in Foundries, C. H. S. Tupholme. Foundry Trade Jl., vol. 37, no. 592, Dec. 22, 1927, p. 216. Points out that proper use of oxy-acetylene cutting flame has enabled many foundry managers to reduce their rejections, and flame, when employed for cutting risers, has exerted an important influence on casting practice; cutting flame may play important part in reclamation of defective castings, particularly where defect is minor in degree, such as blowhole, shrinkage crack or part of lug missing; another opportunity to use flame for reclamation is in case of aluminum castings.

OXY-ACETYLENE WELDING

PROCEDURE CONTROL. Procedure Control in Welding a Storage Tank. Sheet Metal Worker, vol. 18, no. 24, Dec. 30, 1927, pp. 921-923 and 929, 8 figs. Considerations involved in fabricating tank of 3/16 in. plate, to hold 1,500 gal. of fuel oil under gravity pressure; check on welders; qualification tests; design and layout of welded joints; preparation of plates for welding; welding technique; test of completed tank. (Reprinted from Oxy-Acetylene Tips.)

STAMPINGS. Stampings Welded into Complex Units, A. G. Wikoff. Iron Age, vol. 121, no. 5, Feb. 2, 1928, pp. 321-324, 9 figs.

P

PAVEMENTS

BRICK. Brick-Paved Roads. Engineering, vol. 125, no. 3237, Jan. 27, 1928, pp. 96-97. Experiments are being made in London with surfacing of concrete road foundations with bricks, in order to carry heavy road traffic; bricks were supplied from France for this purpose.

MAINTENANCE AND REPAIRS. Pavement Repairs Planned to Reduce Street Closing Time, E. A. Kemmler. Eng. News-Rec., vol. 100, no. 1, Jan. 5, 1928, p. 16, 1 fig. Plan and working schedule required of contractors carrying on street subsurface operations in Akron, Ohio; policy of requiring continuous construction day and night has produced results that are eminently satisfactory; as example of practice, account is given of very complicated situation which arose, involving construction activities at same time of three service companies in two blocks of Main street.

PHOTOGRAPHY, AERIAL

AFRICA AND ASIA. Aerial Survey Makes Good. Flight, vol. 20, no. 1, Jan. 5, 1928, p. 12. Latest developments in aerial survey and photography work of two British firms briefly discussed; Aircraft Operating Co.'s air survey of 1,000 sq. miles of territory, adjacent to Bagdad; air survey of Zambesi river; maps of 12,000 sq. mi. to be prepared for Government of Northern Rhodesia; work of Air Survey Co. in India; survey and mapping entire Malda district; radial method of plotting with close net-work of control points; 1,680 control points established by ground party; D.H. 9 aircraft and Eagle Air Cameras used.

PIERS

NEW YORK HARBOUR. Erie Builds Large Modern Pier in New York Harbour. Ry. Age, vol. 84, no. 3, Jan. 21, 1928, pp. 180-184, 7 figs. Description of pier No. 9 built in Jersey City by Erie R.R.; 2-storey steel structure, 1,250 ft. long by 150 ft. wide, carrying 2 standard-gauge railroad tracks on main deck; pier is over Holland tunnel and required special type of foundations, which are described; also machinery equipment for handling cargo and loading and unloading cars; steelwork design shown.

PIPE, CAST IRON

WELDING. Bronze Welding Cast Iron Pipe by Back-Stepping Method, H. Y. Carson. Iron Trade Rev., vol. 82, no. 2, Jan. 12, 1928, pp. 138-139, 6 figs. Bronze welding not only simplifies and reduces cost of complicated fittings such as manifold illustrated, but also is being used more extensively for general repair work. Paper presented before Am. Water Works Assn.

PLATES

FLAT DEFLECTION OF. The Deflection of Flat Plates Fixed at the Circumferences, H. Carrington. Engineering, vol. 125, no. 3235, Jan. 13, 1928, pp. 31-32, 6 figs. Gives results which were obtained with view to determining experimentally more precisely effects of strains in middle surface and approximate ratio of deflection to thickness at which Poisson's theory ceased to apply; same plate was used throughout experiments; it was of annealed mild steel 0.62 in. thick and 26.5 in. in diameter; conclusions drawn for circular elastic plates fixed at circumference and deflected at uniform pressure.

POLES

WOODEN, TESTING. Maximum Load for Treated Poles Measured in Test Series. Eng. News-Rec., vol. 100, no. 3, Jan. 19, 1928, p. 108, 1 fig. Load applied as side pull at top by locomotive crane and measured by dynamometer placed in pulling line in series of tests on Douglas fir poles treated according to present standard specifications of Creosoted Douglas Fir Pole Producers, conducted at Long Beach, Calif.; average modulus of rupture for all poles was 9,815 lb. per sq. in.

POWER PLANTS, DIESEL

EQUIPMENT. Modern Steam Plant Gives Place to Diesel Power. Oil Engine Power, vol. 6, no. 2, Feb. 1928, pp. 98-100, 6 figs. Successful municipal oil-engine central station operating under highly competitive conditions, plant of city of Cedar Falls, Iowa; savings on oil engine sufficient to finance purchase of another oil engine; McIntosh-Seymour 750-h.p. Diesel engine; water-works equipment; engines installed of 4-stroke cycle, air-injection, trunk-piston type direct-connected to General Electric alternators with exciters driven by silent chains; Bowser pressure lubricator; exhaust discharges through Maxim silencer.

NEW YORK. A Diesel Plant in Metropolitan New York, G. Grow. Power, vol. 67, no. 3, Jan. 17, 1927, pp. 98-100, 3 figs. Details of 1,060-h.p. Diesel plant of Gates Co. supplying energy used in lumber yard and planing mill; two 18,000-gal. fuel-oil storage tanks were provided and embedded in concrete in accordance with New York City Fire Underwriters' Laws; three 360-h.p. Diesel engines were installed each direct-connected to 300-kva., 40-deg., 3-phase, 60-cycle, 440-volt engine-type alternator, together with direct-connected 10-kw. excited for each alternator.

POWER PLANTS, HYDRO-ELECTRIC

BELLOWS FALLS, VT. Sixty Thousand Horse Power from the Connecticut River, R. G. Skerrett. Compressed Air Mag., vol. 33, no. 2, Feb. 1928, pp. 2305-2310, 21 figs. Construction of plant at Bellows Falls, Vt.; power drawn from Connecticut river to generate large block of electric energy for New England; effective head of about 60 ft. to drive 3 single-runner wheels, each capable of producing 20,000 h.p.; dam crossing Connecticut river in straight line; modernizing of canal; excavating for power house and tailrace; compressed air for drilling, operating pumps and blacksmith shop equipment.

LOW-HEAD. Low-Head Plant at the Falls of the Ohio to Produce 100,000 Kw. Power. vol. 67, no. 6, Feb. 7, 1928, pp. 232-236, 9 figs. Under heads of 37 to 10 ft., this plant was designed to utilize widely varying flow of Ohio river at Louisville, Ky.; turbines of propeller type and generator stators of welded steel-plate construction have effected reduction in size and weight of units and in power-plant cost; economy is maintained by operating generators star-connected above three-quarter load and delta-connected for loads below this rating.

POWER PLANTS, STEAM

EQUIPMENT, RECONDITIONING. $60,000 Per Year to Be Saved by Revamping Old Power Plants, J. J. Daley. Power, vol. 67, no. 5, Jan. 31, 1928, pp. 170-174, 7 figs. By reconditioning equipment that had been in service for years in two distinct plants, shutting down one boiler room and raising settings in other, improving water supply and purchasing current during summer, an efficient plant was produced that will effect saving in operating expense exceeding $60,000 per year.

HIGH-PRESSURE. Industrial Production of High-Pressure Steam (La production industrielle de la vapeur d'eau à haute pression), C. Roszak and M. Vernon. Chaleur et Industrie, vol. 8, no. 92, Dec. 1927, p. 703, 4 figs. Treats of addition to central station of Issy-les-Moulineaux (Paris), describing turbines, boilers, feeding and auxiliary machinery; discusses also various types of boilers with small reservoirs, marine boilers and double-circuit boilers.

Operating Experiences with 1,200-Lb. Steam Pressure, J. Anderson. Engineering, vol. 125, no. 3234-5, Jan. 6 and 13, 1928, pp. 25-28, 7 figs., and 55-58, 5 figs. Jan. 6: Experience with high-pressure installation at Lakeside station, Milwaukee.

RAILROAD REPAIR SHOPS. Northern Pacific Power Plant Effects Large Savings. Ry. Age, vol. 84, no. 3, Jan. 21, 1928, pp. 200-202, 4 figs. Nine months' operation of new plant at Brainerd, Minn., indicates fuel, labour and other savings of $66,900 per annum; power plant is used to generate steam, electric energy and compressed air for use in various buildings within shop grounds; designed to burn low-grade fuels; boiler house and equipment, coal and ash handling, engine-room equipment of steam turbines, generators (2,400-volt, 3-phase, 60-cycle) and auxiliaries; results of boiler test with Montana lignite and eastern screenings; comparative cost of old and new plants.

POWER PLANTS, STEAM-ELECTRIC

SO. CAL. EDISON CO. Construction of Steam Plant No. 3, W. D. Campbell. Nat. Engr., vol. 32, no. 1, Jan. 1928, pp. 1-3, 2 figs. Construction details of Southern California Edison Co; this will be first of unit of new million-horse power plant at Long Beach; with completion of new plant, Terminal Island will be greatest power-generating centre in world; steam turbines; boilers; condensers.

Steam Plant Development of Southern California Edison Company, R. Wilcox. Power, vol. 67, no. 4, Jan. 24, 1928, pp. 130-134, 4 figs. Third steam plant of company that eventually will have capacity of 1,000,000 kw. now under way; tandem-compound turbine rated at 94,000 kw. will be one of largest in operation and boilers having individually more than 34,000 sq. ft. of surface will be largest used for power purposes; flow diagrams for three steam stations show advance made in power-plant design.

POWER PLANTS

TRANSFORMER ROOMS, VENTILATION. Costly Alterations Avoided by Use of Fan Ventilation, M. D. Smith. Elec. World, vol. 91, no. 3, Jan. 21, 1928, p. 141. Difficult problems of providing adequate ventilation in underground transformer room which was 7 feet underground housing three 75-kva. transformers; it was found that a spare 5 in. lateral duct existed, from room to a nearby pole; method employed was to extend spare lateral 10 feet up pole and connect other end through hose to blower capable of moving 10,000 cu. ft. of air a minute.

PRESSURE VESSELS

WELDING. Control in Pressure Vessel Welding, H. E. Rockefeller. Heat Treating and Forging, vol. 14, no. 1, Jan. 1928, pp. 34-37, 3 figs. Describes material used and methods pursued in fabricating by welding six pressure vessels each six ft. in diam. and designed for working pressure of 300 lb.; results of tensile tests on qualification test specimens; preparation of material for welding; welding longitudinal seams; presents table of strain measurements. Paper presented before Int. Acetylene Assn.

Procedure Control in Pressure Vessel Welding, H. E. Rockefeller. West. Machy. Wld., vol. 19, no. 1, Jan. 1928, pp. 13-16 and 28, 5 figs. Methods used in constructing 6 large tanks designed for 300-lb. operating pressure; design of vessel and welded joints; selection of material; check of welders; results of tensile tests on qualification-test specimens; preparation of material for welding; welding longitudinal seams; welding of manhole reinforcing ring to manhead; lining up and tacking head seams; welding head seam; providing ventilation; test of tank; factor of safety.

The Application of Welding to the Construction of Large Pressure Vessels, T. McL. Jasper. Boiler Maker, vol. 28, no. 1, Jan. 1928, pp. 8-9. Fundamentals of good welding; explanation of results obtained from long series of tests on arc-welded specimens of carbon steels having yield point from 30,000 to 35,000 lb. per sq. in. and ultimate strength of from 55,000 to 60,000 lb. per sq. in.

PRESSWORK

FORMED SHELLS. Formed Shells Produced in Hydrostatic Dies, G. P. Anthes. Am. Mach., vol. 68, no. 5, Feb. 2, 1928, pp. 207-209, 4 figs. Tools and methods used in producing formed shells; drawing shell of suitable diameter and length from which to make desired stamping; bulging shell into required shape; blank drawn and redrawn in five operations; same punch holder and die shoe used for four subsequent reducing operations; die for performing bulging operations; heavy grade oil for filling shells before bulging.

PUBLIC BUILDINGS

ELECTRIC EQUIPMENT. Electrical Equipment in East Block Ontario Parliament Building, F. G. Stroud. Contract Rec., vol. 42, no. 4, Jan. 25, 1928, pp. 75-78, 4 figs. Standardized outlets throughout; economy in cost due to careful design; conduit concealed in concrete floor; connected lighting load amounts to 257,000 watts and connected power load is 350 h.p.; considers typical floor of any one of wings; main switchboard and transformer equipment, transformer room; main switchboard; exposed conduit eliminated; telephone systems.

PUNCH PRESSES

DEFLECTION. Spring or Deflection in Presses and Die, E. V. Crane. Iron and Steel Wld., vol. 1, no. 10, Nov. 1927, pp. 709-714, 5 figs. Influence of design upon deflection of frame and working parts of presses; arc spring causes heavy die wear and impressions which are not sharp due to alteration of clearances and bending; explains how, by correct selection of press, output of dies may be greatly increased, savings per year in die upkeep often exceeding several times price of press.

PYROMETALLURGY

METHODS. Pyrometallurgy—Lead and Copper, E. H. Robie. Eng. and Min. Jl., vol. 125, no. 3, Jan. 21, 1928, pp. 122-123. Though development in hydrometallurgy and in concentration of ore by flotation have received somewhat more publicity in last year or two than has progress made in pyrometallurgy, it must not be inferred that fire methods are being displaced or that operators of such plants are not improving their practice.

R

RADIO

ATMOSPHERIC DISTURBANCES. Chairman's Address to Wireless Section, A. G. Lee. Instn. Elec. Engrs.—Jl., vol. 66, no. 372, Dec. 1927, pp. 12-24, 20 figs. Defence against atmospherics considered with reference to transatlantic-telephony problems; nature of atmospherics; distribution of atmospherics in azimuth; distribution with latitude; effect of rainstorms; spectrum of atmospherics; received problem; directive reception with wave antenna; antenna arrays; leaf diagram.

Methods of Reducing the Effect of Atmospheric Disturbances, E. H. Armstrong. Inst. Radio Engrs.—Proc., vol. 16, no. 1, Jan. 1928, pp. 15-26, 10 figs. Describes method of reducing effects of atmospheric disturbances by selective means as distinguished from means which depend on geography of situation; directional reception.

APPARATUS EXHIBITION, LONDON. The Physical Society's Annual Exhibition. Wireless Wld., vol. 22, no. 4, Jan. 25, 1928, pp. 99-101, 8 figs. Some interesting radio exhibits described; stretched diaphragm loud speaker; on Marconi stand was to be seen new short-wave receiver; sensitive galvanometer of suspension type having pointer and scale in place of usual mirror; neon wavemeter of interest to transmitters.

COMMUNICATION. Radio Communication, G. Marconi. Inst. Radio Engrs.—Proc., vol. 16, no. 1, Jan. 1928, pp. 40-69, 13 figs. Brief historical sketch of investigations carried out by author and his assistants on subject of short waves, describing some of strides that have already been made in their application to radio communications over long distances.

INTERFERENCE. Tracing Radio Interference, J. H. Hanly. Elec. Wld., vol. 91, no. 2, Jan. 14, 1928, pp. 101-102, 2 figs. Details of routine method of locating various kinds of trouble; test set proves value of audio-radio selective hook-up; method of testing which can be used on high-tension systems up to 22,000 volts.

LOUD SPEAKER. The Moving Coil Loud Speaker, F. H. Haynes. Wireless Wld., vol. 22, no. 4, Jan. 25, 1928, pp. 91-95, 5 figs. Loud speaker was demonstrated and formed subject of discussion at recent meeting of Radio Society of Great Britain; moving coil loud speaker scores principally by virtue of liberal diaphragm movement which can be obtained; every endeavour has been made to render this instrument as perfect as possible, both as regards performance and convenience of construction; constructional details are elaborated and additional apparatus is described so that correct working conditions can be obtained. (To be continued.)

TRANSMISSION. Decreasing Radio Congestion, R. D. Duncan. Elec. World, vol. 91, no. 4, Jan. 28, 1928, pp. 195-197, 2 figs. Single side-band transmission offered as means of increasing number of transmitting stations without interference augmentation; transmitting filters involved in plan following proved principles; experiments indicate applicability of plan.

RAILROADS

ROADBEDS, CONCRETE. What One Year's Service on Concrete Roadbed Has Shown, P. Chipman. Ry. Age, vol. 84, no. 2, Jan. 14, 1928, pp. 129-133, 3 figs. Experimental section of concrete roadbed installed by Pere Marquette in Dec. 1926, 1,326 ft. long and located in westbound main of double-track section near Detroit; consists of thirty-four 39-ft. slab sections 21 in. thick and 10 ft. wide; discusses necessity of rail-supporting blocks; experimental installation decided on; observations from first year's use; some settlement has appeared; concrete is in excellent condition; possibilities for improvement.

TIES, TREATMENT. What the Lackawanna Has Gained by Treating Ties, G. J. Ray. Ry. Age, vol. 84, no. 5, Feb. 4, 1928, pp. 307-310. Adopt flat-bottom tie plate for use on all main track ties; from start have treated all switch timber and bridge ties; savings effected; summary of advantages; submits a comparison of maintenance ratio for few typical roads selected at random; Lackawanna shows by far lowest ratio of any of roads in table.

RAILWAY MOTOR CARS

GASOLINE. Gasoline Motor Cars on French Systems (Les automotrices à essence sur les réseaux français d'intêret local), M. Vergniole. Industrie des Voies Ferrées et des Transports Automobiles, vol. 21, no. 252, Dec. 1927, pp. 546-568 and (discussion) 569-570, 28 figs. Geographical distribution in France of gasoline motor cars and characteristics of various types; engines, gear boxes, axles, wheels, brakes, weight, etc., are taken up, also gas-electric cars; tendencies of design. Report presented at Fourth General Technical Assembly, Marseilles.

RAILROADS

REPAIR SHOPS, EQUIPMENT. Electricity in a Modern Railroad Shop, E. Sheldon. Am. Mach., vol. 68, no. 5, Feb. 2, 1928, pp. 215-217, 5 figs.

Railway Wheel Repair Shop Has Some Unique Features, D. M. Duncan. Can. Machy., vol. 39, no. 2, Jan. 26, 1928, pp. 21-23, 6 figs.

SIGNALS AND SIGNALLING. Signalling of L.A. & S.L. Completed in 1927. Ry. Signalling, vol. 21, no. 1, Jan. 1928, pp. 5-8, 7 figs. Latest construction includes a.c. floating system with line transformers at stations only; type and equipment used on signalling installed in 1927; a.c. floating system; unique a.c. distribution; signal foundations precast; signal construction; cost of installation, $3,010 a mile.

TERMINALS, MOTOR TRUCK TRANSPORTATION. Rail-Terminal Trucking to Be Investigated, G. L. Wilson. Operation and Maintenance, vol. 37, no. 1, Jan. 15, 1928, pp. 32-33. Motor trucking as part of railroad-terminal service; Interstate Commerce Commission investigations to determine rights and liabilities of rail carriers, cartage companies, shippers and consignees; extend railroad service through arrangements with cartage companies to inland or off-track stations; service offered in St. Louis, Cincinnati, Chicago and New York; how cartage companies function; demountable container shipments; cartage companies as agents.

RAIN AND RAINFALL

RUN-OFF. Rainfall and Flow-Off, River Garry, Inverness-shire. Water and Water Engineering, vol. 30, no. 349, Jan. 20, 1928, pp. 9-13. Discussion of paper by W. N. McClean in same journal, vol. 29, p. 475, which described area, rainfall and gauges installed.

RECTIFIERS

MERCURY ARC. Mercury Arc Rectifier, S. Aoki. Inst. Elec. Engrs. Japan—Jl., no. 472, Nov. 1927, pp. 1153-1168, 19 figs. Theory and construction of rectifier; oil vacuum pump, mercury-vapour pump, McLeod manometer and resistance manometer; special reference to 300-kw. set made by Shibaura Engineering Works; operating characteristics of rectifier, with its transformer connected in various ways; action of interphase reactor; principal causes of arc back, flashing, abnormal high voltage, telephone-line interference. (In Japanese, with brief English abstract.)

REFRACTORY MATERIALS

DEVELOPMENTS. The History of the Refractories Industry, J. D. Ramsay. Heat Treating and Forging, vol. 14, no. 1, Jan. 1928, pp. 62-64. Manufacturing process dependent on refractories; growth of industry traced; co-operation between producer and consumer. Paper presented before joint session of Am. Inst. of Chm. Engrs. and Am. Refractories Inst.

REFRIGERATING COMPRESSORS

DESIGN. Refrigerating Compressors—Their Design and Application, T. M. Gunn. Power House, vol. 22, no. 1, Jan. 5, 1928, pp. 25-29, 11 figs. Space requirements; speed of compressors; when compressors pound; clearance pockets; methods of regulation; separates hot and cold parts; dual back-pressures.

REFRIGERATING MACHINERY

AMMONIA CONTROL VALVES. Automatic Ammonia Control Valves, H. G. Venemann. Refrigeration, vol. 43, no. 1, Jan. 1928, pp. 46-50, 12 figs. Study of conditions affecting control valves and why no automatic valve can be made that will function properly under all of them; four types of automatic control valves in common use; stop valves, constant-pressure valves, constant-liquid level values, load-demand valves.

REFRIGERATION

DRY-ICE (CO_2). The Field of Dry Ice in Modern Refrigeration, J. W. Martin, Jr. Refrig. Eng., vol. 15, no. 2, Feb. 1928, pp. 33-34, 43 and (discussion) 55, 2 figs. Probably most noticeable characteristic of solid carbon dioxide is its extremely low temperature—109.3 deg. Fahr.—at atmospheric pressure, surrounded by its own gas; amount of heat that this ice is capable of absorbing is twice that absorbed in melting of water ice; method of producing carbon dioxide from burning of coke is by far the most important, but other methods are described, including: fermentation tubs, lime kilns, cement kilns, power-house flue gases, blast-furnace stoves, natural wells, chemical plants.

RIVERS

IMPROVEMENTS, ST. LAWRENCE. The Improvement of the River St. Lawrence, E. W. Lane. Engineering, vol. 125, no. 3237, Jan. 27, 1928, pp. 114-116, 8 figs. Improvements planned are in three sections: International Rapids section, from head of Galoup Rapids to Lake St. Francis; Soulanges section, between Lake St. Francis and Lake St. Louis; and Lachine section, between Lake St. Louis and Montreal; describes improvement of international section; includes maps of sections under discussion. (To be continued.)

The Improvement of the River St. Lawrence, E. W. Lane. Engineering, vol. 125, no. 3236, Jan. 20, 1928, pp. 62-63, 2 figs. Summary of findings of Joint Board of Engineers; general features of navigation canals; power development; general problem considered was improvement of river above Montreal for navigation by ocean ships and enlargement of existing channels of Great Lakes. (To be continued.)

ROADS

CONCRETE, TESTING. Device Detects High and Low Spots in Concrete Road Surface, H. Andrew. Eng. News-Rec., vol. 100, no. 4, Jan. 26, 1928, pp. 161-162, 2 figs. Describes machine used for detecting high and low spots in pavements and dimension of irregularity; consists of wooden frame made up of two parallel members to which cast iron end wheels are attached; indicator is swung from frame at its middle point; attached to indicator are steel scrapers; machine was developed by writer.

CONSTRUCTION. Drained Paving Used to Stabilize Road on Sliding Side Hill. Eng. News-Rec., vol. 100, no. 5, Feb. 2, 1928, pp. 199-200, 2 figs. Describes remedial measures undertaken in California to prevent side hill from sliding down on highway at its foot; excavation of 116,000 cu. yd., draining and paving slope of bench cut and oiling 200,000 sq. ft. of surface on top of hill.

GRAVEL, OILING. Oiled Subgrade Stops Frost Boils in Gravel Roads, H. G. Nicholson. Eng. News-Rec., vol. 100, no. 3, Jan. 19, 1928, p. 109. Oiling clay roadbeds reduces spring break-up, lessens loss of gravel by submergence, diminishes dust; result of experiments on gumbo and clay tried in Minnesota.

MACADAM. Penetration Macadam in Illinois Towns. Mun. News, vol. 74, no. 1, Jan. 1928, pp. 3-8, 10 figs. How contractor is paving small community streets at low cost with assurance of long service; men and equipment required; typical specifications; base course; double fork for spreading; penertation surface; double seal coat; Elmhurst work, done under supervision of Ed. Hancock Eng. Co. of Chicago, was governed by specifications that are used as standard by that engineering firm.

MAINTENANCE AND REPAIRS. Hints That Cut Cost and Time for the Contractor and Engineer. Eng. News-Rec., vol. 100, no. 1, Jan. 5, 1928, pp. 30-31, 1 fig. Contains following contributions: Broom for Roughening Concrete Road Surfaces in Delaware, C. D. Buck; Curing Concrete Paving with Asphalt Skin Coat; Comparing Parabolic and Circular Arcs for Pavement Crowns, H. O. Olson.

Hints That Cut Cost and Time for the Contractor and Engineer. Eng. News-Rec., vol. 100, no. 1, Jan. 5, 1928, pp. 28-30, 3 figs. Contains following contributions: "Easing Off" Frost Boils by Snow and Ice Ramps, H. F. Larson; Tar Paint Traffic Lines Increase Road Capacity, C. MacDonald; Patching Bituminous Macadam with Asphaltic Concrete in Ohio, H. P. Chapman; Training School and Tandem Patrol Are Maintenance Innovations in New Mexico, W. C. Davidson; Storing Snow Fence at Points Used in Michigan, H. A. Clementsen.

MATERIALS, LOCAL. Economics of Using Local Materials in Road Building, C. R. Stokes. Eng. News-Rec., vol. 100, no. 1, Jan. 5, 1928, pp. 13-15. Purposeful development of near-by gravel and stone deposits in Wisconsin has cheapened state and local road work; rail-haul and truck-haul savings amount to $3,000 per mile on 5-mile local, compared to 100-mile rail haul; development of local deposits cited and method of working; plant and operation costs of typical plant are given.

WEAR. Relation of Road Type to Tire Wear, O. L. Waller and H. E. Phelps. Am. Soc. Civ. Engrs.—Proc., vol. 54, no. 2, Feb. 1928, pp. 583-584. Discussion on paper by O. L. Waller and H. E. Phelps, continued from Nov. 1927 issue of Proceedings.

ROLLING MILLS

BLOOMING MILLS. Power Requirements and the Rolling Capacity of Blooming Mills, C. Schmitz. Iron and Steel World, vol. 2, no. 1, Jan. 1928, pp. 21-26, 6 figs.

BROAD-STRIP. The Evolution of the Broad-Strip Rolling Mill, S. Badlam. Iron and Coal Trades Rev., vol. 116, no. 3125, Jan. 20, 1928, pp. 69-70, 1 fig. Outstanding achievement of present decade; rolling of wide thin sections has developed along two distinct and originally widely separated lines: (1) rolling of strip, characterized by limitations in width and gauge, rather than in length; (2) rolling of sheets, characterized by limitations in length, rather than in width and gauge.

CHILLED ROLLS. Selection of Special Purpose Rolls, W. H. Melaney. Iron and Steel World, vol. 2, no. 1, Jan. 1928, pp. 45-46. Selection of rolls should be made according to particular service for which they are to be used; use of mild chilled and hard chilled rolls.

The Use and Abuse of Chilled Rolls, W. H. Melaney. Blast Furnace and Steel Plant, vol. 16, no. 1, Jan. 1928, pp. 12-15, 2 figs. Relates in concise form how rolls are manufactured and how they should be handled when in service; refers especially to sheet-mill rolls; chilled cast iron is most desirable because of its cheapness, its hard face and fact that heat it must stand in rolling sheets has very little effect in reducing hardness; physical characteristics.

ELECTRIC DRIVE. Electric Drives in the Steel Rolling Mills, A. F. Kenyon. Blast Furnace and Steel Plant, vol. 16, no. 1, Jan. 1928, pp. 24-27, 5 figs. Review of important installations on continuous and reversing mills, together with discussion regarding use of synchronous motors; includes table of mill-drive motors above 300 h.p. furnished by Westinghouse Elec. & Mfg. Co. from Dec. 1, 1926, to Dec. 1, 1927.

IMPROVEMENTS. New Ideas Overturn Traditions in Rolling Mill Industry. Iron Trade Rev., vol. 82, no. 1, Jan. 5, 1928, pp. 32-33, 2 figs. Opinions of authorities on 1927 developments in rolling steel briefly told; installation of mills for rolling wide strips; accurate mechanical production of sheets; many advantages of continuous process; economic status of new mills; installation of mill designed for wide flange beams; more general use of antifriction bearings; electric drives; developments in mills for rolling practically every material.

TUBE MILLS. Diagonal Rolling of Billets into Seamless Tubes. Iron and Steel World, vol. 2, no. 1, Jan. 1928, pp. 15-20 and 26, 5 figs. Interpretation of mathematical calculations by use of three-dimensional diagrams; conclusions to be drawn from mathematical investigations.

S

SAND, FOUNDRY

TESTING. Sand Tests—What Do They Mean? A. A. Grubb. Instruments, vol. 1, no. 1, Jan. 1928, pp. 39-49, 2 figs.

SANITARY ENGINEERING

HISTORY. Historic Review of the Development of Sanitary Engineering in the United States During the Past One Hundred and Fifty Years. A Symposium, G. H. Fenkell, N. T. Veatch, Jr., E. R. Jones and L. Greenburg. Am. Soc. Civ. Engrs.—Proc., vol. 54, no. 2, Feb. 1928, pp. 605-614. Discussion of symposium continued from Jan. 1928 issue of Proceedings.

SEAPLANES

DESIGN. Seaplanes—Fifteen Years of Naval Aviation, A. Guidoni. Royal Aeronautical Soc.—Jl., vol. 32, no. 205, Jan. 1928, pp. 25-64, 52 figs. Theory and calculation of hydrovaned floats; early seaplanes; work of Forlanini and Crocco; theory of seaplane floats; author's own researches; shape of hydrovaned floats; area, angle of attack and form of hydrovanes; advantages and inconveniences of hydrovanes; practical applications.

SEMI-STEEL CASTINGS

MACHINE PARTS. Casting Semi-Steel Machine Tool Parts at Galt, E. G. Brock. Can. Machy., vol. 38, no. 26, Dec. 29, 1927, pp. 182-184 and 187, 4 figs. History and manufacture of Canada Machinery Corp.; semi-steel used for parts; semi-steel castings eliminate warping; foundry practice; large castings made in green sand; means of dropping cupola bottom after daily heat; several steps in process of moulding 10-ton bulldozer frame; hard dry sand gate; reinforcing with rods; spacious core room; conditions in plant reflected in product.

SEWAGE DISPOSAL

TORONTO, ONTARIO. Scarborough Township Sewerage System. Can. Engr., vol. 54, no. 5, Jan. 31, 1928, pp. 180-182, 1 fig. Ratepayers endorse engineer's proposal few sewerage system and disposal plant; system of trunk sewers includes tunnel 1½ miles long on Blantyre avenue to activated-sludge disposal plant on Massey Creek, Canada; area drained, 1,200 acres; this sewage-disposal plant will be of activated-sludge type, will have screens, aeration chambers and mechanically operated settling basins; from disposal plant will be built trunk sewer, most of which will be done by tunneling.

STEAM

HIGH-PRESSURE. Recent High-Pressure Development in Germany, Loeffler. Power Plant Eng., vol. 32, no. 3, Feb. 1, 1928, pp. 178-179, 2 figs. Pressure above 1,500 lb. and block steam plants for power and municipal heating service are believed to be most economical; examples of new turbines using extremely high pressure; turbines are preferable to engines in large buildings. Abstract translated from V.D.I. Zeit.

STEAM ENGINES

UNIFLOW. The Uniflow Steam Engine, E. A. Allcut. Eng. Jl., vol. 11, no. 1, Jan. 1928, pp. 3-11, 16 figs. General notes including historical reference, results of tests, its application and bibliography of subject.

STEAM GENERATORS

DESIGN. The Steam Generator in Service, G. Burgess. Power, vol. 67, no. 6, Feb. 7, 1928, pp. 245-247, 5 figs.

STEAM PIPE LINES

CORROSION. Carbon Dioxide and Imposed Electromotive Force as Factors Affecting Rates of Corrosion of Iron in Return Mains of Steam Heating Systems, A. Hayes, E. L. Henderson and C. E. Staneart. Iowa State College of Agriculture and Mechanic Arts—Official Pub., vol. 26, no. 3, June 4, 1927, 27 pp., 4 figs. Explains how carbon dioxide is found in hot-water heating pipes; its influence on corrosion and how corrosion is measured.

STEAM TURBINES

BACK-PRESSURE. Back-Pressure Turbines (Les turbines à contre-pression), G. Vie. Vie Technique et Industrielle, vol. 10, no. 100, Jan. 1928, pp. 42-44, 2 figs Treats of turbines whose exhaust is used for industrial purposes in mills and factories for heating or drying, cooking, etc.; explains regulation of speed and pressure and type of turbine used.

DESIGN. New 40,000-Kilowatt Turbines for the Duquesne Light Company, J. D. Schmidt. Elec. Jl., vol. 25, no. 1, Jan. 1928, pp. 36-38, 5 figs. Turbines are connected to generators rated at 48,500 kva. at 80 per cent power factor; no direct connected exciters are provided; operating conditions are 260 lb. gauge pressure at throttle with 214 deg. Fahr. superheat and back-pressure of one inch of mercury, absolute; arrangements are provided for bleeding turbines at four points for feedwater heating.

HIGH-PRESSURE. Higher Steam Pressures and Their Application to the Steam Turbine, A. H. Law and J. P. Chittenden. Instn. Elec. Engrs.—Jl., vol. 66, no. 373, Jan. 1928, pp. 89-117 and (discussion) 117-123, 31 figs.

STEEL

ALLOY. *See Alloy Steels.*

ANNEALING. The Constitution of Steel and Cast Iron, F. T. Sisco. Am. Soc. Steel Treating—Trans., vol. 8, no. 2, Feb. 1928, pp. 305-317, 8 figs. Discusses three steps in annealing operation: (1) heating material to annealing temperature; (2) holding steel at proper temperature, and (3) cooling from annealing temperature; in each of these steps various structural changes taking place are discussed; operation of annealing as discussed is description of that process as it involves heating to temperature above critical range; includes photomicrographs and iron-carbon diagram, also diagram illustrating annealing of steel.

CHROME-VANADIUM. *See Chrome-Vanadium Steel.*

DIE. Some Suggestions for the Choice of Die-Steel, W. Oertel. Am. Soc. Steel Treating—Trans., vol. 8, no. 2, Feb. 1928, pp. 320-321. Translated from Maschinenbau, Oct. 7, 1926, pp. 878-880. See reference to original article in Eng. Index, 1926, p. 708.

HARDENING. Hardening by Reheating After Cold Working, M. A. Grossmann and C. C. Snyder. Am. Soc. Steel Treating—Trans., vol. 8, no. 2, Feb. 1928, pp. 201-215 and (discussion) 215-220 and 281, 19 figs.

LOCOMOTIVE FORGINGS. Steels for Locomotive Forgings, E. J. Edwards. Iron Age, vol. 121, no. 4, Jan. 26, 1928, pp. 255-258, 7 figs. Special care taken by American Locomotive Co. to insure better locomotive forgings; must be sound and clean under fracture and deep-etch test, heated with deliberation and finally normalized and annealed for highest qualities; sound steel selected at source; well-made acid heat preferable to basic heat; deep-etch test on forging blooms; carbon segregation limited to 15 per cent; heat-treatment practices; testing finished forgings.

PROPERTIES. The Mechanical Properties of Steel at High Temperature, H. J. Tapsell and W. J. Clenshaw. Engineering, vol. 124, no. 3233, Dec. 30, 1927, p. 837, 6 figs. Review of Eng. Research Special Report No. 2, describing work on mechanical properties of materials at high temperatures being carried out at National Physical Laboratory; work was done on .51 per cent carbon steel in rolled bars of 1 in. diam., said to have been normalized before delivery, and 0.53 per cent carbon cast steel.

TOOL. *See Tool Steel.*

BRIDGE. High-Strength Steels for Modern Bridges, L. S. Moisseiff. Eng. News-Rec., vol. 100, no. 4, Jan. 26, 1928, pp. 155-156. Trend in building, with special steels and problems metallurgists must solve for bridge engineer; as a rule, new material must be produced under special conditions, with more care and with increased rejections, all of which result in higher cost of production; kinds of high-strength steel used, where and when; wires for bridge cables and their increase in strength; rivets and castings touched upon. From paper presented to N.Y. Sec., Am. Soc. for Steel Treating.

STEEL CASTINGS

WELDING. When Should Steel Castings Be Welded? R. A. Bull. Foundry, vol. 56, no. 2, Jan. 15, 1928, pp. 48-50, 4 figs. Abstracted from Research Group News, Oct. 1927.

STEEL, HEAT TREATMENT OF

PROGRESS. Mechanics of Heat Treating Are Better Applied to Work. Iron Trade Rev., vol. 82, no. 1, Jan. 5, 1928, pp. 36-37, 2 figs.

QUENCHING. Quenching—A Practical Study of Rapid Cooling, P. J. Haler. Ry. Mech. Engr., vol. 102, no. 2, Feb. 1928, pp. 99-103, 8 figs. Discussion of methods of quenching speed plunging and effect produced on various shapes; common methods of quenching; treats of form as determining factor in methods of quenching and how these forms should be treated; relative values of quenching mediums.

SUPERHARDENING. Superhardening of Heat-Treated Steel, E. G. Herbert. Iron Age, vol. 121, no. 5, Feb. 2, 1928, pp. 332-333, 2 figs. Possibility of hard steel articles being superhardened beforehand as means of resisting wear; subjecting articles to impact of cloud of balls, thus producing work-hardened surface; any soft spot revealed by roughened area; successive tests showed progressive increase in hardness up to certain maximum, and thereafter slow softening; method of superhardening by impact; quantity testing for hardness.

Engineering Index

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A

AERIAL PHOTOGRAPHY

USES. Location Survey for Transmission Line, A. C. Goodwin. Eng. and Contracting, vol. 67, no. 1, Jan. 1928, pp. 43-44. How aerial photography was used for 200-mile line; aerial photography used by Hydro-Electric Power Commission of Ontario in locating and purchasing easements for 220,000-volt transmission line now under construction from Fitzroy harbour, on Ottawa river, to Toronto; aerial survey; advantages of aerial survey. Reprinted from Can. Engr.

AIR COMPRESSORS

CENTRIFUGAL, TESTING. Centrifugal Air Compressor Testing, R. B. Ingersoll. Sibley Jl. of Eng., vol. 42, no. 2, Feb. 1928, pp. 35 and 66. Tests on centrifugal air compressor at General Electric Co.; machines treated varied from single-stage types of 1 or 2 h.p. to those of more than 7,000 h.p.; single-stage machines driven by electric motors; multi-stage machines direct connected to steam turbine; measurement of input; measuring air pressures about machines; operation of constant-volume governor; distinction between centrifugal compressor and centrifugal blower.

AIR PREHEATERS

CALCULATION. Calculation of Air Preheaters (Le calcul des réchauffeurs d'air), E. Prat and De Kergaradec. Technique Moderne, vol. 20, no. 3, Feb. 1, 1928, pp. 132-138, 8 figs. Air preheaters with parallel plates; determination of coefficient of transmission, how to increase it; up to what point can surfaces be reduced by raising resistances; cases of slight, moderate and strong recuperation are studied.

AIRPLANE ENGINE

PERFORMANCE TESTING. The Relative Performance Obtained with Several Methods of Control of an Overcompressed Engine Using Gasoline, A. W. Gardiner and W. E. Whedon. Nat. Advisory Committee for Aeronautics—Report, no. 272, 13 pp., 5 figs.

STARTERS. Aircraft-Engine Starters, J. W. Allen. Soc. Automotive Engrs.—Jl., vol. 22, no. 3, Mar. 1928, pp. 387-388.

AIRPLANE PROPELLERS

VARIABLE PITCH (TURNBULL). The Turnbull Variable Pitch Propeller. Aviation. vol. 24, no. 8, Feb. 20, 1928, pp. 446-448, 3 figs. Design features of new propeller.

AIRPLANES

AIRFOILS, SLOTTED. Results of Aerodynamic Tests on Slotted Airfoils in the Aerotechnical Laboratory (S.T. Ae.) of Rhone St. Genese, Brussels, P. Puvrez. Nat. Advisory Committee for Aeronautics—Tech. Memorandums, no. 449, Feb. 1928, 19 pp., 6 figs. Investigation of maximum lift obtainable with slotted airfoils derived from symmetrical airfoil; centre of lift travels contrary to usual direction as angle of attack is increased; tests of series of slotted airfoils derived from dissymmetrical airfoil. Translated from Service Technique de L'Aérotechnique Belge—Bul., nos. 1 and 4, Apr. and July, 1927.

AUTOMATIC SLOT (HANDLEY-PAGE). The Handley-Page Automatic Slot, O. H. Lunde. Aviation, vol. 24, no. 9, Feb. 27, 1928, pp. 506-508, 11 figs. Handley-Page slot described.

RESISTANCE. Calculation of the Resistance to Forward Motion of an Airplane Fuselage Having a Front Radiator (Calcul de la résistance à l'avancement d'un fuselage d'avion muni d'un radiateur frontal), Toussaint. Aérophile (Paris), vol. 6, nos. 3-4, Feb. 1-15, 1928, pp. 50-54, 6 figs. Calculations made from tests conducted in aerodynamic laboratories; influence of truncation of front of fuselage; influence of air discharge through radiator.

WELDING WORK ON. Welding in Airplane Construction, A. Rechtlich and M. Schrenk. Nat. Advisory Committee for Aeronautics—Tech. Memorandum, no. 453, Feb. 1928, 28 pp., 2 figs. Principles for production of perfect weld; possibilities of testing strength and reliability of welded parts; most important and dangerous stresses for welded structures are alternating or oscillating stresses; production of perfect welded joint depends on suitability of structure for welding, use of suitable material and welding wire and on knowledge and conscientiousness of welder. Translated from Schweissen im Flugzeugbau.

WIND-TUNNEL TESTS. Wind-Tunnel Tests of DH-4B Model Fitted with Various Fins and Rudders. Air Corps Information Circular, vol. 7, no. 603, Nov. 1, 1927, 11 pp., 17 figs. Tests to determine change in slipstream effects and rudder control due to variations in shape and vertical location of rudder and fin.

WING-BEAM DESIGN. The Design of Airplane Wing-Beams, J. S. Newell. Am. Soc. Civil Engrs.—Proc., vol. 54, no. 3, part 1, Mar. 1928, pp. 725-787, 22 figs. Presents method developed by U.S. Army Air Corps for analysis and design of beams used in airplane wings; parts I and II completely cover analysis and designs of wooden beams subjected to combined loadings; part III presents and discusses results of several tests made on pin-ended struts at McCook Field, Dayton, Ohio.

WING-PRESSURE DISTRIBUTION. Pressure Distribution on Wing Ribs of the VE-7 and TS Airplanes in Flight, R. V. Rhode. Nat. Advisory Committee for Aeronautics—Tech. Notes, no. 277, Jan. 1928, 61 pp., 57 figs. Complete results of pressure-distribution tests made at Langley Field on wing and tail ribs for particular manœuvre of flight; curves show variation of pressure distribution, total loads, normal acceleration and centre of pressure with respect to time.

ALLOYS

MAGNETIC. Magnetic Alloys Named and Defined. Iron Age, vol. 121, no. 8, p. 534. Several important brands in common use described in terms of properties and composition; permalloy; hipernick; copernick; "A" metal; thermalloy; K.S. magnetic steel, cobaltcrom; permanite and nomag.

ASBESTOS MINES AND MINING

CANADA. Asbestos Mining in Canada, T. Marvin. Explosives Engr., vol. 6, no. 2, Feb. 1928, pp. 49-52, 9 figs. Asbestos veins occur in altered periodtite which, with other closely associated intrusive rocks, are in what is called serpentine belt; an asbestos deposit is worked in 35-ft. levels, faces being blasted down with 38-ft. to 40-ft. holes; movements of all trains in and out of mine are controlled by dispatcher in traffic tower.

ASPHALT

MINES AND MINING. Natural Solidified Petroleum—Its Mining, Treatment and Uses, W. F. Hartzell. Eng. and Min. Jl., vol. 125, no. 6, Feb. 11, 1928, pp. 253-254, 2 figs. Mining native lake asphalt is simple operation; another form of asphalt is known as gilsonite, found in immense deposits in western United States, most of which are in Utah.

ASTRONOMICAL INSTRUMENTS

MACHINING. Machinery Aids the Astronomer. Am. Mach., vol. 68, no. 7, Feb. 16, 1928, pp. 310-311, 8 figs. Eight half-tones of operations in producing astronomical instruments, accompanied with brief description of each; draughting room, machine shop and physical and optical laboratories of engineering department of Mount Wilson Observatory.

AUTOMOBILE ENGINES

FUEL CONSUMPTION. Relation of Fuel Consumption to Engine Compression in Cars, G. G. Brown. Oil and Gas Jl., vol. 26, no. 40, Feb. 23, 1928, pp. 196, 198 and 200. Brings out relative advantages and disadvantages inherent in different methods of increasing engine displacement in motor cars; both of these methods of increasing car performance invariably increase fuel consumption.

HIGH-COMPRESSION. Ricardo Discusses High-Compression Engines, H. R. Ricardo. Automotive Industries, vol. 58, no. 6, Feb. 11, 1928, p. 200. Abstract of paper read before Brit. Instn. of Petroleum Technologists.

VIBRATION REDUCTION. Isolating Engine Vibration. Autocar, vol. 60, no. 1683, Feb. 3, 1928, pp. 203-204, 14 figs.

AUTOMOBILES

BODIES, FINISHING. Abrasive Engineering Practice in Automobile Manufacturing Plants, F. B. Jacobs. Abrasive Industry, vol. 9, no. 3, Mar. 1928, pp. 76-77, 3 figs.

TRANSMISSIONS. Internal Gears Used in Detroit 3- and 4-Speed Gearsets, A. F. Denham. Automotive Industries, vol. 58, no. 6, Feb. 11, 1928, pp. 196-197, 3 figs. Adoption of internal gear reductions for next-to-high speed in two types of transmission manufactured by Detroit Gear & Machine Co.; both units offered for original equipment; spur and internal gear reductions located in different compartments of transmission case to facilitate lubrication.

Research on Noiseless Automobile Construction: A Machine for Studying Vibration in Gear Boxes (Le recherche du silence en construction automobile. Une machine pour l'étude des vibrations des boites de vitesses). Technique Moderne, vol. 20, no. 4, Feb. 15, 1928, pp. 174-175, 3 figs. Describes machine used for testing gear boxes to determine noises due to gears; amplification by grid tubes of vibrations in box which are detected by magnetic detector.

B

BAFFLE PIERS

HYDRAULIC MODELS. Baffle-Pier Experiments on Models of Pit River Dams, B. E. Torpen, O. Reed and H. K. Fox. Am. Soc. Civ. Engrs.—Proc., vol. 54, no. 3, part 1, Mar. 1928, pp. 857-869, 8 figs. Other unpublished data on tests of spillway models may add to value of discussions, and writer presents results of series of such tests for Bull Run dam now under construction for water supply of Portland, Ore. Discussion of paper by I. C. Steele and R. A. Monroe from Jan. issue of Proceedings.

BAKELITE

MOULDING. Bakelite Moulding Methods, F. W. Curtis. Am. Mach., vol. 68, no. 9, Mar. 1, 1928, pp. 361-364, 8 figs. Methods applied in making bakelite products and constructional features of dies and presses used by Reynolds Spring Co.

BALANCING MACHINES

DYNAMIC-STATIC. New Dynamic-Static Balancing Machines, F. Hert. Am. Soc. Naval Engrs.—Jl., vol. 40, no. 1, Feb. 1928, pp. 123-129, 6 figs. New balancing process lately developed consisting of combined dynamic-static method of balancing used in balancing machines built by Krupp in Essen, Germany; gives fundamentals of new method of balancing and apparatus used. Translated from Kruppsche Monatshefte, Oct. 1927.

BEAMS

CONTINUOUS—THEORY. Continuous Beams Over Three Spans, I. Oesterblom. Am. Soc. Civil Engrs.—Proc., vol. 54, no. 3, part 1, Mar. 1928, pp. 709-724, 2 figs. For continuous construction, particularly prevalent on account of increasing use of reinforced concrete, proper solution of moment equations is most tedious task; author provides necessary tables showing moment factors for all most common conditions, so that moments may be found with expenditure of less effort and time; also shows significance of variables and seriousness of usual conventional errors; safety and economy of materials are obtained simultaneously.

BLAST FURNACES

CONSTRUCTION. Improvements in Blast Furnace Construction, J. P. Dovel. Am. Inst. Min. and Met. Engrs.—Tech. Pub., no. 73, 1928, 3 pp. Rebuilding lining while in operation by insertion of series of rows of bronze cooling plates from outside, attached to and supported by shell; this promptly agglomerates material about plates and rebuilds linings to desired dimensions permanently.

DESULPHURIZING. Desulphurizing in the Blast Furnace, C. H. Herty, Jr., and J. M. Gaines, Jr. Blast Furnace and Steel Plant, vol. 16, no. 2, Feb. 1928, pp. 233-237, 5 figs. Condensation of findings of Kinney, Goldberg and Michel, to which has been added data secured by authors; probable reactions in sulphur elimination explained.

BOILER FURNACES

HIGH-CAPACITY. Some Factors in Furnace Design for High-Capacity, E. G. Bailey. Universal Engr., vol. 47, no. 2, Feb. 1928, pp. 28-32. Reports progress in furnace designs for high-capacities; principal factors that should control furnace designs; stoker furnaces; ash removal; rates of heat transfer.

PULVERIZED-COAL. Boiler Tests with Unit Mills at Cahokia, E. H. Tenney. Power Plant Eng., vol. 32, no. 4, Feb. 15, 1928, pp. 238-239, 2 figs. Three-months' continuous operation of new boiler unit has proved entirely satisfactory; each boiler is fired by 2 Simplex-unit pulverizers with capacity of 15,000 lb. per hr. each, using 4-in. white-iron paddles; boiler fired with turbulent burners.

BOILERS

CONTROL. The Hagan Control System, H. E. O'Breen. Eng. and Boiler House Rev., vol. 41, no. 8, Feb. 1928, pp. 380 and 382-384, 5 figs. Outlines what automatic installation consists of; particulars of one of many plants where Hagan system has been installed; with Hagan regulators quick and accurate adjustments are made, and improved efficiency has resulted in saving of 608 tons of coal per year, equal to nearly 4 per cent of former fuel consumption.

HEAT TRANSMISSION IN. Heat Transmission in Modern Boilers; Boilers with Large Radiation and Convection Surface (Processus de la transmission de la chaleur dans les chaudières modernes; chaudières à grand rayonnement: chaudières à grande convection), Roszak and Veron. Société des Ingénieurs Civils de France—Proces-Verbal (Paris), no. 3, Feb. 24, 1928, pp. 93-98. Shows how heat-transfer laws explain and co-ordinate phenomena observed and justify success of certain devices which have been developed in steam boilers.

HIGH-PRESSURE. Some Experiences with the High-Pressure Boilers at Edgar Station (Boston). Power, vol. 67, no. 11, Mar. 13, 1928, pp. 459-461, 5 figs. Account of experiences with two boilers comprising second high-pressure unit; each designed to generate 270,000 lb. of steam per hour and fired by 16-retort, 45-tuyere underfeed stoker; troubles encountered to date have consisted chiefly of water-wall tube failures, superheater burnouts and some difficulty in operating stokers with highly preheated air.

BRASS CASTING

CUTTLEFISH METHOD. Cuttlefish Castings, C. C. Hopkins. Engineer (Lond.), vol. 145, no. 3762, Feb. 17, 1928, p. 191. Easy way to make small, single castings in brass is to use cuttlefish method; description of process; cuttlefish is material that can be used for making moulds into which molten metals can be poured to produce small castings.

BRICK

TESTING. Strength of Brick in Tension, J. W. McBurney. Am. Ceramic Soc.—Jl., vol. 11, no. 2, Feb. 1928, pp. 114-117, 2 figs. Self-aligning grip for use in testing brick in tension is described; values for tensile strength of several types of brick are given; comparison between transverse and tensile strength of brick; conclusion is that tensile strength is closely related to transverse length

BRIDGES

DESIGN. Steel vs. Reinforced Concrete for Bridges, R. Modjeski. Iron and Steel of Can., vol. 11, no. 2, Feb. 1928, pp. 53-54. Discussion of relative merits of steel and reinforced concrete construction; steel tested and relied upon to carry loads assigned better than reinforced concrete; stresses in steel calculated with more precision than in reinforced concrete; time required for steel construction shorter; steel construction when carried on during freezing weather; absolutely permanent when protected from moisture. Paper read before Am. Inst. Steel Construction.

LIFT, RAILROAD. New Bridge Replaces Car Ferry on the Maine Central. Ry. Age, vol. 84, no. 10, Mar. 10, 1928, pp. 565-569, 6 figs. Double-deck structure 2,076 ft. long over Kennebec river involved 234-ft. lift span; caisson work established new record for depth; single track on lower deck, and 20-ft. roadway with two 5-ft. sidewalks on upper deck; span involves interesting features; operation of lift span.

MOVABLE, HIGHWAY. Sabine River Highway Bridge. Pub. Works, vol. 59, no. 2, Feb. 1928, pp. 68-69.

MOVABLE, INTERLOCKING. Interlocking of Opening Bridges. Ry. Gaz., vol. 48, no. 4, Jan. 27, 1928, pp. 98-99, 3 figs. Keadby canal bridge, London & North Eastern Railway, is latest example of how opening bridge is interlocked with signals whether turning, draw or lift type; where opening bridges are providd in Great Britain their operation is controlled from signal boxes, and control levers are interlocked with fixed and block signals.

REPAIRS, WELDING. Repair Corroded Bridges, G. J. Green. Iron Age, vol. 121, no. 10, Mar. 8, 1928, p. 677. Notable structures in Pittsburgh and Rochester reinforced by welding on new metal to replace losses; bars were welded into position vertically, and tied together at close intervals with cross-bars of same section; strength of weld tested; slack diagonal eyebars and tie rods tightened for Pittsburgh & Lake Erie Railroad.

WOODEN, RAILROAD. Report on Wooden Bridges and Trestles. Ry. Age, vol. 84, no. 9B, Mar. 7, 1928, pp. 560-D82-D85. Simplication of grading rules and classification of timber for railway uses; revise present specifications for treated and untreated timber piling; specifications for timber piles; supply yards for standard trestle timbers throughout country. Abstract of report to Am. Ry. Eng. Assn.

WOODEN, STRESSES. Stress Analysis of 90-Year-Old Wooden Bridge, N. J. Bell and J. K. Grannis. Eng. News-Rec., vol. 100, no. 6, Feb. 9, 1928, pp. 234-235, 1 fig. Exactness of design and craftsmanship on 240-ft. span fits it to carry traffic far heavier than original design contemplated; at Camp Nelson, Ky., about 20 miles from Lexington, there is 90-year-old bridge, unusual in design and construction and in its preservation; description of bridge; truss is essentially an arch braced laterally and vertically by stiffener truss; in analysis, no allowance was made for impact.

SUSPENSION—HUDSON RIVER, NEW YORK CITY. The Hudson River Bridge, O. H. Ammann. Tech. Eng. News, vol. 9, no. 1, Feb. 1928, pp 7-9, 28, 34 and 38, 4 figs. Details of sixty-million-dollar structure which is to be largest of its kind; span of 3,500 ft.; bridge traffic studies; location, type and general proportions, general structural characteristics; floor structure and its traffic capacity; vertical and horizontal stiffening systems; cables; cable anchorages; towers and their foundations; loads, wind and temperature forces.

BRIDGES, CONCRETE

ARCH. The Effect of Climatic Changes Upon a Multiple-Span Reinforced Concrete Arch Bridge, W. M. Wilson. Univ. of Ill.—Bul., vol. 25, no. 24, Feb. 14, 1928, 65 pp., 35 figs. Investigation to observe change that took place in multiple-span arch bridge in order that magnitude of changes might be determined, and in order that measured and computed changes might be compared; bridge on which observations were made is six-span, two-rib highway bridge over Vermillion river at Gilbert street, Danville, Ill

SKEW-ARCH. The Design and Construction of a Skew Arch, S. C. Hollister. Am. Concrete Inst.—Advance Paper for Mtg., Feb. 28, 29 and Mar. 1, 1928, 30 pp., 17 figs. Paper deals with solution of skew-arch problem, in building of bridge in Chester, Pennsylvania, to carry West Ninth street over Chester river; span in direction of roadway is 160 ft., with theoretical rise of 12.62 ft.; width of bridge is 60 ft., and angle of skew is over 42 deg.; treats in sequence discussion of skew-arch design; design and construction of bridge; and certain strain-gauge measurements made upon span after completion.

BUILDING CODES

JOINT STANDARD. Design and Cost Data for the 1928 Joint Standard Building Code, A. R. Lord. Am. Concrete Inst.—Advance Paper for Mtg., Feb. 28, 29 and Mar. 1, 1928, 115 pp., 18 figs. Includes complete set of designers' tables and diagrams for use with proposed 1928 Joint Standard Building Code; these tables and diagrams introduce important simplifications in design of doubly reinforced beams and in spacing of stirrups.

C

CASE-HARDENING

DIFFUSION. The Diffusion of Carbon in Carburized Iron. Fuels and Furnaces, vol. 6, no. 2, Feb. 1928, pp. 211-212, 6 figs. Investigation by E. Zingg; microscopic examination showed exclusively that with steel samples within temperature range of 1,200 to 1,470 deg. Fahr., surface zones had been transformed into cementite layer; results show that true diffusion takes place only up to content of saturated mixed crystals, while with reaction diffusion, content of highest chemical composition may be attained. Translated from Stahl u. Eisen.

CAST IRON

SEMI-STEEL. The Manufacture of Steel-Mix Grey Cast Irons, with Special Reference to Their Treatment in the Foundry, A. Smith. Foundry Trade Jl., vol. 38, no. 598, Feb. 2, 1928, pp. 77-79, 2 figs. By adoption of suitable mixtures and correct melting technique, it is possible to make with perfect regularity 30 to 60 per cent steel-mix grey cast irons which will be almost entirely pearlitic in structure, readily machinable and yet possess vastly superior properties to grey cast irons made from pig irons alone or pig irons mixed with cast iron scrap; classification of semi-steel cast iron; graphite in semi-steel cast iron; cupola design.

CEMENT MORTAR

SALTS IN MIXING WATERS. Effect of Salts in Mixing Water on Compressive Strength of Mortar. Pub. Roads, vol. 8, no. 11, Jan. 1928, pp. 248-249. Investigation has recently been completed at Univ. of Texas on effect of various salts in mixing water on compressive strength of mortars; it is quite evident from results that, so far as mixing water is concerned, sulphate ion is not necessarily injurious to strength of Portland cement mortars; of three sulphates used, sodium salt is injurious, magnesium salt shows slight effect and ferrous sulphate increases strength materially.

STRENGTH. Effect on Cement of Certain Salts in Mixing Water. Pub. Works, vol. 59, no. 2, Feb. 1928, p. 74. Shows that all of sodium salts used are injurious to Portland cement mortars, chloride, sulphate and carbonate showing progressively greater reduction in strength for given percentage of negative ion; two magnesium salts used have only slight effect; calcium chloride and ferrous sulphate are beneficial.

CEMENT, PORTLAND

ANALYSIS. Effect of Different Procedures on Results of Analyses of Portland Cement. Rock Products, vol. 31, no. 3, Feb. 4, 1928, p. 77. Present tests were made to compare results of four operators and numerical values of determinations of silica and sesquioxides by two different procedures. Abstract taken from Zement, 1927, p. 974.

CITIES AND TOWNS

PLANNING, QUEBEC. Planning and Building a Modern Industrial Town in Northern Quebec. Town Planning, vol. 7, no. 1, Feb. 1928, pp. 10-12, 1 fig. New town of Dolbeau; plan for model town was prepared and building regulations were adopted; town is divided into zones, A and B; plan of Dolbeau is reproduced.

COAL

CARBONIZATION, LOW-TEMPERATURE. Low-Temperature Carbonization, H. P. Hird. Chem. and Industry, vol. 47, no. 2, Jan. 13, 1928, pp. 30-32. Discusses value of coal from standpoint of products obtained by distillation; value of by-products as compared to loss resulting from burning it as fuel; Hird process; value of products obtained by low-temperature carbonization; coke and gas produce more power than coal burned direct, leaving oil as clear profit; principal products obtained by distillation of coal are gas, coke or smokeless fuel, oils and ammonia; coke represents some 70 per cent of coal, and is of equal importance to oil, if not more so.

CLASSIFICATION. Pure Coal as a Basis for Classification, F. V. Tideswell and R. V. Wheeler. Am. Inst. Min. and Met. Engrs.—Tech. Pub., no 104, Mar. 1928, 12 pp. Inorganic materials must be regarded as impurities in coal, and their presence introduces errors into composition as found by analyses which are not adequately corrected for by usual calculation to ash-free basis; by calculation to pasis of "pure coal," that is to say, coal free from associated inorganic matter, which is greater in amount than derived ash, errors can be reduced considerably.

COAL HANDLING

RAILWAY TERMINALS. Coal Terminal Renders Unusual Service. Ry. Age, vol. 84, no. 7, Feb. 18, 1928, pp. 399-402, 3 figs. Complex business of supplying New York City with coal is much facilitated by Reading; describes terminal built principally to handle traffic of fuel jobbers of New York and vicinity; fuel moved through Port Reading terminal during 1926; facilities at Port Reading; yard operations; boat-transfer operations; cars are clamped in place at cradle, elevated and turned over, coal running through pan conveyor and movable chute into barges; total of 336 cars has been unloaded by this dumper in 10 hours; lighterage system.

COAL MINES AND MINING

STEEL PROPS. Supporting Underground Roads by Steel Arches, D. C. Gemmell. Iron and Coal Trades Rev. (Lond.), vol. 116, no. 3129, Feb. 17, 1928, p. 226, 3 figs. This system of roof support has been in use for over a year, and several thousand sets of girders have been erected under conditions stated.

VENTILATION. The Resistance of Coal-Mine Entries to the Flow of Air, H. P. Greenwald and G. E. McElroy. U.S. Bur. Mines—Reports of Investigations, no. 2853, Jan. 1928, 4 pp., 1 fig. Tests show conclusively that two bends close together, a common condition in coal-mine ventilation practice, should be considered as separate bends only when flow is reversed at second bend; for single square cornered bend loss may be figured as approximately 1.5 VP with increase to 2.0 VP for double bend of type tested, that is, 6- by 9-ft. bends on 50-ft. centres.

COAL MINING GEOLOGY

CANADA. A Note on Recent Investigations, F. W. Gray. Can. Min. Jl. (Gardenvale, Que.), vol. 49, no. 8, Feb. 24, 1928, pp. 168-169, 1 fig. Outline of carboniferous stratigraphy and geologic history of Maritime provinces that contains interesting implications; astonishing thickness of some of carboniferous sediments has recently been disclosed by deep borings for oil in Prince Edward Island

COAL RESEARCH

GENERAL. Coal, Coke and Py-Production, W. A. Forbes. Min. Congress Jl., vol. 14, no. 3, Mar. 1928, pp. 185-189, 4 figs. Cleaning of coal; utilization of coal-mine dumps; coking properties of coal; by-product coke ovens; coke by-products; economical burning of gaseous fuel; low-temperature carbonization of coal.

COKE MANUFACTURE

COAL PREPARATION. Coal Preparation for Coke and Gas Manufacture, H. J. Rose. Chem. and Industry, vol. 47, no. 2, Jan. 13, 1928, pp. 32-37. Methods employed to reduce objectionable features in coal before coking begins; kind of coal best fitted for coking; treatment of coal to reduce ash and sulphur; necessity of careful sampling pointed out; coal preparation should begin in mine by selective mining, wherever that is practicable.

COLD STORAGE

WAREHOUSES. Canadian Rail and Harbour Terminals at Toronto. Ice and Refrigeration, vol. 74, no. 2, Feb. 1928, pp. 121-125, 10 figs. Description of plant erected by Canadian Rail & Harbour Terminals, Ltd.; designed to serve dual purpose of cold and dry storage warehouse; largest of its kind in British Empire; equipment most modern in character; cold-storage plant; "spira-flo" condensers; ice plant boiler room and coal-handling equipment; outstanding feature of plant is extent to which welding has been used in installing equipment.

COMMUTATORS

INSULATION BREAKDOWNS. Preventing Insulation Breakdowns in Commutators, W. E. Warner. Power, vol. 67, no. 10, Mar. 6, 1928, pp. 428-429. Frequent cause of breakdown in d.c. motors, generators and rotary converters is collecting of copper and carbon dust on surfaces at back of commutator; good results can be obtained by using thin muslin through which certain amount of air circulation is possible.

CONCRETE

CRACKS. Crazing in Concrete and the Growth of Hair Cracks into Structural Cracks, A. H. White, V. A. Aagaard and A. O. L. Christensen. Am. Concrete Inst.—Advance Paper for Mtg., Feb. 28-Mar. 1, 1928, 12 pp., 6 figs. Experimental study of formation of hair cracks; growth of hair cracks into structural cracks; crazing may be prevented by using lean mixtures, and by keeping moisture content of concrete constant.

STRENGTH. A Method for Predicting Concrete Strengths with Increased Precision, H. J. Gilkey. Am. Concrete Inst.—Advance Paper for Mtg., Feb. 28-Mar. 1, 1928, 28 pp., 8 figs. Presentation of problem, including partial analysis of certain of leading factors bearing upon strength and quality of concrete; explanation of method; tables of factors and their use; explanation of figures.

TESTING. Concrete in the Field. Engineering, vol. 125, no. 3238, Feb. 3, 1928, p. 121. Review of papers presented at meeting of Am. Soc. for Testing Matls. D. A. Abrams dealt with mixing of concrete, showing that strength is increased within range studied as time of mixing is prolonged; H. S. Mattimore dealt with transverse-beam tests as criterion of quality; other contributions briefly reviewed.

Plastic Yield, Shrinkage and Other Problems of Concrete and Their Effect on Design, O. Faber. Instn. Civil Engrs.—Proc., 1927-1928, 49 pp., 17 figs. Description of series of experiments made to determine how concrete behaves under loads for long periods, especially from standpoint of plastic yield, shrinkage and deflection and their bearing on design; effect of reinforcement.

CONCRETE CONSTRUCTION

QUALITY CONTROL. Experience with a Strength Specification Contract, R. C. Johnson. Concrete, vol. 32, no. 3, Mar. 1928, pp. 31-34, 4 figs. Detailed description of methods used on 22,000 cu. yd. quality controlled concrete job in Wisconsin; tests check quality of concrete secured; quality control brought savings in cement, aggregates and labour.

MATERIALS HANDLING. Concrete Plant Placed on Spoil Bank to Obtain Gravity Flow. Eng. News-Rec., vol. 100, no. 10, Mar. 8, 1928, pp. 396-397, 2 figs. Contractor on Amarillo water reservoir finds new use for waste-material embankment in level country; concrete distribution was made by chutes from 80-ft. mast.

CONCRETE MIXING

DESCRIPTION. Measurement of Concrete Materials, R. T. Giles. Can. Engr., vol. 54, no. 6, Feb. 7, 1928, pp. 203-204, 3 figs. Essential features in mixing of concrete for road construction; weighing method for fine and coarse aggregate; several general conditions as to requirements of measuring equipment; no equipment should be allowed which will give more material than specified amount; measuring equipment should be easy to calibrate for accuracy; weighing fine aggregate; inundation method of measuring; measurement of coarse aggregate is usually accomplished by one of two methods, volume or weight. Paper read before Am. Road Bldrs'. Assn.

CONVEYORS

BELT. Handling Mill Refuse on 1,600-Ft. Belt Conveyor Line, W. A. Scott. Power Transmission, vol. 32, no. 1, Jan. 1928, pp. 130-131, 2 figs.

COOLING TOWERS

DESIGN. Cooling Towers, C. W. Olliver. Power Engr., vol. 23, no. 263, Feb. 1928, pp. 58-60, 2 figs. Provocative discussion on theory and design, with special reference to concrete construction; "rain" or finespray effect, is of very great importance.

COPPER CASTINGS

BULKY. Presents Notes on Making Bulky Copper Castings, W. J. Clark. Foundry, vol. 56, no. 5, Mar. 1, 1928, pp. 181-184, 6 figs. Method of pouring heavy copper castings; reasons why copper is difficult metal to cast; impurities resulting from atmospheric contact; charcoal in runner box forms protective covering throughout pouring; manner of gating casting for its running; correct pouring rate; difficulty of adequately feeding against shrinkage; tenure of fluidity over that of casting depends on form, volume and temperature.

COPPER MINING GEOLOGY

SEDIMENTARY DEPOSITS. Sedimentary Metalliferous Deposits of the Red Beds, J. W. Finch. Am. Inst. Min. and Met. Engrs.—Tech. Pub., no. 51, Feb. 1928, 7 pp. Carbonate-silicate ores are not found in sufficient quantity in any one area to justify erection of milling plants for their treatment; deposits lend themselves best to purposes of individual miner and leaser who can search for lenses of ore, and ship sorted product to custom smelters.

GEOPHYSICAL EXPLORATION. Earth-Resistivity Measurements in the Lake Superior Copper Country, W. O. Hotchkiss, W. J. Rooney and J. Fisher. Am. Inst. Min. and Met. Engrs.—Tech. Pub., no. 82, Mar. 1928, 15 figs. Scheme of measurement is based on special case of four terminal conductors; if electric current is passed between any two points in homogeneous conducting material, current lines will distribute themselves according to well-established laws; apparatus used was developed by Dept. of Terrestial Magnetism of Carnegie Instn.; diagram of earth-resistivity meter, showing connections to earth.

QUEBEC. Copper in the Eastern Townships, J. A. Dresser. Can. Min. and Met. Bul. (Montreal), no. 191, Mar. 1928, pp. 341-346. Résumé indicates that Eastern Townships is not new field; yet it offers, not only possibilities, but even probabilities that further deposits will yet be disclosed.

CORES

DRY-SAND. The Effect of Moisture Absorption on the Properties of Dry-Sand, H. L. Campbell. Iron and Steel of Can., vol. 11, no. 2, Feb. 1928, pp. 48-50. Investigation to determine changes in strength and permeability of dry-sand cores when placed in green-sand moulds for different periods of time; core-sand mixtures; methods used in obtaining data; effects of moisture absorption on transverse strength and on permeability of cores; moisture absorbed by dry-sand cores.

CRANES

FOUNDRY. Foundry Jib Crane of Great Flexibility. Iron Age, vol. 121, no. 8, p. 530, 1 fig. Design fitted for work in limited space; unusual ball-bearing arrangement; electric welding employed in attaching crane supports.

TRACK. A Track Crane with New Features. Ry. Eng. and Maintenance, vol. 24, no. 2, Feb. 1928, pp. 76-77, 1 fig. Crane is mounted on flat car between other cars and loads or unloads two cars before switching, thus reducing switching to one-half of what would be required if crane could work from end of car only; power is supplied by 40-h.p., 4-cylinder gasoline engine and has two speeds in each direction; crane has capacity of 5,000 lb. with hoisting speeds of 90 ft. and 180 ft. per min.

CRUSHED STONE PLANTS

UP-TO-DATE. Bringing the Stone-Crushing Plant Up-to-Date, F. W. Westbrook. Indus. Eng., vol. 86, no. 2, Feb. 1928, pp. 79-81, 6 figs. Plant construction on slopes above Hudson river; as stone passes from operation to next it steadily progresses down hill; all of machinery is operated by individual motors; great deal of mechanical handling by means of belt conveyors is involved; all of conveyors have individual motors and are driven through De Laval worm-reduction gears.

CUTTING TOOLS

DIAMOND. Diamond Cutting Tools. Machy. (Lond.), vol. 31, no. 799, Feb. 2, 1928, pp. 577-578, 7 figs. Application of diamond cutting tools to finish turning of aluminum-alloy pistons and boring of white-metal liners for crankshaft and connecting-rod bearings; advantage in finish and accurate sizing; eliminates hand scraping or bedding bearings; feed should be about 0.001 in. per revolution of tool; design of tools for machining alloy pistons; diamond boring tools.

D

DAMS, ARCH

DESIGN. Approximate Formulas for Arch Dam Design, B. F. Jakobsen. Eng. and Contracting, vol. 67, no. 1, Jan. 1928, pp. 25-27, 4 figs. Why ordinary cylinder formula is not satisfactory; formulas used in design of 400-ft. dam; how dam may be designed roughly for cost estimates; writer presents formulas which he has used extensively in design of Pacoima dam of Los Angeles Flood Control District and which he has found to be fairly accurate when checked with more elaborate and also more accurate formulas for arches.

TESTING. Arch Dams, C. D. Marx. Engrs. and Eng., vol. 45, no. 1, Jan. 1928, pp. 16-17. Unique research in civil engineering; experimental Stevenson creek dam; completed to height of 60 ft.; shaped like symmetrical, triangular piece of side of round can; built of Portland cement concrete without steel reinforcements; announcement by U.S. Bur. of Standards; complete sets of deformations, strains and slide measurements made by varied loads; tests made at night to eliminate temperature effects; only signs of failure two vertical cracks in centre line.

DAMS

DIVERSION, WYOMING. Construction of Willwood Diversion Dam, I. E. Houk. New Reclamation Era, vol. 19, no. 2, Feb. 1928, pp. 26-28, 3 figs. Concrete gravity dam built in 1922 and 1923 diverts water for Willwood division of Shoshone project; dam is concrete gravity structure 320 ft. long, surmounted by 3-span, pony Warren, riveted, steel-truss highway bridge having reinforced-concrete floor; design of dam; foundation conditions; construction operations; cost records.

EARTH. Building a Rolled-Fill Dam of Prewetted Earth, W. Lowry. Eng. News-Rec., vol. 100, no. 10, Mar. 8, 1928, pp. 388-391, 5 figs. McKay dam 165 ft. high in Umatilla irrigation works takes advantage of stable material to cut down costs by steep slopes and concrete paving; building and paving of fill; comparison is suggested with semi-hydraulic fill method adopted by reclamation engineers at Guernsey dam.

GRAVEL-FILL. Building the Guernsey Irrigation and Power Dam, F. F. Smith. Eng. News-Rec., vol. 100, no. 7, Feb. 16, 1928, pp. 264-268, 7 figs. Semi-hydraulic method of construction adopted for gravel-fill dam built on permeable river bottom; material dumped from trestles was sluiced into place; design and construction of dam on North Platte river in Wyoming for control and conservation of river, which supplies federal irrigation project, comprising 237,000 acres of irrigated land in Wyoming and Nebraska; power penstock; concrete power house provides for two 3,400-h.p. turbines direct connected to 3,000-kv.a. generators.

IMPOUNDING, PERMEABLE MATERIAL. Reservoir Dam of Permeable Material. Pub. Works, vol. 59, no. 2, Feb. 1928, pp. 78-80, 1 fig. In connection with increasing water supply of city of Chicopee, Mass., impounding dam, 48 ft. high, was built of permeable material and resting upon permeable soil; continuous row of steel-sheet piles 30 ft. long was driven for full length of dam directly under centre of core wall; embankment is approximately 550 ft. long, height above bed of stream 48 ft.

Multiple-Arch. High Multiple-Arch Dam at Lake Pleasant, Arizona. Engineering, vol. 125, no. 3239, Feb. 10, 1928, pp. 159-161, 7 figs. Construction details of highest multiple-arch dam built up to present time; forms reservoir of 8 miles length, and has capacity of 173,000 acre-ft.; water will be used for irrigation of 40,000 acres of land; has double-wall buttresses; spaced on 60-ft. centres; there are 26 arches and 27 buttresses.

Design. New Type of Dam (Su un nuovo tipo di dighe), E. Kalman. Energia Elettrica, vol. 4, no. 12, Dec. 1927, pp. 1282-1303, 28 figs. Critical discussion of recent practice in dam design, with special reference to Noetzli's hollow-buttress multiple-arch design of Horseshoe dam in Arizona; describes and analyzes new patented types consisting of thin vertical wall held in position by one or more solid or hollow inclined slabs built upstream or downstream of vertical wall.

Italy. Italian Water-Power Plants. Engineering (Lond.), vol. 125, no. 3241, Feb. 24, 1928, pp. 237-238. Particulars concerning more important dams being built or nearing completion on April 1 of last year; information relates to condition of works in early part of 1927. Abstract translated from Annali dei Lavori Pubblici.

Upward Pressure. Upward Pressures Under Dams: Experiments by the United States Bureau of Reclamation, J. Hinds. Am. Soc. Civil Engrs.—Proc., vol. 54, no. 3, Mar. 1928, part 1, pp. 685-708, 20 figs. Uplift measurements on three gravity diversion dams and one gravity storage dam; founded on gravel, on sandstone and shale and on columnar basalt foundation.

DEPRECIATION ACCOUNTING

Review of. Depreciation Practice and Plant Records, O. E. Fischer. Jl. of Accountancy, vol. 45, no. 3, Mar. 1928, pp. 161-174. Review of practice of estimating factory and machine depreciation and criticism of methods of keeping plant records, with suggestions for proper record keeping with minimum of labour.

DIES

Bending. Examples of V-Die Bending. Machy. (Lond.), vol. 31, no. 800, Feb. 9, 1928, pp. 606-607, 1 fig. Examples of various types of bends that may be made in V-die; construction of die and punch used is such that it will permit large variety of right-angle bends to be made on angular strips of sheet metal; gauge generally used for locating work on die; bending operations.

Brass-Forging. Characteristics of Brass-Forging Dies, F. W. Curtis. Am. Mach., vol. 68, no. 8, Feb. 23, 1928, pp. 319-320, 10 figs.

DIESEL ENGINES

Design. American and German Diesel Engines Described. Soc. Automotive Engrs.—Jl., vol. 22, no. 2, Feb. 1928, pp. 154 and 266-267. Review of Diesel Engine Session; brief abstracts of papers covering Diesel design and construction and aluminum-alloy pistons in wide size range; Diesel Engine Performance Compared, by Dr. W. Riehm; automobile Diesel engines; Horning sees no small Diesels; for aircraft, Diesel engine promises improvement in regard to fire hazard and cruising range; rail-car Diesel engine of 200 h.p.; economy of Diesel-engine locomotives.

High-Speed. High-Speed Diesel Engines, O. D. Treiber. Soc. Automotive Engrs.—Jl., vol. 22, no. 2, Feb. 1928, pp. 183-189, 7 figs. Study to determine efficiencies and mean effective pressures when Otto and Diesel cycles are combined in varying percentages; improvement in thermal efficiency up to 30 per cent of fuel burned at constant volume; new metal alloys and weight reduction; high-pressures necessitate heavy construction; time-lag serious barrier; possibilities of direct injection.

Improvements. Bringing Larger Powers Into the Diesel Electric Field, H. Becker. Oil Engine Power, vol. 6, no. 2, Feb. 1928, pp. 103-106, 5 figs. Improvements in double-acting Diesels increase speed and reduce weight; recent developments by M.A.N. Co.; increasing speed of engines and reducing weight of both engine and generator materially decreases production cost; adaptation of solid injection to high-speed double-acting Diesel; marine applications; marine types designed for air injection and stationary units for solid injection; details of high-speed type; change in cylinder-block design; cylinder heads in two parts; fuel valves; piston-cooling system.

Thermal Efficiency. Diesel Engine Thermal Efficiency and M.E.P., B. M. Thornton. Power Plant Eng., vol. 32, no. 5, Mar. 1, 1928, pp. 296-297, 1 fig. Method of quickly determining thermal efficiency of Diesel engine from its card, based upon newly-derived formula and chart.

DITCHES

Flow of Water. Flow of Water in Drainage Ditches, C. E. Ramser. Eng. and Contracting, vol. 67, no. 1, Jan. 1928, pp. 7-10, 20 figs. Describes measurements made on eleven drainage ditches and one natural river channel in central Illinois to determine roughness coefficient " n " in Kutter's formula for use in design of drainage channels, in computing discharge capacity of existing channels, and to determine effect of vegetation upon their capacity; experiments were conducted by U.S. Dept. of Agriculture in co-operation with Engineering Experiment Station of Univ. of Illinois.

E

ELECTRIC CABLES

Aluminum, Steel-Cored. Steel-Cored Aluminum Cables, W. Bode. A.E.G. Progress (Berlin), vol. 4, no. 2, Feb. 1928, pp. 40-41, 1 fig. Investigations of losses occurring in steel-cored aluminum cables.

Arcing Tests. Arcing Tests on Cables, Fuchs and Kaufmann. Elec. World, vol. 91, no. 9, Mar. 3, 1928, p. 467. Wind or sudden shedding of sleet may cause cables of overhead transmission line to clash, causing destructive arcing; authors investigated durability of 15 types of cables when subjected to heavy arcs; hollow cables lasted longer than equivalent solid sables. Brief abstract translated from Elektrotechnische Zeit., Jan. 26, 1928.

Rubber-Insulated. The Heating of Rubber-Insulated Wires and Cables, L. B. Desbleds. India-Rubber Jl., vol. 75, no. 4, Jan. 28, 1928, pp. 10-11, 4 figs. Results of French tests to establish permissible current densities; determination of heating of wire or cable in terms of current which traverses it, with view to estimating current which produces maximum permissible heating; results obtained form subject of report which is here summarized; measurement of resistance; sequence of operations.

ELECTRIC CAPACITORS

Uses. What Relief for the Overloaded System? R. C. Muir. Indus. Eng., vol. 86, no. 2, Feb. 1928, pp. 76-78, 6 figs. Describes use of capacitors for power-factor improvement; purpose of this discussion is to acquaint industrial-plant men with salient factors that must be considered in selection and application of this equipment.

ELECTRIC CURRENTS, ALTERNATING

Calculation. Chart for Solving Alternating Current Problem, C. A. Kulmann. Power, vol. 67, no. 9, Feb. 28, 1928, pp. 377-378, 1 fig. Present alignment chart designed by author for calculation of a.c. power problems; provides easy means of obtaining any of related values, power factor, kilowatts, reactive kilovolt-amperes (wattless kilowatts) and kilovolt-amperes, when any two of values are known.

ELECTRIC CIRCUITS

Ground Detection. Ground Detection, J. Auchincloss. Gen. Elec. Rev., vol. 31, no. 2, Feb. 1928, pp. 76-81, 2 figs. Means of detecting grounding faults in electric circuits; general considerations; two-wire low-voltage d.c. and a.c. circuits; Edison three-wire systems; higher voltage requirements; two-phase three- and four-wire systems; three-phase three-wire systems; 125-volt two-wire ungrounded circuit; Edison three-wire ungrounded neutral systems; three-phase electrostatic instrument for ground detection.

ELECTRIC COILS

Laying Out. Laying Out and Making Pulled Coils, A. C. Roe and D. H. Braymer. Indus. Eng., vol. 86, no. 2, Feb. 1928, pp. 65-68, 9 figs.

ELECTRIC CONDENSERS

Dielectrics. Dielectrics for Electrical Condensers, P. R. Coursey. Engineering, vol. 125, no. 3238, Feb. 3, 1928, pp. 133-134. Reviews development of dielectrics, as dependent upon research and experiment.

ELECTRIC FURNACES

Heat-Treating. Rotary Hearth Furnace Automatically Discharges Parts into Quench Tank. Fuels and Furnaces, vol. 6, no. 2, Feb. 1928, pp. 197-200, 3 figs. Electrically heated furnace with rotary hearth and automatic dumping mechanism, placed in operation in heat-treating department of the Nash Motors Co., Racine, Wis., is used in heat treatment of various types of automobile parts such as steering knuckles, gear blanks, piston pins, etc.

ELECTRIC GENERATORS

Alternating Current, Protection. Protecting Generator Fields Against Overvoltage, R. B. Greenwood. Elec. World, vol. 91, no. 10, Mar. 10, 1928, p. 508, 1 fig. Protection against excitation circuit overvoltages has been obtained in a few hydro-electric plants by installation of aluminum-cell lightning arresters; installation of this nature was made in Moccasin plant of San Fransciso and has proved very satisfactory.

Automotive. Automotive Current Generators, M. Leece. Soc. Automotive Engrs.—Jl., vol. 22, no. 3, Mar. 1928, pp. 390-392. Exacting requirements for generation of electric current for modern automotive vehicles, especially motor coaches, airplanes and dirigibles, and how these needs are met by manufacturers of generators; heavy demands on electric source; voltage-regulated versus third-brush types; why operators and makers have trouble; large equipment economical but needs space. Discussion.

Compound, Parallel Operation. Parallel Operation of Compound Generators, H. N. Blackmon. Power, vol. 67, no. 8, Feb. 21, 1928, pp. 332-335, 8 figs. Problem resolves itself into study of conditions at loads below peak of voltage curves.

Direct Current. Selecting the Most Desirable Type of Direct-Current Generator, S. Hancock. Elec. Jl., vol. 25, no. 3, Mar. 1928, pp. 141-146, 8 figs. Deals with shunt, compound, differentially compound and series generators; separately excited d.c. generators.

Sparkless Commutation. Obtaining Sparkless Commutation, E. J. Morrissey. Power Plant Eng., vol. 32, no. 5, Mar. 1, 1928, pp. 301-303, 6 figs. Points out that ordinary sparking troubles are easily corrected if care is taken in analyzing their cause and applying proper remedies.

Spring Mounting. Spring Mounting Prevents Vibration from Frequency Converter, A. P. Fugill. Power, vol. 67, no. 10, Mar. 6, 1928, pp. 427-428, 3 figs. Unit installed by New York, New Haven & Hartford Railroad, at New Haven, permits supply of power from local power company to railroad system; one of important features is use of spring mounting on single-phase generator, which has maximum rating of 10,700 kva.; spring mounting, which means that stator is mounted in flexible manner, is used to absorb vibration inherent to machine and prevent it from being transmitted to foundations.

Synchronous. Synchronous Machines, R. E. Doherty and C. A. Nickle. Am. Inst. Elec. Engrs.—Jl., vol. 47, no. 3, Mar. 1928, pp. 200-204, 5 figs. Solves general case, including salient-pole machines; principal assumption which distinguishes present theory from extensively studied cylindrical-rotor theory is that total armature self-inductance is here taken as variable with respect to rotor positions, whereas previous theory of short circuits, as represented by Boucherot, for instance, assumes this inductance to be constant, in other words that air gap is uniform.

ELECTRIC LINES

Alternating Current. The Transmission of Alternating Current, W. B. Woodhouse. Elec. Rev. (Lond.), vol. 102, no. 2621, Feb. 17, 1928, p. 269. Author advocates adoption of four-phase system for a.c. transmission as means of reducing number of wires necessary for balanced protection with other incidental but important advantages.

ELECTRIC LOCOMOTIVES

Design. Recent Electric Locomotive Designs, J. D. Airich. Sibley Jl. of Eng., vol. 42, no. 2, Feb. 1928, pp. 36-38 and 58, 60 and 62, 3 figs. Brief résumé of different types of electric locomotives; low-voltage d.c., high-voltage d.c. and single-phase a.c. locomotives; principal data on New York Central passenger locomotives.

Tri-Voltage. Tri-Voltage Locomotives, W. R. Taliaferro. Elec. Traction, vol. 24, no. 2, Feb. 1928, pp. 80-81, 1 fig. New electric locomotives built for Sacramento-Northern Railway operating on three different voltages, and power collected from third-rail trolley.

ELECTRIC MOTORS

Controllers. Features to Consider When Selecting Motor Controllers, W. H. Costello. Power, vol. 67, no. 7, Feb. 14, 1928, pp. 294-297, 5 figs.

Direct Current. A Review of the Development of Direct Current Motor Design, E. Thomson. Gen. Elec. Rev., vol. 31, no. 3, Mar. 1928, pp. 116-118, 4 figs. History of d.c. motor development, how design has been improved and developed from Gramme dynamos.

Speed Torque. High-Slip Versus High-Torque Motors, F. J. Johns. Elec. Jl., vol. 25, no. 2, Feb. 1928, pp. 100-101, 2 figs. These points discussed with reference to speed-torque curves of three typical motors, which represent probably most common variations from what might be considered normal motor; only speed torque and current characteristics of these motors discussed.

Squirrel-Cage. High-Torque Motors Permit Large Savings. Power, vol. 67, no. 7, Feb. 14, 1928, p. 297, 1 fig. Savings of approximately $100,000 are expected by Philadelphia Grain Elevator Co. as result of installation of high-torque, high-reactance, squirrel-cage induction motors for driving machinery of its new export grain elevator at Port Richmond, Philadelphia, Pa.

ELECTRIC NETWORKS

Low-Voltage. Low-Voltage, A.C. Networks, D. K. Blake. Gen. Elec. Rev., vol. 31, no. 2, Feb. 1928, pp. 82-84, 4 figs. Service possibilities of low-voltage a.c. networks; application; investigations tend to indicate that a.c. system can be devised to give at lower cost as reliable service as Edison system without storage-battery reserve; some form of secondary network necessary to approach continuity of service given by Edison system. (To be continued.)

Low-Voltage A.C. Networks, D. K. Blake. Gen. Elec. Rev., vol. 31, no. 3, Mar. 1928, pp. 140-143, 16 figs. Types of combined light and power network systems; they should permit load to be easily balanced over phases, should permit grounding to limit voltage on lighting circuits below 150 volts to ground, and should have same nominal voltage for lamps as circuits that are not in network area; about 15 of networks now installed use Y-connected transformer secondary. (Continuation of serial.)

ELECTRIC RHEOSTATS

CALCULATION. Method of Calculating Rheostats for the Control of Illumination and Its Practical Application. Am. Inst. Elec. Engrs.—Jl., vol. 47, no. 3, Mar. 1928, p. 217. Describes graphic method which easily permits exact determination of sections of conductors of rheostats for control of illumination produced by incandescent lamps.

ELECTRIC SPARK GAPS

LAG. Surge Impulse Breakdown of Air, J. J. Torok. Am. Inst. Elec. Engrs.—Jl., vol. 47, no. 3, Mar. 1928, pp. 177-181, 14 figs Describes phenomenon which is used as method of studying development of high-voltage spark-over; phenomenon described is of intense interest because it presents intermediate stages between initiation of and actual flashover between spheres; effect of time lag of flashover, with special reference to state of ionization of gas previous to flashover. Bibliography.

ELECTRIC SWITCHES

EQUIPMENT SCHEDULES. Switch-Structure Equipment Schedules, W. F. Sutherland. Elec. World, vol. 91, no. 9, Mar. 3, 1928, pp. 454-455, 3 figs. Logically and carefully arranged system of preparing drawings saves time and results in more valuable records; with practice followed by Toronto Hydro-Electric System, complete inventory of electric equipment is always available, down to nuts and bolts for fixing component details.

ELECTRIC SWITCHING

AUTOMATIC. Automatic Switching of Incoming A.C. Lines, A. R. Anderson. Power Plant Eng., vol. 32, no. 4, Feb. 15, 1928, pp. 249-253, 2 figs.

EOTVOS TORSION BALANCE

METHOD. The Eotvos Torsion Balance Method of Mapping Geologic Structure, D. C. Barton. Am. Inst. Min. and Met. Engrs.—Tech. Pub., no. 50, Feb. 1928, 51 pp., 13 figs.

ELECTRIC TRANSFORMERS

AIR BLAST EQUIPMENT. Forced Air-Blast Equipment for Oil-Immersed Transformers, L. H. Hill. Elec. Jl., vol. 25, no. 2, Feb. 1928, pp. 60-62, 9 figs.

ELECTRIC TRANSMISSION AND DISTRIBUTION

THEORIES. The Rigorous and Approximate Theories of Electrical Transmission Along Wires, J. R. Carson. Bell System Tech. Jl., vol. 7, no. 1, Jan. 1928, pp. 11-25. Problems here dealt with are to investigate conditions under which specification of system by means of its self and mutual impedances is valid and to provide general method for calculating these circuit parameters from geometry and electrical constants of system.

BULK. Some Factors Involved in the Bulk Transmission of Power, G. D. Floyd. Elec. News. vol. 37, no. 3, Feb. 1, 1928, pp. 30-33, 4 figs. How frequency, voltage and conductor size are chosen and how power-loss costs are estimated; economics of design; 100 per cent annual cost is that for transmission of 250,000 h.p., 300 miles over 6 circuits at 120 kv.; cost of power loss.

LOSSES. Reducing Distribution Losses, J. B. Moorhouse. Elec. World, vol. 91, no. 6, Feb. 11, 1928, p. 296, 1 fig. Deals with load and voltage tests; graphic instruments should be readily portable, light in weight, accurate and sturdy; charts should be continuous.

PLANNING. Simplified Distribution Planning, W. R. Bullard. Elec. World, vol. 91, no. 10, Mar. 10, 1928, pp. 499-503, 1 fig. Methods of calculating economic characteristics of electric distribution systems, particularly transformer spacing and sizes of line conductor; system of planning described was utilized in rebuilding of extensive and heavily loaded system in southern city.

ELECTRIC-WELDING, ARC

ATOMIC-HYDROGEN. Atomic Hydrogen Arc Welding, J. D. Wright. Iron and Steel Engr., vol. 5, no. 2, Feb. 1928, p. 100. Description of atomic-hydrogen method of arc welding; alternating current maintained between adjustable tungsten-wire electrodes, and hydrogen gas fed to arc around electrodes; equipment required; designed to operate from single phase, 60 cycles; welding of alloy steels and thin metals; test data.

MACHINES. Arc Welding for Machinery, A. F. Davies. Elec. World, vol. 91, no. 10, Mar. 10, 1928, pp. 513-515, 5 figs. Analysis of underlying factors governing use of arc welding, with some examples of cost comparison with cast iron; insofar as welding may be used to fabricate jobs which were formerly made using castings or riveted steel, and produce equivalent job at less cost, welding will be used.

NON-FERROUS METALS. Arc-Welding of Non-Ferrous Metals, A. Churchward. Can. Machy., vol. 39, no. 4, Feb. 23, 1928, pp. 36-37.

ELECTRICITY SUPPLY

INDUSTRIAL LOADS. Characteristics of Industrial Loads. Elec. World, vol. 91, no. 10, Mar. 10, 1928, pp. 515-516, 7 figs. Performance of individual plants departs widely from averages; useful data must be based on individual processes; to show this fact, 50 industrial plants representing five major classes of business were investigated to ascertain whether any average figures can be obtained for specific industries that mean anything.

ELEVATORS

ELECTRIC, CABLE-LOAD EQUALIZING. Equalizing the Load on Elevator Cables, D. R. Paddock. Power, vol. 67, no. 11, Mar. 13, 1928, pp. 472-473, 3 figs. Evans equalizer increases life of cables, reduces wear on sheave grooves and improves elevator operation.

EXTENSOMETERS

CONCRETE MEASUREMENT. Extensometer for the Determination of Young's Modulus for Concrete, V. C. Davies. Engineering, vol. 125, no. 3238, Feb. 3, 1928, pp. 131-132, 6 figs. It was necessary to construct instruments able to read 0.00001-in. extension with fair accuracy, and sufficiently robust to stand violent jar and sudden extension of at least ¼-in. bound to occur when specimen fractured; method of calibration employed is identical with that used in Ewing extensometer.

F

FACTORIES

BUILDINGS, REMODELING. Remodeling Old Manufacturing Buildings to Cut Operating Costs, T. S. Rogers. Mfg. Industries, vol. 15, no. 2, Feb. 1928, pp. 135-138, 4 figs. Points out that operating charges can be lowered and production costs cut either by remodeling present structures or by buying well-built but unused factory at bargain price.

LAYOUT. Plan the Plant for Its Job, M. Kahn. Factory, vol. 75, no. 2, Feb. 1928, pp. 316-318, 5 figs. Building should allow manufacturer to change his methods whenever necessity arises; he should never be called upon to accommodate his process of manufacture to layout of building; building should be constructed around ideal manufacturing layout; column spacing; proportion of glass to working-floor space; layout of plant for manufacture of automobiles considered.

FITS

FORCE. Allowance for Force-Fit, Diameter and Materials Taken into Consideration, H. Yaskawa. Soc. Mech. Engrs. (Japan) Jl., vol. 31, no. 129, Jan. 1928, pp. 1-12, 5 figs. Allowances for force-fit generally given by diameter alone independent of other factors involved, and so new chart is constructed to include all factors; stresses induced in outer and inner cylinders calculated; thickness of cylinders and elastic constants of materials computed; application of chart to calculation of maximum stresses induced by force-fit. (In English.)

FLOOD CONTROL

MISSISSIPPI RIVER. To-day in the Mississippi Flood Area, W. W. De Berard. Eng. News-Rec., vol. 100. nos. 10 and 11, Mar. 8 and 15, 1928, pp. 398-402 and 434-439, 17 figs. Mar. 8: New levee designs and their construction; construction problems; levees of larger sections to-day are built by tower machines, draglines and steam shovels with long booms, and to limited extent with tractor- and mule-hauled wagons loaded by shovel or by elevating grader. Mar. 15: Revetment and some river hydraulics; comparisons between travel of flood waves and mean velocity at bank-full stage.

FLOORS

CONCRETE. Floors Without Forms. Constr. Methods, vol. 10, no. 3, Mar. 1928, pp. 11-13, 8 figs. Contractor poured concrete directly on paper-backed steel mesh reinforcement for six-storey building; besides doing away with forms, this type of construction prevents droppings of concrete during pouring, insures proper imbedding of wire mesh reinforcement, and has certain sound-deadening properties.

FLOW OF GASES

MEASUREMENT. Thermal Volume Meter, G. W. Penney and C. J. Fechheimer. Am. Inst. Elec. Engrs.—Jl., vol. 47, no. 3, Mar. 1928, pp. 181-184, 6 figs. Originally brought out by Prof. Thomas; temperature of gas is raised by means of electric heater, change in temperature being accurately measured either by means of resistance thermometers connected in Wheatstone bridge network or by means of thermopile; possible sources of error in meter; notes on design, including means of calculating proportions of heater; advantages and disadvantages of various methods of measuring gas volumes; comparison of resistance thermometers and thermocouples for temperature measurement.

FLOW OF WATER

MEASUREMENT. Chemical-Electric Measurement of Water, A. Barbagelata. Soc. Civil Engrs.—Proc., vol. 54, no. 3, part 1, Mar. 1928, pp. 789-802, 12 figs. Accurate method of measuring flow, called "salt solution method," depends on dilution of salt liquid introduced at constant rate; this dilution may be measured chemically by titration, but better, perhaps, by its electrical conductivity; in its final development method requires knowledge only of total amount and intensity of salt solution introduced, and of time required for this mixing.

FOUNDATIONS

EXCAVATION. Tidal Marsh Excavation Aided by Well Points. Eng. News-Rec., vol. 100, no. 6, Feb. 9, 1928, p. 245, 2 figs. Well-point systems were used around pumping-station excavations, 28 by 48 ft. in plan and extending to depth of approximately 16 ft. below normal groundwater level; water was lowered by 8-in. centrifugal pump and level was maintained by 6-in. pump.

THEORY. The Science of Foundations—Its Present and Future, J. A. Holmes and J. Feld. Am. Soc. Civil Engrs.—Proc., vol. 54, no. 3, part 1, Mar. 1928, pp. 871-879, 1 fig. Although discussion relates particularly to foundations, it has, together with author's previous investigations, bearing on another engineering activity, viz.: investigation, design and construction of earth dams. Discussion of paper by C. Terzaghi, continued from Feb. issue of Proceedings.

FOUNDRIES

REFRACTORY MATERIALS FOR. The Selection and Use of Refractories for Iron Foundries, C. Presswood. Foundry Trade Jl., vol. 38, no. 596, Jan. 19, 1928, pp. 43-47 and (discussion) 47, 3 figs.

G

GAUGES

WESTINGHOUSE PLANT. Inspection Devices in the Westinghouse Plant, W. H. Miller. Machy. (N.Y.), vol. 34, no. 7, Mar. 1928, pp. 501-503, 8 figs. More examples of 8,000 special inspection devices required in building electrical machinery and equipment at plant of Westinghouse Elec. & Mfg. Co.; two adjustable beam-type gauges; spherical and depth gauges for bearings; testing device for extension springs; fixtures for checking various drilling, boring and milling operations; checking squareness of commutator bars; device for checking flat springs.

GEARS

TOOTH MEASUREMENTS. Measurement of the Thickness of Involute Gear Teeth, A. H. Candee. Am. Mach., vol. 68, no. 9, Mar. 1, 1928, pp. 365-368, 3 figs. Formulas for pin measurement of gear-tooth thickness developed; measuring distance across round pins or plugs placed between teeth on opposite sides of gear to determine tooth thickness; tables from which dimension across pins for standard involute spur gears can be obtained very easily; direct methods of calculation given for special cases of spur gears and for helical gears.

GEOPHYSICAL EXPLORATION

METHODS. Geophysical Methods of Prospecting, A. S. Eve and D. A. Keys. Min. Rev., vol. 29, no. 22, Feb. 29, 1928, pp. 7-15 and 18, 27 figs.

EOTVOS GRAVITY EFFECTS. The Computation of Eotvos Gravity Effects, E. Lancaster-Jones. Am. Inst. Min. and Met. Engrs.—Tech. Pub., no. 75, Mar. 1928, 25 pp., 10 figs.

WORKING METHODS. Working Methods of Practical Geophysics, H. Haalck. Am. Inst. Min. and Met. Engrs.—Tech. Pub., no. 64, 9 pp.

GRINDING

CYLINDRICAL. Recent Practice in Cylindrical Grinding. Automobile Engr., vol. 18, no. 238, Feb. 1928, pp. 56-59, 9 figs. Examples of modern equipment for reducing cost; application of self-contained motor drive; grinding operations on boring bar 48 in. long; plunge-cut grinding; saddle-type grinder fitted with wide wheel or plunge-cut wheel head for grinding tapered end of axle shaft.

SURFACE. Precision Surface Grinding, E. C. Larke and F. C. Smith. Machy. (Lond.), vol. 31, no. 799, Feb. 2, 1928, pp. 579-581, 6 figs. Design of drill jig for accurate work; end face tested for parallelism with machined slot; grinding columns; obtaining accurate relative planes; figured vice jaws to enable compound gap to be milled in square compartment, shaped vees functioning as gripping units; grinding compound gaps.

H

HARDNESS TESTS

BRINELL. Does Hardness Govern? E. Bremer. Foundry, vol. 56, no. 3, Feb. 1, 1928, pp. 106-108. Points out that correlating of Brinell hardness with other hardness qualities is complicated; it is believed that definite steps should be taken to investigate various relationships and establish Brinell hardness test as indicator of certain qualities on standard basis; need for this is exemplified in number of replies received in answer to letters requesting information on value of Brinell test.

HARDNESS TESTING MACHINE. An Improved Hardness Tester. Iron Age, vol. 121, no. 9, Mar. 1, 1928, pp. 602-603, 4 figs. Accurate and proportional Brinell numerals claimed for British machine developed by Vickers, Ltd.; diamond pyramid indenter pressed into work under low load and at automatically controlled rate; machine is superior for metals of great hardness, and is applicable to finished work and very thin sheets; specially designed micrometer ocular provided; details of operating machine.

HEATING

RADIANT. Radiant Heating, A. H. Barker. Elec. Rev., vol. 102, no. 2619, Feb. 3, 1928, pp. 211-212 and (discussion) 212-213. General survey of heating problem, and description of some of more modern methods of radiant heating; radiant methods of heating divided into two classes, high-temperature, or incandescent, methods, and low-temperature, or distribution, methods; discusses various methods evolved for application of this form of heating, particularly use of metal panels on walls and ceilings, which, in addition to being heated by means of hot-water pipes, lend themselves to use with gas or electricity as heating medium and would probably become very general. Paper read before Royal Soc. of Arts.

HIGH-SPEED STEEL

QUENCHING. What Happens When High-Speed Steel Is Quenched? B. H. De Long and F. R. Palmer. Am. Soc. Steel Treating—Trans., vol. 13, no. 3, Mar. 1928, pp. 420-430 and (discussion) 430-434, 11 figs. Deals with metallography of high-speed steel when tempered at 1,100 deg. Fahr. after cooling during quenching to varying temperatures below 1,300 deg.; high-speed tools tempered (drawn) before being allowed to become sufficiently cold in quench are brittle due to mixed structures; straightening of high-speed tools may be readily carried out during quenching at between 1,300 and 700 deg.

HYDRAULIC TURBINES

HIGH-HEAD. Western Conditions Responsible for Development of High-Head Reaction Turbines, E. M. Breed. Hydraulic Eng., vol. 4, no. 2, Feb. 1928, pp. 74-76, 82 and 110-111, 8 figs. Unusual problems of design encountered when first high-head reaction turbines were considered for development; required very definite departure from accepted low-head turbine design; efficiency curve of high-head, low specific speed-reaction turbine; this type of unit permits very high efficiencies over wide range of load capacities; describes latest-type turbine installed in Portland Elec. Power Co., Oak Grove plant, Calif.

HYDRO-ELECTRIC POWER DEVELOPMENTS

BOULDER CANYON PROJECT. The Boulder Canyon Project. Elec. World, vol. 91, no. 6, Feb. 11, 1928, pp. 297-301. Proposed project includes: Dam in Colorado at Black Canyon, not far from Las Vegas, Nev., creating reservoir with storage capacity of 26,000,000 acre-ft. estimated at cost $41,500,000; power house with 1,000,000 h.p. of installed capacity, estimated to cost $31,500,000; All-American Cnaal, estimated at $31,000,000, located just north of Mexican boundary, starting from Laguna dam in Colorado at Yuma.

HYDROGEN

ATOMIC, USE IN RESEARCH. Atomic Hydrogen as an Aid to Industrial Research, I. Langmuir. Science, vol. 67, no. 1730, Feb. 24, 1928, pp. 201-208. History of gas-filled lamp research work at laboratory of General Electric Co.; peculiar phenomena observed in studying effect of hydrogen; studies of heat losses from filaments of various diameters at incandescent temperatures; invention of gas-filled lamp is nearly direct result of experiments made for purpose of studying atomic hydrogen. Address given at joint meeting of Soc. of Chemical Industry, Société de Chimie Industrielle, American Chemical Soc. and American Electrochemical Soc.

I

INDUSTRIAL MANAGEMENT

PRODUCTION CONTROL. Handling Large Production in Metal Stamping, R. Schmidt. Am. Mach., vol. 68, no. 9, Mar. 1, 1928, pp. 357-358, 5 figs. Large-scale production of sheet-metal parts invariably requires rapid movement of work in process and quick turnover of material; methods of Westinghouse Elec. & Mfg. Co. in controlling its press department; 20,000 separate items in process of manufacture every month; ratio of non-productive labour and of material higher than plant average, and must be off-set by rapidity of handling work in production.

Production Control in Pump Plant, S. G. Koon. Iron Age, vol. 121, no. 8, Feb. 23, 1928, pp. 521-524, 3 figs. Control of production in manufacture of considerable line of pumps of various descriptions is handled by Nash Engineering Co., South Norwalk, Conn.; for most part, all production machines in plant are scheduled for some time in advance, some of schedules running as far ahead as two months; visual control board occupies entire side of good-sized room and from floor to ceiling.

REORGANIZATION. Reorganization Under Scientific Management, W. R. Williamson. Soc. Indus. Engrs.—Bul., vol. 10, no. 1, Jan. 1928, pp. 3-26, 17 figs.

INSULATING OIL

ELECTRICAL. Electrical Insulating Oil, D. Harvey. Elec. Jl., vol. 25, no. 2, Feb. 1928, pp. 96-99, 3 figs. Requirements for insulating oil; production involves selection of suitable crude oil, its distillation, treatment, testing and delivering to customer in good condition; storage; placing oil in service; inspection and testing; sampling oil from shipping containers; causes of deterioration in transformers and in circuit breakers. (To be continued.)

INSULATORS, ELECTRIC

HUMIDITY EFFECT. The Effect of Humidity on the Dry Flashover, J. T. Littleton, Jr., and W. W. Shaver. Am. Inst. Elec. Engrs.—Jl., vol. 47, no. 3, Mar. 1928, pp. 189-192, 6 figs. Shows that humidity affects considerably flashover voltages of porcelain and pyrex insulators; flashover potential rises as humidity is increased; tests were made on pin-type insulators and on rods; results show that this rising characteristic is surface effect which varies with absolute water content of surrounding atmosphere.

INTERNAL-COMBUSTION ENGINES

INDICATOR FOR. An Electrical Indicator for High-Speed Internal-Combustion Engines, J. Obata and Y. Yosida. Tokyo Imperial Univ., Aeronautical Research Inst. Report, vol. 2, no. 28, Dec. 1927, pp. 397-405, 10 figs. Indicator described of simple disk form; very thick steel disk, 2 mm. thick and 5 cm. in diam.; extremely sensitive electrical means of measuring; generating valve circuit for recording minute motion of thick disk caused by pressure in cylinder; records of actual engine pressure obtained by means of Einthoven string-galvanometer, Lutz-Edelmann string electrometer and Duddell oscillograph.

PERFORMANCE TESTING. Improving Engine Performance, H. M. Jacklin. Soc. Automotive Engrs.—Jl., vol. 22, no. 3, Mar. 1928, pp. 337-344, 13 figs. Tests to secure improvement of internal-combustion engine performance; multiple ignition increases power about 9 to 10 per cent at full throttle and generally gives smoother operation; increasing compression ratio from 5.3 to 1 to 10 to 1 resulted in 13 per cent increase in power; operating engine on constant-compression principle resulted in fuel saving of as much as 34 per cent; fixed spark is entirely feasible under constant-compression operation.

PISTONS, ALUMINUM-ALLOY. Aluminum-Alloy Pistons in Gasoline and Oil Engines, H. A. Huebotter. Soc. Automotive Engrs.—Jl., vol. 22, no. 3, Mar. 1928, pp. 325-330, 8 figs. Aluminum-alloy pistons are now also made for oil engines with bores up to 18 in., as well as for small gasoline engines; expansion controlled by steel bands embedded in aluminum but not bonded thereto; slots cast in piston allow for linear expansion of alloy without corresponding increase in piston diameter and change in cylinder clearance; advantages of strut-type pistons shown by thermal diagrams.

THERMAL EFFICIENCY. Comment on Report of Heat Engine Trials Committee, D. Clark. Gas and Oil Power, vol. 23, no. 269, Feb. 2, 1928, pp. 85-87, 4 figs. Discussion of ideal efficiency standards for four distinct engine cycles; constant-volume, constant-pressure, Diesel and Atkinson cycles; abstract of paper brought forward for discussion at Institution of Civil Engineers; method of calculating formula for Diesel cycle; Atkinson cycle quite unsuitable for any engine of any other cycle.

Standards of Thermal Efficiency for Internal Combustion Motors, D. Clark. Instn. Civil Engrs.—Proc. (Lond.), no. 4670, 1928, 18 pp., 4 figs. Discussion of report of Heat Engine Trials Committee; ideal efficiency standards for four distinct engine cycles; constant-volume, constant-pressure, Diesel and Atkinson cycles taken up; points in which author disagrees with Committee and new values computed for them; necessity of calculating temperatures corresponding to each cycle; Committee's proposal to adopt Atkinson cycle instead of actual cycle of operation as standard for all types of engine criticized.

WASTE-HEAT RECOVERY. Waste-Heat Recovery and Engine Economy, W. P. Sillince. Oil Eng. and Technology, vol. 9, no. 1, Jan. 1928, pp. 19-21. Several successful exhaust-heat boilers, usually of tubular type, having efficiencies of from 50 to 75 per cent are on market, generating steam under pressures up to 180 lb. per sq. in. from exhaust gases of internal-combustion engines; certain electricity-generating stations using mixed internal-combustion engines and steam plant apply exhaust from former to heat feedwater for latter.

See also Airplane Engine; Automobile Engines; Diesel Engines; Oil Engines.

IRON CASTINGS

HEAT TREATMENT. Grey Iron Castings Heat-Treated. Iron Age, vol. 121, no. 10, Mar. 8, 1928, pp. 663-664, 3 figs.

IRON-CHROMIUM ALLOYS

INVESTIGATION OF. The Alloys of Chromium and Iron. Metallurgist (Supp. to Engineer, Lond.), Feb. 24, 1928, pp. 26-28, 2 figs. Reviews investigations made by Oberhoffer and Esser at Aachen (Stahl u. Eisen, Dec. 1, 1927), who, with aid of X-ray examination, have endeavored to rectify somewhat tentative conclusions of earlier work of Pakulla and Oberhoffer; great advance made by these investigations in knowledge of chromium-iron system is to be attributed largely to their perfection of technique of high-temperature melting under vacuum conditions.

L

LIFTING MAGNETS

DESIGN AND CONSTRUCTION. The Design and Construction of Lifting Magnets. Mech. World, vol. 83, no. 2142, Jan. 20, 1928, p. 47, — figs. Lifting magnets for handling materials in iron and steel industry; subjected to arduous service and rough handling; body of modern magnet made of high permeability dynamo steel; assembly; magnet subjected to 20-in. vacuum then pressure of 100 lb.; result of moisture in interior of magnet; lifting capacities.

LIGHTING

FACTORY. An Investigation of Electric Lighting in the Engineering Industry, J. L. H. Cooper. Illum. Engr., vol. 21, Jan. 1928, pp. 5-13 and (discussion) 13-15, 14 figs. Results of investigation in large industrial area; general attitude of employers to lighting; large engineering and manufacturing concerns more progressive; average hours of artificial light; requirements of good illumination; cleaning of lamps and equipment; daylight lamps; indirect glare in workshops; erecting shops; lighting machine tools; local lighting in machine shops. Paper read before Illum. Eng. Soc.

Lighting of High Bays in Industrial Plants, D. H. Tuck. Indus. Eng., vol. 86, no. 2, Feb. 1928, pp. 60-61, 7 figs. Tabloid presentation with illustrations of schemes for lighting high bays in shops with craneways.

LOCOMOTIVE BOILERS

DESIGN. The Design and Proportion of Locomotive Boilers, C. A. Brandt. Ry. Age, vol. 84, no. 10, Mar. 10, 1928, pp. 575-579, 7 figs. Discusses problems of boiler and superheater, or steam-producing part of locomotive; design of boiler and superheater determine not only efficiency at which steam is produced, but also efficiency and capacity of locomotive; speed factor; general boiler design; watertube firebox; results obtained with superheater.

LOCOMOTIVE REPAIR SHOPS

ILLINOIS CENTRAL SYSTEMS. A Modern Boiler Shop for Railroad Repairs. Am. Mach., vol. 68, no. 9, Mar. 1, 1928, pp. 373-375, 8 figs. Layout of boiler shop of Illinois Central System and some of production equipment used in making repairs; machines for hot and cold flanging; 2,100-ton Southwark flanging press and 66-in., 100-ton Chambersburg sectional flanging press hydraulically operated; radial drill mounted on rails; automatic machine for drilling staybolts; machine for grinding superheater joints.

Illinois Central Occupies Modern Railway Shops at Paducah, F. W. Curtis. Am. Mach., vol. 68, no. 8, Feb. 23, 1928, pp. 327-328, 4 figs.

LOCOMOTIVES

OIL-BURNING. Furnace Conditions in Oil-Burning Locomotives, G. M. Bean. Pac. Ry. Club—Proc., vol. 11, no. 9, Dec. 1927, pp. 9-23. Study of conditions in oil-burning locomotive furnace because it offers problems not met with in use of other fuels; what is required in furnace designed for proper handling of liquid fuel; flame study as pertaining to furnaces operating in higher temperature ranges.

OIL-ELECTRIC. Battery-Oil-Electric Locomotive. Ry. Age, vol. 84, no. 9, Mar. 3, 1928, pp. 525-527, 3 figs. Novel type of motive power is being tried by New York Central for operation in freight yards on west side, New York City; locomotive is equipped with storage battery of relatively large capacity; 300-h.p. oil-engine direct connected to 200-kw. generator is provided for charging battery; third-rail shoes are provided and also overhead collector; mechanical design; traction motors.

LUBRICATING OILS

AUTOMOTIVE, VISCOSITY OF. Motor Oil Characteristics and Performance at Low Temperatures, R. E. Wilkin, P. T. Oak and D. P. Barnard, 4th. Soc. Automotive Engrs.—Jl., vol. 22, no. 2, Feb. 1928, pp. 213-220, 12 figs. Experimental study of viscosity characteristics of motor oils at low temperatures; their influence upon cranking torque and circulation within engine; circulation tests in engine equipped with comparatively small-mesh screen over pump intake; circulation not obtained until oil in sump attained pour-point temperature; free circulation requires oil, effective viscosity of which does not increase too rapidly at very low shearing stresses.

Numbers for Oil Viscosities. Soc. Automotive Engrs.—Jl., vol. 22, no.

3, Mar. 1928, pp. 323-324 and 395-396. Animated discussion at Standards Committee meeting for and against S.A.E. system of numbering lubricating oils; numbers represent viscosity, not quality; not afraid of competitors' advertising; implied endorsement of Society; might use numbers without Society initials; filler stations ignorant of truck requirements; reaction of oil-manufacturing division; best system suggested for recommending oils; small oil company would capitalize system; trial alone will prove system.

M

MAGNETIC FIELDS

Graphical Determination. Graphical Determination of Magnetic Fields, A. R. Stevenson, Jr., and R. H. Park. Gen. Elec. Rev., vol. 31, no. 2, Feb. 1928, pp. 99-109, 22 figs. Calculation of magnetic-flux distribution, particularly in current-carrying region; results of American and European research; theoretical considerations; calculation of flux leakage between poles in alternator with approximately parallel pole sides; point conditions in coplanar magnetic fields; application of method to polar co-ordinate systems. (To be continued.)

Graphical Determination of Magnetic Fields, A. R. Stevenson, Jr., and R. H. Park. Gen. Elec. Rev., vol. 31, no. 3, Mar. 1928, pp. 153-164, 18 figs. Summation of most important principles in brief rules for plotting flux in air, with particular reference to pair of alternator field poles; calculation of inductance from knowledge of vector potential. (Continuation of serial.)

MANGANESE STEEL

Machining. Machining Manganese Steel on a Commercial Basis, A. S. Martin. Iron Trade Rev., vol. 82, no. 9, Mar. 1, 1928, pp. 564-565. Tests on cutting capacity of new type of high-speed steel conducted by Firth-Sterling Steel Co.; cutting medium gives greater production than standard high-speed steels; cutting manganese steel; tests carried on under ordinary machine-shop conditions; chip formed was very tight and compactly curled ribbon of deep blue or brownish gunmetal colour; film chucking desirable.

METAL MINES AND MINING

Blasting. Liquid-Oxygen Blasting at Chuquicamata, Chile, H. C. Schultz and F. K. Middleton Hunter. Am. Inst. Min. and Met. Engrs.—Tech. Pub., no. 61, 1928, 16 pp., 14 figs.

METALS

Cutting. The Relation of Depth of Cut to Feed on a Shaper, D. L. Perkins. Am. Mach., vol. 68, no. 7, Feb. 16, 1928, pp. 305-306, 6 figs. Tests to determine on power-consumption basis, advantage or disadvantage of deep cuts with light feeds over shallow cuts with heavy feeds for different numbers of strokes per minute; cutting speeds of 9, 13 and 19 strokes per min.; 32-in. Invincible Type Gould & Eberhardt shaper, motor-driven and other instruments used; power consumption least with shallow cut and wide feeds.

Deformation. Plastic Deformation and Fracture of Metals, W. Rosenhain. Iron and Steel World, vol. 2, no. 2, Feb. 1928, pp. 105-110. Straining of crystal lattice, slip and orientation of crystals in cold-worked metal. From address before Int. Congress for Testing Materials of Amsterdam.

Fatigue. Fatigue Phenomena, H. J. Gough. Engineering, vol. 125, nos. 3240 and 3241, Feb. 17 and 24, 1928, pp. 200-201 and 232-233. Feb. 17: Review of first of series of Cantor lectures presented at Roy. Soc. of Arts; fatigue of metals is defined as behaviour of metals under repeated cycles of stress; mathematical theory of elasticity indicates clearly that uniform stress distribution would not be obtained at any cross-section where form or size was changing, and that, where change was rapid, stress concentration effect produced would be large. Feb. 24: Second Cantor lecture made special reference to single crystals; reviews three epochs in history of fatigue testing; one of more interesting phenomena is fact, regarded as definitely established, that metal subjected to repetitions of safe range of stress finally achieved state in which, although no further permanent set would appear, strain hysteresis was present, and would persist indefinitely without causing fracture of material.

Internal Stresses. Internal Stresses. Metallurgist (Supp. to Engineer), Jan. 27, 1928, pp. 7-8. Review of recent works by E. Maurer, G. Sachs and Goeler, published in German periodicals; most frequent type of failure is season cracking of drawn rods and tubes made of brass or other alloys of copper; steel and aluminum members are prone to similar failures, although to less marked extent; for removal of internal stresses, low-temperature annealing is found to be most effective method; risk of season cracking can be also materially reduced in case of rods, tubes and similar articles by certain mechanical treatment.

Properties. Interatomic Forces in Metals and Alloys, R. F. Mehl. Am. Inst. Min. and Met. Engrs.—Tech. Pub., no. 57, Feb. 1928, 16 pp., 2 figs. It is shown that data on compressibility and internal pressure furnish basis for analysis of hardness of pure metals; it is suggested that electron distribution around atom periphery probably introduces slip-resistance factor in addition to that of crystalline symmetry and interatomic forces.

Rolling. Metallic Flow During Rolling, C. H. Mathewson. Iron Age, vol. 121, no. 10, Mar. 8, 1928, pp. 666-667 and 710, 4 figs. Plastic flow of metal upon rolling or forging; formation of twins in original crystals is often earliest effect of overstrain; subsequent severe deformation is combination of two processes, viz., development of crystalline twins, and of slip along crystal planes; twinning is action requiring small atomic displacements; recrystallization starts at twin boundaries. Abstract of paper presented before Inst. of Metals.

X-Ray Analysis. X-Rays: A New Tool in the Foundry. Iron Age, vol. 121, no. 10, Mar. 8, 1928, pp. 655-656, 4 figs. Examination of X-ray before machining castings reveals hidden defects and reduces foundry costs; two cases cited; with grey iron or steel castings it is now possible to X-ray through thickness of 3½ in.; such flaws as blowholes, cracks, bubbles and foreign material are relatively easy to detect in one or two exposures; X-ray equipment of low cost utilized for aluminum-alloy castings; examining first run of castings.

High-Speed, High-Voltage X-Ray Diffraction Analysis of Metals, A. St. John. Am. Soc. Steel Treating—Trans., vol. 13, no. 3, Mar. 1928, pp. 485-492, 5 figs. Quick and convenient method of X-ray diffraction analysis is modification of usual "pinhole" method using tungsten radiation at 200,000 volts as in radiographing castings, so that powerful beam passes through ⅛ inch of steel; exposures of two hours or less are sufficient; method has been applied to brass, tin and steel in study of mechanical working, heat treatment, extrusion, aging and effect of exposure to gases.

MILLING CUTTERS

Standards. Milling Cutters and Arbors. Soc. Automotive Engrs.—Jl., vol. 22, no. 3, Mar. 1928, p. 321, 1 fig. Proposed keys and keyways standards submitted for review by industrial users; drawn up by Committee on Milling Cutters; table showing figures for diameter of arbor; nominal width of key, arbor and keyseat, bore and keyway and arbor and key.

MOTOR TRANSPORTATION

Ontario. Ontario Motor Transportation, G. S. Henry. Can. Engr., vol. 54, no. 6, Feb. 7, 1928, pp. 195-196. Review of highway situation in Ontario; mileage of each type of road; total expenditure; bus service; 480 licensed vehicles are operating in province; over 3,400 miles provincial highways, county and township roads are traversed daily by public vehicles, with monthly vehicle mileage of over 700,000. Abstracted from Ont. Gaz.

N

NIAGARA FALLS

Improvement. Measures Proposed to Distribute Flow Over Niagara Falls. Eng. News-Rec., vol. 100, no. 8, Feb. 23, 1928, p. 332, 1 fig. Summary of interim report of Special International Niagara Board made public by State Department; report is of importance as being first in which plans for improving Niagara Falls, which have been under discussion for some time, are given official recognition.

NOZZLES

Steam. Fifth Report of the Steam Nozzles Research Committee. Engineering, vol. 125, no. 3238, Feb. 3, 1928, pp. 147-148, 7 figs. Tests to determine effect of surface finish; and effect of shape of exit; tests were made under different conditions as to pressure range from those which had been previously used; pressure in receiver was maintained at about 60 lb. per sq. in. and initial pressure was adjusted to give velocities of steam jet at exit extending up to velocity of sound in steam; nozzles tested were convergent impulse nozzles, with nominal angle of 20 deg.

O

OIL ENGINES

Heavy-Oil. A 1,750-B.H.P. Six-Cylinder Heavy-Oil Engine. Engineer (Lond.), vol. 145, no. 3763, Feb. 24, 1928, pp. 200-204, 13 figs. Account of origin of design, its principal technical features, together with details of engine performance; supplied by General Electric Co.; makers claim for their engine that design of parts subjected to heat brings about satisfactory solution of problem of combustion-chamber construction, as method possesses means of dissipating heat without setting up harmful heat stresses.

OIL FUEL

Combustion. Propagation of Combustion in Carbureted Mixtures (La propagation de la combustion dans les mélanges carbures), R. Duchene. Génie Civil, vol. 92, no. 6, Feb. 11, 1928, p. 146, 2 figs. Photographic study of flame propagation in carbureted mixtures and effect of anti-knock elements.

ORDNANCE MANUFACTURE

Watertown Arsenal. Making Big Guns at the Watertown Arsenal, J. B. Nealey. Machy. (N.Y.), vol. 34, no. 7, Mar. 1928, pp. 542-545, 10 figs. Some of unusual equipment and few of outstanding operations; guns ranging in size from 1½ in. to 9½ in. are manufactured, starting with making of steel, for which three large open-hearth furnaces with all necessary auxiliary equipment are provided; heat treatment of gun forgings; laboratories are engaged in research and testing; new method of making guns without outer jackets.

OXY-ACETYLENE CUTTING

Economical. Factors Involved in Economical Gas Cutting, J. C. Anderson. Am. Welding Soc.—Jl., vol. 7, no. 1, Jan. 1928, pp. 22-30, 3 figs. Deals specifically with cutting performed on steel plates, but statements made are just as applicable to cutting operations on steel castings or forgings; with these important factors which affect cutting results recognized and put into practice and conscientiously followed, there will result economical use of oxy-acetylene process.

Speed with Oxygen. Cutting Speed with Oxygen, J. L. Anderson. Rly. Jl.. vol. 34, no. 3, Mar. 1928, pp. 29-30. Standard practice in computing cutting costs, in rating operators or in otherwise establishing values, to compare time, oxygen, fuel gas and labour cost in relation to square inches cut considering one cut surface only; table is presented giving results obtained by seven different cutting operators working on same grade and thickness of material. Abstract of paper read before Univ. of Minn. Welding Conference.

OXY-ACETYLENE WELDING

Car Shops. Cutting and Welding in the Shop, W. A. Lacke and W. H. Dreis. Heat Treating and Forging, vol. 14, no. 2, Feb. 1928, pp. 150-151. Two papers that bring out importance of modern methods in car building and in manufacture of heavy machines; striking instances cited; piping from generators; cases of difficult jobs. Presented at Int. Acetylene Assn.

Power-Plant Piping. Welding of Power Plant Piping, A. W. Moulder. Welding Engr., vol. 13, no. 2, Feb. 1928, pp. 27-31, 9 figs. Research of pipe fabricator has developed design and procedure which insure satisfactory results on every welded installation; deals particularly with oxy-acetylene welding, but data may be equally applicable to arc welding; proper materials, tools, methods and instruction; shape of welded fillet; testing of welders; behaviour of welds under high pressures and temperatures. Paper presented at joint meeting of Am. Soc. Mech. Engrs. and Am. Welding Soc.

P

PAVEMENTS

Asphalt, Concrete Base. Concrete Base for Asphalt Pavements, R. M. Green. Can. Engr., vol. 54, no. 6, Feb. 7, 1928, pp. 199-201. Recent researches in Portland cement concrete and their application to design of bases for asphalt pavements; points out essential differences between use of Portland cement concrete as wearing surface and its use as foundation medium for asphalt pavement, and explains why recent researches in use of concrete for wearing surface are only of very limited value to designer of concrete base for asphalt pavement. Paper presented before Asphalt Paving Conference.

Asphaltic Concrete. Asphaltic Concrete Paving Practice in Denver, Colo. Eng. News-Rec., vol. 100, no. 6, Feb. 9, 1928, pp. 141-142, 2 figs. Black-base construction giving good service on more than 100 miles of streets paved in four years; pavement design; stone, crushed gravel or slag, is employed for sub-base and for aggregate; construction methods; conclusions from experience.

PERMEAMETERS

Saturation. Saturation Permeameter, S. L. Gokhale. Am. Inst. Elec. Engrs.—Jl., vol. 47, no. 3, Mar. 1928, pp. 196-200, 9 figs. Device for speedy and accurate measurement of saturation value of magnetic material.

PORTS

Quebec. The Port of Quebec, B. Cunningham. Engineering, vol. 125, no. 3240, Feb. 17, 1928, pp. 183-185, 8 figs. partly on p. 198. Notes on port approaches, accommodation and equipment; shipping and commerce; Wolfe's Cove terminal; historical notes on origin and development of Port Authority.

POWER

Purchased vs Generated. Analyzing Economies of Purchased Power, H. C. Thuerk. Elec. World, vol. 91, no. 9, Mar. 3, 1928, pp. 464-465. Study of power requirements of expanding industrial plant shows that it is cheaper to buy power than to make it.

POWER PLANTS, HYDRO-ELECTRIC

British Columbia. Power Development at Bridge River, B.C. Can. Engr., vol. 54, no. 6, Feb. 7, 1928, pp. 193-195, 5 figs. Preliminary work on hydro-electric power development for British Columbia electric railway; first step in project which will add approximately 625,000 h.p. to company's resources on mainland; contract let for 2½-mile tunnel; Bridge river project consists of diverting waters of Bridge river through tunnel into Seton lake and utilizing head, thus made available, for production of hydro-electric power.

POWER PLANTS, STEAM

High-Pressure. Operating Experience with High-Pressure and High-Temperature Steam, G. A. Orrok. Power, vol. 67, no. 8, Feb. 21, 1928, pp. 339-341. Author has endeavoured to collect particulars of all high-pressure installations in operation or under construction at present time and these data are given in table.

POWER PLANTS, STEAM-ELECTRIC

High-Pressure. Operating Experiences with 1,300-Lb. Pressure, J. Anderson. Power Plant Eng., vol. 32, no. 4, Feb. 15, 1928, pp. 229-232, 4 figs. Summary of operating experiences and difficulties encountered during period of 11 months at Lakeside station, Milwaukee, Wis.; experiences with tube failures from scale formation; boiler-tube corrosion troubles; chemical control of feedwater and resulting correction of trouble. Abstract of paper presented before Inst. of Fuel, London.

Norfolk, Va. Reeves Avenue Station at Norfolk, Va., J. W. Keeney. Elec. Light and Power, vol. 6, no. 3, Mar. 1928, pp. 28-29, 2 figs. Virginia Elec. and Power Co. builds $5,000,000 addition and installs new 40,000-kw. unit; all equipment pertaining to boiler and stoker operation is automatically controlled; completed plant has total generating capacity of 90,000 kv.a.; 7-mile steel tower transmission line was built, is insulated for and operates at 110,000 volts.

PRESSURE VESSELS

Welding. Fabricating Pressure Vessels from Inch-and-a-Quarter Plate. Iron Trade Rev., vol. 82, no. 10, Mar. 8, 1928, pp. 622-623, 4 figs. Construction of pressure vessels, 6 ft. in diameter by 26 ft. in length, and designed for 300-lb. operating pressure; welding reinforcing ring to manhead; welding of head seam; providing for contraction. Abstract from Oxy-Acetylene Tips.

PULVERIZED COAL

Drying. Importance of Drying Coal for Pulverizing. Power Plant Eng., vol. 32, no. 6, Mar. 15, 1928, pp. 341-344, 8 figs.

PUMPING STATIONS

Intake Pipes. Intake Well Forms Sand Catcher. Eng. News-Rec., vol. 100, no. 6, Feb. 9, 1928, p. 249, 3 figs.

R

RAILROADS

Operation. Report of Economics of Railway Operation. Ry. Age, vol. 84, no. 9C, Mar. 8, 1928, pp. 560, D131-D135. What volume of business justifies change from flat to hump switching; railway operation affected by motor trucks and bus lines. Abstract of report to Am. Ry. Eng. Assn.

Signals and Signaling, Automatic. Direct Current Automatic Block Signaling. Am. Ry. Assn. (Signal Section)—Proc., vol. 25, no. 3, Feb. 1928, pp. 576-586. Report of Committee IV. Specification for wood trunking and capping; requisites for d.c. automatic block-signaling circuits.

Alternating Current Automatic Block Signaling. Am. Ry. Assn. (Signal Section)—Proc., vol. 25, no. 3, Feb. 1928, pp. 455-470. Report of Committee VIII. Signal lighting and rectifier transformers; a.c. current circuits and apparatus as applied to train control; protection from lightning.

Signals and Signaling, Instructions. Instructions. Am. Ry. Assn. (Signal Section)—Proc., vol. 25, no. 3, Feb. 1928, pp. 471-534, 30 figs. Report of Committee V. Specifications for portable a.c. current voltmeters; instructions for installation and operation of switchboards; symbols, aspects and indications; transformers; definitions for technical terms used in signaling.

Snow Fences. Building Snow Fences of Trees. Ry. Eng. and Maintenance, vol. 24, no. 2, Feb. 1928, pp. 67-68, 6 figs. Canadian Pacific has found them effective as well as attractive; how trees are planted.

Ties, Maintenance. Care of Ties Pays Large Returns on the Lackawanna, G. J. Ray. Ry. Eng. and Maintenance, vol. 24, no. 2, Feb. 1928, pp. 59-61, 1 fig. Analysis of results secured from comprehensive programme of protection against decay and mechanical injury; large tie plates essential; records of renewals; savings effected; summary of advantages; explanation of low renewals; status of screw spikes.

REFRACTORIES

Properties of. The Important Properties and Requirements of Some Special Refractories, M. F. Beecher. Am. Soc. Steel Treating—Trans., vol. 13, no. 3, Mar. 1928, pp. 473-483 and (discussion) 483-484 and 492, 2 figs. Author points out how fused alumina, silicon carbide and combinations of silica and alumina as now manufactured offer properties which are superior to those of clay refractories; these manufactured refractories are all electric-furnace products and are obtained under variety of trade names; common causes of failure in refractories.

RESERVOIRS

Gunite Lining. Relining Payson Park Reservoir. Pub. Works, vol. 59, no. 2, Feb. 1928, pp. 49-51, 3 figs.

Concrete, Construction. Concrete Control Methods in the Construction of a Filtered Water Reservoir, W. C. Mabee. Am. Water Works Assn.—Jl., vol. 19, no. 2, Feb. 1928, pp. 193-200.

RETAINING WALLS

Earth Pressure. Graphical Determination of Earth Pressures (Détermination graphique de l'action des terres), R. de Diesbach. Schweizerische Bauzeitung (Zurich), vol. 91, no. 6, Feb. 11, 1928, pp. 69-72, 5 figs. Statical theory of retaining walls; graphical determination of stability of retaining wall with back batter on basis of Resal theory. (To be continued.)

RIVERS

Improvement, St. Lawrence. The Improvement of the River St. Lawrence, E. W. Lane. Engineering, vol. 125, no. 3239, Feb. 3, 1928, pp. 125-128, 3 figs. Deals with Soulanges and Lachine rapids sections; improvements of Great Lakes; effects of Chicago diversion and channel enlargement; methods of improving lake levels; improvement by compensation works; channel deepening; improvements on Montreal harbour and lower St. Lawrence; maps of sections discussed. (Concluded from Jan. 27.) See also editorial comment on pp. 137-138.

ROADS

Bituminous-Concrete, Hot-Mix. Hot-Mix Plant Layout. Contractors' and Engrs'. Monthly, vol. 16, no. 2, Feb. 1928, pp. 104-105, 6 figs. Duplicate plant built for State Highway bituminous-concrete projects near Chatham on Cape Cod; State Highway Department of Mass. has used hot-mix for greater part of its Cape Cod work; sand production; hot-mix plant.

Concrete, Construction. Recent Practical Development in Concrete Road Construction, J. E. Foster. Contract Rec. (Toronto), vol. 42, no. 8, Feb. 22, 1928, pp. 201-204, 7 figs.

ROLLING MILLS

Disk. Disk Rolling, with Special Reference to Steel Differential Cases. Iron Age, vol. 121, no. 10, Mar. 8, 1928, p. 659, 1 fig. New method of steel working found in production of steel differential case for automobiles; machines rolled radially; production of about 10 disks per minute; proper speed relation to prevent distortion; each disk driven by 150-h.p. motor; provision for lubrication.

ROOFS

Reinforced Concrete. Reinforced Concrete Roof Construction. Concrete and Constr. Eng., vol. 23, no. 2, Feb. 1928, pp. 176-179, 7 figs. In Germany, one of latest developments in roof construction is to use cement gun for covering roofing surfaces supported by concrete framework.

S

SANITARY ENGINEERING

Symposium. Historic Review of the Development of Sanitary Engineering in the United States During the Past One Hundred and Fifty Years. A Symposium, G. S. Webster, M. Knowles, R. A. Hart, L. L. Hidinger and R. N. Towl. Am. Soc. Civ. Engrs.—Proc., vol. 54, no. 2, Jan. 1928, pp. 303-310. Discussion symposium continued from Dec. 1927 issue of Proceedings.

SEWAGE DISPOSAL

Activated Sludge Method. The Dissolved Oxygen Absorption-Time Relation of Activated Sludge Effluents, P. Gaunt and W. E. Abbott. Chem. and Industry, vol. 47, no. 2, Jan. 13, 1928, pp. 14T-16T, 1 fig.

Sludge Digestion. Deep-Pit Sludge Digestion at Indianapolis Sewage-Works, C. K. Calvert. Eng. News-Record, vol. 100, no. 6, Feb. 9, 1928, pp. 230-231, 1 fig.

SEWAGE DISPOSAL PLANTS

Delaware, Ohio. The Sewage Treatment Works at Delaware, Ohio, W. L. Havens. Am. City, vol. 38, no. 3, Mar. 1928, pp. 78-80, 2 figs. Description of new works, designed to serve population of 14,500 persons; type of plant; pumping equipment; clarification of the sewage by Imhoff tanks; disposal of sludge.

SEWERS

Storm-Water Overflows. Some Details of Storm-Water Sewer Overflows, A. Wells. Eng. News-Rec., vol. 100, no. 10, Mar. 8, 1928, pp. 402-404, 5 figs. Actual examples from practice at Hartford, Conn., with explanations of local governing conditions; considerations that enter into selection of type of overflow suitable in particular location; required features.

Flow Control. Automatic Sewage Flow. Pub. Works, vol. 59, no. 2, Feb. 1928, p. 78. Motor-controlled sluice gate diverts flow from tributary to outfall sewer when flow in either reaches predetermined amount; there has recently gone into operation in England project which includes interesting features provided for controlling flow from one sewer to another.

SHAFTS

Force Fits. Researches Dealing with Force Fits of Steel Shafts. Soc. Mech. Engrs. (Japan)—Jl., vol. 31, no. 129, Jan. 1928, pp. 13-38, 20 figs. Experimental researches dealing with force fits of steel shafts on steel and cast-iron bosses; limiting value of allowances which practically produce permanent set on bosses; if greater allowance than limiting value should be given, both force-fit pressure and slipping resistance can never be increased at same rate; limiting value of allowance depends on material only and not on radial thickness of bosses. (In Japanese.)

SHAPERS

Power Required for Cutting. Relation of Shaper Stroke to Power Consumed, D. L. Perkins. Am. Mach., vol. 68, no. 10, Mar. 8, 1928, pp. 427-428, 5 figs. Tests showing that power decreases for increase in length of stroke; variations given for power consumed in removing definite amounts of metal at approximately constant cutting speed but for different lengths of stroke; curves show maximum power consumption on shaper with strokes of 4, 8, 12 and 18 in. for various materials under cut.

SIPHONS

Steel Pipe. Mono-Bear Creek Siphon, E. R. Davis. West. Constr. News, vol. 3, no. 4, Feb. 25, 1928, pp. 111-115, 3 figs. Big Creek-San Joaquin hydro-electric project of Southern California Edison Co.; construction of steel pipe siphon, containing approximately 5,500 tons of steel, 13,806 ft. in length; varies in diam. from 72 to 102 in. and thickness from ⅜ to 1 in.; pipe was fabricated in 17.25-ft. lengths.

SPILLWAYS

Ice Prevention. Ice Prevented Along Spillway by Compressed Air, F. A. Dale. Elec. World, vol. 91, no. 10, Mar. 10, 1928, p. 487, 2 figs. Compressed-air system for preventing ice formation along spillway flashboards has been in successful operation for two winters on Tippecanoe river in Indiana at Norway plant of Indiana Hydro-Electric Power Co.

STEAM APPARATUS

Temperature Control. Tag Steam Operated Controller. Instruments, vol. 1, no. 2, Feb. 1928, pp. 119-120, 3 figs. Device which utilizes portion of steam which heats apparatus to obtain enough power to work valve, opening and closing of which governs temperature of apparatus where one best temperature must be maintained; controller designed to operate on pressures between 5 and 100 lb.; furnished with 40-deg. range anywhere between limits of 95 and 290 deg. Fahr.

STEAM ENGINES

Uniflow vs. Counterflow. Counterflow and Uniflow Non-Condensing Engine Economies, A. D. Skinner. Power Plant Eng., vol. 32, no. 4, Feb. 15, 1928, pp. 259-261, 3 figs. Author refers to articles by A. J. Nicholas and A. F. Sheehan, published in previous issues of this journal; states that it is established fact that well-designed uniflow engine is more economical than even compound Corliss engine, either condensing or non-condensing, under varying loads which obtain in most power plants, to say nothing of its superiority over single-cylinder Corliss type.

STEAM GENERATION

Developments. Trend and Development in Steam Generation, T. E. Murray. Power Plant Eng., vol. 32, no. 5, Mar. 1, 1928, pp. 322-323. Author does not believe that it will ever be expedient to standardize on given steam pressure for power stations; reference to binary-vapour system and also to Hartmann boiler in which water in closed system is heated in furnace and circulated through coil in drum where it generates steam from independent source of water; Loeffler and Benson boilers.

STEAM GENERATORS

Design. New Steam Generator Installation. Combustion, vol. 18, no. 2, Feb. 1928, pp. 102-106 and 128, 4 figs. Installation at Morgan & Wright Detroit plant of U.S. Rubber Co.; features incorporated are full water-cooled combustion-chamber wall, integral with circulatory system of generator, practical elimination of brickwork in furnace, water-screen, tangential firing; these features are discussed.

Pulverized-Coal. Steam Generator. Feature at New Staley Plant, Decatur, Ill. Power Plant Eng., vol. 32, no. 4, Feb. 15, 1928, pp. 242-248, 11 figs.

STEAM HEATING

Vacuum. A New Idea in Heating of Buildings, M. W. Shears. Contract Rec., vol. 42, no. 7, Feb. 15, 1928, pp. 157-159. Differential vacuum system of steam heating explained; new scheme as far as Canada is concerned; effect of differential vacuum system; design of steam-piping system must be proportioned to heat demand of each radiator; to obtain wide range of heat emission, it is essential that steam be circulated through radiation under varying pressures and corresponding temperatures that will make possible this varying heat emission; operation of differential vacuum system.

STEAM TURBINES

EUROPE. Developments in European Steam Turbine Design, C. H. S. Tupholme. Power, vol. 67, no. 10, Mar. 6, 1928, pp. 419-421, 4 figs. Great efforts have been made by European designers to reduce heat consumption of these machines on account of rise in price of coal following World War and because of enormous increase in capacity of these units; latest design of Oerlikon Co., Switzerland, includes impulse type with, as a rule, partial admission in high-pressure part and full admission in low-pressure portion; acceptance test on 10,000-kw. turbine.

MIXED-PRESSURE. Developing Power from a Factory Waste. Power, vol. 67, no. 11, Mar. 13, 1928, pp. 465-467, 3 figs. Mixed-pressure turbine uses exhaust of steam hammers in Henry Vogt Machine Co.'s plant; reduction in power costs is enough to repay investment in short time; diagrams of old power layout and new hook-up.

STEAM REHEATING, EFFECT OF. Effect of Steam Reheating and Stage Feed Water Heating on Turbine Development, E. H. Brown. Power, vol. 67, no. 10, Mar. 6, 1928, pp. 443-444. Considerations given by turbine builder to problems that have arisen from application of reheat and regenerative cycles, with comment on boiler reheating vs. steam reheating. Paper presented before Mid-West Power Conference, Chicago.

STEEL

AIRCRAFT. Steel for Aircraft Construction, E. A. Richardson. Am. Inst. Min. and Met. Engrs.—Tech. Pub., no. 94, Mar. 1928, 19 pp. Principles of airplane construction; structural design; testing methods; construction practice; relative advantages of wood and metal; all-metal construction; promising steels; cost of materials. Brief abstract in Iron Age, vol. 121, no. 10, Mar. 8, 1928, p. 709.

PROPERTIES. A Contribution to the Theory of Hardening and the Constitution of Steel, Z. Jeffries. Am. Soc. Steel Treating—Trans., vol. 13, no. 3, Mar. 1928, pp. 369-404, 20 figs. Conclusions are adopted that carbon-steel austenite is gamma iron containing carbon in atomic dispersion; freshly formed carbon steel martensite is alpha iron containing carbon largely in atomic dispersion; carbon-steel martensite aged at room temperature or somewhat above contains myriads of particles of iron carbide; when acicular martensite forms orientations of new alpha iron grains have some relations to orientation of parent austenite.

STRENGTH AT HIGH TEMPERATURES. The Strength of Steel at Elevated Temperatures, with Particular Reference to Safety Factors, T. McL. Jasper. Power, vol. 67, no. 10, Mar. 6, 1928, pp. 446-447, 4 figs. Strain value in main cylinder, at unreinforced manways and ordinary dished head; strain values with reinforced manways and elliptical head; ordinary steel used in construction of pressure containers has yield point that is very pronounced; corrosion as factor; stress-time curves for two steels tested at 900 deg. Fahr. Abstract of paper read before Am. Petroleum Inst., Dec. 1927.

STEEL CASTINGS

SHRINKAGE. Shrinkage and Contraction of Steel Castings, C. W. Sherman. Can. Ry. and Mar. World, no. 360, Feb. 1928, p. 81.

STEEL, HEAT TREATMENT OF

HARDENING. The Mechanism of the Hardening of Steel, K. Honda. Fuels and Furnaces, vol. 6, no. 2, Feb. 1928, p. 191. Based upon extensive experimental investigation, author considers volume change during transformation of austentite into alpha martensite as most important factor in formation of dangerous cracks; thermic tension, on other hand, is of lesser importance; also considerable tension still exists in hardened steel. Translated from paper read at meeting of Raw Material Committee of Soc. of German Iron Founders.

HIGH-TEMPERATURE. High-Temperature Processes, J. C. Woodson. Purdue Univ. Eng. Extension Dept.—Bul., vol. 11, no. 1, June 1927, pp. 23-31. Brief summary of standard heat-treating processes that lie within temperature range of 1,000 to 2,000 deg. Fahr. and notes regarding perfected apparatus available; annealing; heat treatment of metals; carburizing; normalizing; case-hardening; malleabilizing; vitreous enameling of steel; vitreous enameling of cast iron; patenting of wire.

QUENCHING STEELS. Tempering Changes in Carbon Steel, R. Hay and R. Higgins. Roy. Tech. College—Jl., no. 4, Dec. 1927, pp. 62-76, 7 figs. Tempering for combustion; presents tables of standard setting heights for natural-determining Brinell hardness number, specific volume, yield stress, maximum stress, percentage elongation and Charpy impact value of specimens which had been water quenched from 1,000 deg. cent. and tempered from room temperature to 650 deg. cent. at 25 deg. intervals.

TEMPERATURE CONTROL. The Control of Temperature in Heat Treating, G. C. Davis. Heat Treating and Forging, vol. 14, no. 2, Feb. 1928, pp. 199-200. Final temperature of work being heated that is interesting; great steps forward have been made in approach to this ideal heating by growing use of liquids for heating; in case of carbon-steel hardening, there are great possibilities ahead for improving heating of work.

STOKERS

TRAVELLING-GRATE. Design and Application of Travelling-Grate Stokers, T. A. Marsh. Power, vol. 67, no. 8, Feb. 21, 1928, pp. 328-331, 5 figs. Natural-draught stokers; furnaces for natural-draught chain grate; supplying air for combustion; presents tables of stnadard setting heights for natural-draught chain grates, of test values with various fuels burned on natural-draught travelling stokers, and of operating records.

Design and Application of Forced-Draught Chain Grates, T. A. Marsh. Power, vol. 67, no. 10, Mar. 6, 1928, pp. 414-417, 6 figs. Forced-draught travelling grates are well suited to burning of following fuels: anthracite, coke breeze, bituminous coal (free burning), sub-bituminous coal, lignite; furnace designs for forced-draught stokers differ from those of natural-draught stokers in that not as much arch is required for ignition of given amount of coal; test results with anthracite and coke breeze; forced-draught chain-grate stoker tests.

STORAGE BATTERIES

CHARGING. The Constant-Potential System of Accumulator Charging, T. C. Gilbert. Elec. Rev., vol. 102, no. 2617, Jan. 20, 1928, pp. 94-97, 1 fig. Author discusses pros and cons of constant-pressure system of charging, and describes methods which he has found successful in practice; various difficulties enumerated indicate that straight constant-potential method requires skilled supervision, and, while difficulties are not serious, they may be completely eliminated by use of modified system of constant-potential charging.

STREET LIGHTING

GROUND RETURN. Ground Return for Series Street Lighting, J. A. Cook. Elec. World, vol. 91, no. 4, Jan. 28, 1928, pp. 201-202, 3 figs. Ground return for series street-lighting circuits is being successfully used by Lynn Co. in its recent extension of "White Way" lighting; one conductor per circuit is saved in underground cable system; lighting units on extension involve 2,500, 10,000 and 15,000-lumen incandescent lamps supplied by 20-kw., type "R.O." General Electric constant-current transformers, mounted on poles on side streets adjacent to underground district.

STREET TRAFFIC

CONTROL. Promoting the Best Use of City Streets, M. McClintock. Acra, vol. 19, no. 2, Feb. 1928, pp. 103-106. So far as congestion in larger American cities is concerned, city planning can never offer any very complete relief to problem, for reason that cost of such projects is far beyond capacity of any community to carry; other method of relief, generally called traffic control; too much red and too little green in traffic control; scientific routing of traffic needed; needless obstructions block street in busy hours, non-essential uses must yield to transportation needs.

STREETS

PAVEMENT WIDTHS. Pavement Widths. Mun. News, vol. 74, no. 1, Jan. 1928, pp. 27-28, 4 figs. Recommended for streets in Chicago region by Chicago Regional Planning Association; standards represent combined opinion of many engineers and officials of region and members of committee on highways of Chicago Regional Planning Assn. and also conform to standards now in use through United States.

STRUCTURAL STEEL

WELDING. Welding Trusses for Industrial Buildings, W. Vogel. Welding Engr., vol. 13, no. 2, Feb. 1928, pp. 33-35, 9 figs. Determination of definite strength values for structural welds makes it possible to design welded trusses with confidence.

SURVEYING

BENCH MARKS. A Combination Survey Monument and Bench Mark. Eng. News-Rec., vol. 100, no. 6, Feb. 9, 1928, p. 248, 2 figs.

BOUNDARY. Boundary Surveys, R. H. Randall and W. H. Halsey. Am. Soc. Civ. Engrs.—Proc., vol. 54, no. 2, Feb. 1928, pp. 746-749. Dsicussion of paper by C. T. Johnston, continued from Jan. 1928 issue of Proceedings.

T

TAPS AND DIES

THREAD MEASUREMENTS. Devices for Thread Measurements—Methods and Equipment for Accurately Gauging Tap Threads, A. L. Valentine. Machy. (Lond.), vol. 31, no. 794, Dec. 29, 1927, pp. 417-421, 10 figs.

Methods and Equipment for Accurate Gauging of Tap Threads, A. L. Valentine. Machy. (Lond.), vol. 31, no. 796, pp. 477-478, 4 figs.

TELEGRAPH

TRANSMISSION THEORY. Certain Topics in Telegraph Transmission Theory, H. Nyquist. Am. Inst. Elec. Engrs.—Jl., vol. 47, no. 3, Mar. 1928, pp. 214-216, 9 figs. Discussion of minimum frequency range required for transmission at given speed of signalling; in case of carrier telegraphy, discussion includes comparison of single-sideband and double-sideband transmission; sets forth results of theoretical studies of telegraph systems which have been made from time to time.

TELEPHONE LINES

CARRIER CURRENT. 220-Kv. Carrier-Telephony, R. B. Ashbrook and R. E. Henry. Elec. World, vol. 91, no. 10, Mar. 10, 1928, pp. 495-497, 4 figs. Southern California Edison Co. installation covers over 270 miles of 220-kv. transmission line; single-frequency duplex system with selective ringing used; outstanding advantage of system is that number of station can enter into full "party-line" communication; General Electric Co. type CC3D set is designed to give duplex conversation between similar sets, using the same frequency for transmission and reception; features of receiving equipment; operation of equipment.

TELEPHONES

AUTOMATIC. The Holborn Automatic Telephone Exchange. Engineering, vol. 124, no. 3233, Dec. 30, 1927, pp. 854-855, 3 figs. System of automatic telephony which is to be used in London is based on Strowger principle, combined with special piece of apparatus known as "director controller," which imposes call-storing and translating devices on Strowger step-by-step equipment, and thus gives practically same flexibility as is possible with panel system.

TELEVOX

ACTION OF. The Televox, R. J. Wensley. Tech. Eng. News, vol. 8, no. 8, Jan. 1928, pp. 340-342, 12 figs. Describes action of televox sending and receiving apparatus, how they act and function of televox in telephone work; diagrams of circuits are given and control scheme for operating substation equipment over telephone.

TEXTILE INDUSTRY

MANAGEMENT. Scientific Management in a Textile Business, H. P. Kendall. Taylor Soc.—Bul., vol. 12, no. 6, Dec. 1927, pp. 519-525. Notes on operating number of plants in different localities which are managed as horizontally and vertically integrated group carrying material from cotton bale to ultimate consumer, and which involve both continuous and intermittent processing.

TEXTILE MACHINERY

DESIGN. Important Influence of Rayon on the Design and Construction of Textile Machinery, F. W. Sturtevant. Textile World, vol. 73, no. 6, Feb. 11, 1928, pp. 29-30, 2 figs. Existing equipment refined to allow greater variety of constructions and better fabrics; shows how some of existing cotton, silk and wool machinery has been adapted to handle rayon; doubling and twisting machines; winding machinery; improvements in looms; dyeing equipment; finishing machinery.

TEXTILE MILLS

MANUFACTURING COSTS. Reduction of Manufacturing Costs by Labour Extension Methods Based on a Mill Survey, S. S. Paine. Textile Wld., vol. 73, no. 5, Feb. 4, 1928, pp. 152-153.

SERVICE EQUIPMENT. Interesting Structural and Equipment Features at New Plant of Chicopee Mfg. Corp. of Georgia. Textile Wld., vol. 73, no. 5, Feb. 4, 1928, pp. 408-409, 8 figs. Describes features of building construction and building equipment as heating, ventilating, humidifying, lighting; machinery installation is mentioned briefly.

THERMODYNAMICS

ENTROPY. The Concept of Entropy. Limits of Validity of the Second Law of Thermodynamics, R. Plank. Information on Refrigeration (Institut Int. du Froid)—Monthly Bul., nos. 9-10, Sept.-Oct. and Oct.-Nov. 1928, pp. 830-835. Points out that second law of thermodynamics is only law that is vectorial, all others being scalar; reversible and irreversible changes may be distinguished essentially by character of physical laws which govern them; application of theorem to steam engine and refrigerating machine. Abstract translated from V.D.I. Zeit., nos. 25 and 27, 1926, pp. 841 and 915. See reference to original article in Eng. Index, 1926, p. 735.

TOOLS

STANDARDIZATION. Advantages of Standard Tools for Quantity Production, M. E. Lange. Am. Mach., vol. 68, no. 6, Feb. 9, 1928, pp. 255-259, 20 figs. Examples of how careful planning can often save extra cost of special tools; special tools made costly by frequent changes in design of products; standard tools adapted to varying conditions and changes, and have longer useful lives; multiple turning head; large slide tool; no special tools used unless their reason for existence is proved on a " facts and figures " basis.

TOOL STEEL

SPECIFICATIONS. Tools and Tool Steel Specifications, E. S. Lawrence. Heat Treating and Forging, vol. 14, no. 1, Jan. 1928, pp. 26-31 and 37, 11 figs. Factors to be considered in specifying for purchase of tool steels; classification, chemical limits, hardening and tempering practice; importance of microscopic examination; presents table giving mechanical limits of carbon tool steels heat-treating features; photomicrographs. Bibliography.

TUBES, STEEL

HEAT TREATMENT. The Effect of Heat Treatment on Cold-Drawn Steel Tubes, F. C. Lea. Engineering, vol. 124, no. 3233, Dec. 30, 1927, pp. 831-834, 9 figs. Load-strain curves under repeated stress; types of failure; effect of pinch and sink on properties of tubes; cold-drawn tubes after final pass have low limit of proportionality, but strength is much higher than that of normalized material.

TUNNELS

SUBAQUEOUS. Construction Methods on Oakland Estuary Tube, S. W. Gibbs. Eng. News-Rec., vol. 100, no. 3, Jan. 19, 1928, pp. 100-105, 10 figs. Describes construction methods used on subaqueous tunnel between Oakland and Alameda, Calif., for vehicular and electric railway traffic; tubes 37 ft. in diam. and 203 ft. long were sunk to form tunnel under estuary; 90 ft. below surface of water.

V

VACUUM TUBES

DESCRIPTIONS. Vacuum Tubes as Oscillation Generators, D. C. Prince and F. B. Vogdes. Gen. Elec. Rev., vol. 31, no. 2, Feb. 1928, pp. 97-98, 2 figs. Design of simpler vacuum-tube circuits; vacuum-tube oscillating circuit contains certain amount of stored energy; energy-storage effect calculated; obtaining proper voltages and phase relations for leads to tube; Hartley circuit; determine volt-amperes in oscillating circuit; grid-leak resistance. (To be continued.)

Vacuum Tubes as Oscillation Generators, D. C. Prince and F. B. Vogdes. Gen. Elec. Rev., vol. 31, no. 3, Mar. 1928, pp. 147-152, 11 figs. Special considerations bearing on design and operation of oscillating circuits; grid phase-angle corrections; grid-bias condenser; intermittent oscillation; operating difficulties. (Continuation of serial.)

HIGH-VOLTAGES. Use of Very High-Voltage in Vacuum Tubes, W. D. Coolidge. Am. Inst. Elec. Engrs.—Jl., vol. 47, no. 3, Mar. 1928, pp. 212-213.

VEHICULAR TUNNELS (HOLLAND)

TRAFFIC CONTROL. Holland Tunnel Traffic Control System, J. P. Maxwell. Elec. Rec., vol. 43, no. 2, Feb. 1928, pp. 188-190, 3 figs. Plentiful supply of simple and easily understood signals coupled with complete supervisory system constitutes what is regarded as one of best traffic-control systems in existence; 4 kinds of traffic signals used; accident emergency trucks; fire alarms; signal voltage supply; traffic officer's signal station; supervisory control of lights; momentary contact relays.

VIADUCTS

REINFORCED-CONCRETE. Viaduct Design and Structure, S. Johannesson. Eng. News-Rec., vol. 100, no. 1, Jan. 5, 1928, pp. 5-8, 7 figs. Describes viaducts built and to be built on Holland tunnel highway in New Jersey for 25,000 ft.; 50 ft. roadway; minimum clearance of 14 ft. over public streets and 22 ft. over railroad tracks; foundations are concrete; 5,000 ft completed.

VOLTAGE REGULATION

CONTROL. System Voltage Control, C. P. Hubbard. Elec. World, vol. 91, no. 8, Feb. 25, 1928, p. 410. Control of voltage on Detroit Edison system from generator busbars to customers' outlets is direct responsibility of one man; load conditions are not permitted to affect voltages; system voltages are checked both by voltage charts and by periodical testing.

VOLTAGE REGULATORS

CONTROL BY. Voltage Control by Induction Regulators. World Power, vol. 9, no. 49, Jan. 1928, pp. 63-67, 7 figs. Economies effected by feeder-voltage control; kind of service for which induction regulator is particularly adapted; ring main regulation; operating principles of S. & C. induction regulator; strator cores and windings; 3-phase rotor core; inculation efficiency; oil and air cooled; tested for compliance with B.E.S.A. standards for pressure, dielectric resistance, over-potential, copper and iron losses, leakage, impedance and ratio; and to verify relation of boost to rotor angular displacement; methods of control.

VOLTMETERS

VACUUM-TUBE. A Two-Range Vacuum Tube Voltmeter, C. M. Jansky, Jr., and C. B. Feldman. Am. Inst. Elec. Engrs.—Jl., vol. 47, no. 2, Feb. 1928, pp. 126-132, 14 figs. Design, uses and limitations of new circuit employing three-element vacuum-tube as voltmeter; two overlapping ranges of voltage, together with single operating battery, are unique features; effect of wave form and elimination of that effect; presents schematic and wiring diagrams of voltmeter.

W

WALLS

BRICK-AND-TILE. Some Practices in Erecting Damp-Proof Tile-and-Brick Walls, P. H. Bevier. Eng. News-Rec., vol. 100, no. 7, Feb. 16, 1928, pp. 285-286, 1 fig.

CONCRETE—COLD WEATHER CONSTRUCTION. Sliding Forms Build Double Walls at High Speed. Eng. News-Rec., vol. 100, no. 10, Mar. 8, 1928, pp. 405-407, 7 figs. Four six-storey walls concreted in 12½ days, using 800 ft. of forms rising 4 in. an hour; speed of pouring and exposing concrete walls in cold weather illustrated in cold-storage plant at Cleveland, Ohio; building is 200 ft. square and 94 ft. high; concrete was exposed within nine hours after it was poured.

CONCRETE—MOVING. Reinforced Concrete Wall Moved 1,000 Ft. Eng. News-Rec., vol. 100, no. 6, Feb. 9, 1928, pp. 232-233, 3 figs. Forty sections of concrete fire wall surrounding oil tanks moved on rails to new location; steel oil tanks moved to new site by floating; wall is of vertical cantilever type with light steel reinforcement, having height of 11½ ft. and uniform thickness of 12 in.; base is 18 in. thick and extends 2 ft. on either side of centre line; sections into which wall was cut were 35 ft. long and weighed approximately 70 tons each.

WASTE

ELIMINATION OF. Four Basic Principles of Reducing Waste, W. I. Ferris. Factory, vol. 75, no. 2, Feb. 1928, pp. 311-313, 4 figs. Problem of saving losses in material solved; preventing spoiled work; reducing scrap; recovering most of unavoidable scrap and putting it immediately in best form for use over again; recovering eventually all that is possible of indefinite vanished waste; reduction of waste prime reason for designing many machines, jigs and other aids at plant of L. E. Waterman Co., of which author is vice-president.

WASTE HEAT

RECOVERY. Waste Heat Recovery, W. Gregson. Engineer (Lond.), vol. 145, no. 3763, Feb. 24, 1928, pp. 216-219, 6 figs. In first portion, author deals with theoretical and arithmetical aspects of waste-heat recovery in steel works, in gas works and on ships fitted with oil engines; in second portion, he deals with practical side of waste-heat recovery in same three connections. See also editorial comment on pp. 213-214.

WATER CHLORINATION

METHODS. Data on Applying Chlorine to Safeguard Water Systems, R. V. Donnelly. Water Works Eng., vol. 81, no. 3, Feb. 1, 1928, pp. 162-166. Steps in changing chlorine from liquid to gas; care of various mechanisms; some applications of chlorine in water works; solution and direct-feed systems; chlorine doses; some of uses for chlorine.

WATER FILTRATION PLANTS

DESCRIPTION. One Year's Operation of the Providence Filtration Plant, J. W. Bugbee and E. L. Bean. N.E. Water Works Assn.—Jl., vol. 41, no. 4, Dec. 1927, pp. 399-409 and (discussion) 410-412, 4 figs. Description of operation of Providence, R.I., filters, including analyses of water before and after filtration; quantities of coagulent used and quantity of water filtered; efficiency of filtration.

WATER METERS

TESTING. Loss of Head Through Three Types of Water Meters, C. W. Harris. Univ. of Wash. Eng. Experiments Sta.—Bul., no. 45, Aug. 15, 1927, pp. 5-30, 24 figs. Object of study was to determine amount of water capable of being delivered through average meter setting; test was made of ten separate meters, including three different makes and ranging in size from ⅝ in. to 2 in.; results of tests are shown by tabulations and diagrams.

WATER POWER

APPRAISALS. Water Power Appraisals, L. K. Sherman. Am. Soc. Civil Engrs.—Proc., vol. 54, no. 3, part 1, Mar. 1928, pp. 837-842. Points out some of pitfalls, precautions and need for experienced judgment in applying capitalized net-earnings method to secure reasonable indication of fair market value of water power right. Discussion of paper by W. H. Cushman in Feb. issue of Proceedings.

WATER SUPPLY

COSTS. Municipal Water and Sewerage Costs in Maryland, A. Wolman. N.E. Water Works Assn.—Jl., vol. 41, no. 4, Dec. 1927, pp. 439-448 and (discussion) 448-472, 1 fig. Outline of principles of financing of State Department of Health; fixed maintenance and operation costs with statistical table of municipal costs in Maryland, 1925-26; points out low cost of these utilities to consumer and user; summary of table and deductions; methods used by various cities in United States for financing sewage systems.

CROSS-CONNECTIONS. Present Practice in Cross-Connections in California. Am. Water Works Assn.—Jl., vol. 19, no. 2, Feb. 1928, pp. 121-130. Views of the State Department of Public Health, E. A. Reinke; Cross-Connections in the East Bay Cities, J. D. De Costa; Cross-Connections in Los Angeles, C. Wilson; Pasadena's Method of Handling Cross-Connections, M. S. Jones. Presented before California Section meeting, Oct. 6, 1927.

ENGINEERING. Heading Off Sand and Ice Troubles, J. Jacques. Water Works Eng., vol. 81, no. 3, Feb. 1, 1928, pp. 139-140 and 161-162, 8 figs. Water supply of Canon City, California, involving several unusual engineering problems, is described; ice clogging, avalanches of rock periodically destroying parts of pipe line supplying city and other difficulties have been met by engineers in perfecting this water-works system.

WATER TOWERS

REINFORCED-CONCRETE. Unusual Tank and Tower Structure of Reinforced Concrete. Eng. News-Rec., vol. 100, no. 6, Feb. 9, 1928, pp. 247-248, 2 figs. Structure was built of reinforced-concrete, with tower height of 120 ft.; tank shell is 15 ft. high, with capacity of 75,000 Imp. gallons.

WATER TREATMENT

DESCRIPTION. The Treatment of the Water Supply of the City of Columbus, Ohio, C. P. Hoover. Am. Soc. Civ. Engrs.—Proc., vol. 54, no. 2, Feb. 1928, pp. 471-484, 6 figs. Describes original water supply, processes used in treatment, chemicals used and method of applying them; additions to plant and operation are treated.

DEVELOPMENTS. Recent Developments in Water Treatment and Filtration, J. R. Baylis. Water Works, vol. 67, no. 1, Jan. 1928, pp. 37-39. Type of treatment no longer influenced by public opinion; water of certain chemical balance most suitable for domestic uses; optimum conditions for coagulating water; mixing basins; settling basins; rapid sand filters; instruments to aid filter operator; aeration; excess lime treatment and recarbonation.

IRON REMOVAL. Small Iron-Removal Plant for Redbank Water Works, W. Donaldson. Eng. News-Rec., vol. 100, no. 3, Jan. 19, 1928, pp. 112-114, 3 figs. Describes purification works for eliminating staining properties of water supply of Redbank, N.J., consisting of aeration and rapid-sand filtration; history of water supply and operation of plant are treated.

WATER WORKS

COST ACCOUNTING. Water Works Cost Accounting, P. M. Kydd. Water Works, vol. 67, no. 2, Feb. 1928, p. 60. Simplicity of mechanics of cost accounting pointed out; it is possible to devise cost-accounting system that can be handled by operating force of water works with aid of few clerks; source of basic cost information; distribution of cost items; recording operating results; use of cost data. Paper read before Central State Section, Am. Water Works Assn.

RECONSTRUCTION. Water Works Reconstruction in Winter at Newton, N.J., H. G. Payrow. Eng. News-Rec., vol. 100, no. 5, Feb. 2, 1928, pp. 184-185, 4 figs. Winter conditions were utilized to place submerged concrete intake and intake pipe in Morris Lake, source of water supply of Newton, N.J.; describes building of gate house, repairing dam, hauling of concrete intake over ice and sinking to place through ice.

WATT-HOUR METERS

PRACTICE, CANADA. Canadian Watt-Hour Meter Practice, J. Showalter. Elec. News, vol. 37, no. 3, Feb. 1, 1928, pp. 35-37. Guide for those operating or establishing meter departments, application, installation, reading, records, maintenance and testing of meters; meter sizes; reasons why Canadian meter practice differs from that elsewhere is that electricity is cheap. (To be continued.)

WATERWAYS

ENGINEERING PROGRESS. Advances in Waterways Engineering During a Half Century, C. L. Hall and DeW. D. Barlow. Am. Soc. Civ. Engrs.—Proc., vol. 54, no. 2, Feb. 1928, pp. 643-645. Discussion of paper by W. M. Black, published in Oct. 1927 issue of Proceedings.

WELDING

ELECTRIC. *See Electric Welding; Electric Welding, Arc.*
OXY-ACETYLENE. *See Oxy-Acetylene Welding.*
PRESSURE VESSELS. *See Pressure Vessels.*

WELDS

BRITTLENESS OF. Red-Shortness of Weld Metal, A. H. Gooder. Welding Engr., vol. 13, no. 2, Feb. 1928, pp. 39-43, 6 figs. British welding engineers investigate causes of brittleness of some welds at red heat, and means of controlling crystalline structure; many fusion welds red-short and particularly with electric arc welds; representative compositions of fluxes in commercial use; other effects of fluxes; passage of metal through arc; effect of carbon content of electrode on red-shortness of welds; tensile strength; bend tests; carbon tents of welds; microstructure; welds made in oxygen gas. Paper read before Instn. Welding Engrs.

WIND TUNNELS

SPEED CONTROL. An Automatic Speed Control for Wind Tunnels, A. F. Zahm. Nat. Advisory Committee for Aeronautics—Tech. Note, no. 278, Feb. 1928, 15 pp., 15 figs. Automatic control apparatus used in wind tunnels at Washington Navy Yard.

TESTS. Research on Channel Wall Interference, J. H. Parkin. Royal Aeronautical Soc.—Jl., vol. 31, no. 204, Dec. 1927, pp. 1110-1149, 32 figs. Tests at University of Toronto with cylinders and airfoils, using mirror method, for ten channel sizes; theory of airfoil is unlimited and limited stream; wall interference in square and rectangular cross-section channels; two series of tests on cylindrical models; tests on airfoils; log tables and graphs show results of tests; 4 halftones of apparatus. From Aeronautical Research Paper, no. 17 (Canada).

Wind Tunnel Tests on Autorotation and the "Flat Spin," M. Knight. Nat. Advisory Committee for Aeronautics—Report, no. 273, 1927, 18 pp., 17 figs.

TESTS. The Use of the Wind Channel for Performance Prediction, R. K. Pierson. Roy. Aeronautical Soc.—Jl., vol. 32, no. 206, Feb. 1928, pp. 96-119 and (discussion) 120-126, 35 figs. Wind-channel tests on models to find most efficient combination to fulfill specific requirements; description of model; method of model support; 4-ft. National Physical Laboratory type of wind channel furnished with 20-h.p. motor; propeller driving apparatus; trim very important as large pitching moment is associated with large drag errors; slipstream effect; method of visualizing air flow as means of determining how parasitic drag can be reduced; accuracy of prediction.

WOOD PRESERVATION

EXPERIMENTS IN. Experiments in Wood Preservation, L. P. Curtin and W. Thordarson. Indus. and Eng. Chem., vol. 20, no. 1, Jan. 1928, pp. 28-30. Toxicity data not previously reported are given, also table showing a "killing points" of various inorganic preservatives experimented with; 12 additional fungi have been studied; toxicity of zinc meta-arsenite in powder form toward 14 wood-rotting fungi has also been studied.

WOOD WASTE

USE AS FUEL. Burning Hog Fuel in the Pacific Northwest, O. L. LeFever. Power, vol. 67, no. 6, Feb. 7, 1928, pp. 248-249, 2 figs. Discusses its possibilities and limitations and some of requirements for successful burning for power generation; burning hog fuel in Dutch oven; transportation of hog fuel limited to 100 miles; sturdy conveyors needed for handling.

Institute Committees for 1928

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A

AERIAL PHOTOGRAPHY

MAP COMPILATION. Map Compilation from Aerial Photographs, T. P. Pendleton. U.S. Geol. Survey—Bul., no. 788-F, 1928, pp. 379-419, 12 figs. Photographic optics; control for maps compiled from aerial photographs; photographing quadrangle; successful compilation of maps from aerial photographs is largely dependent on character of traverse of triangulation upon which it is based; both types of control can be used successfully.

AERIAL SURVEYING, TOPOGRAPHIC

CANADA. Aerial Surveying in Canada, F. H. Peters. Eng. and Min. Jl., vol. 125, no. 12, Mar. 24, 1928, p. 491, 2 figs. on p. 490. Canada's pulpwood areas, water power resources and mineral possibilities are very great; necessity for maps is urgent; Topographical Survey of Canadian Dept. of Interior, in aerial surveys work for 1927, photographed 45,850 square miles, 28,650 by oblique and 17,200 by vertical photography, for mapping purposes.

AIR COMPRESSORS

DESIGN. A Contribution to the Design of the Turbo-Compressor, M. Maekawa. Tohoku Imperial University—Technology Reports (Sendai, Japan), vol. 7, no. 2, 1928, pp. 1-44, 15 figs.

AIRPLANE ENGINES

SPECIFICATIONS. Manufacturers' Specifications on Engines Available for Commercial Use as Compiled by Aviation. Aviation, vol. 24, no. 13, Mar. 26, 1928, p. 790. Table of manufacturers' specifications for airplane engines in commercial use.

AIRPLANES

SLIP-STREAM EFFECT. Slip-Stream Effect, M. Watter. Aero Digest, vol. 12, no. 2, Feb. 1928, pp. 175-177 and 297-298, 8 figs. Data accounting for mutual interaction of propeller and objects in its slip-stream; magnitude of its effect; problem in theoretical performance calculation; error in level flight analysis small; slip-stream effect causes comparatively greater error in climb; propeller-ship effect; obstruction effect.

STRESS ANALYSIS. Stress Analysis of Commercial Aircraft, A. Klemin. Aviation, vol. 24, nos. 11-14, Mar. 12-Apr. 2, 1928, pp. 632-633 and 654-660, 14 figs., 704-705 and 723-731, 17 figs., 774-775 and 794-799, 10 figs., and 838-839 and 848-853, 7 figs.

ALLOY STEELS

LOCOMOTIVE FORGINGS. Locomotive Forging Steels, O. V. Greene. Am. Soc. Steel Treating—Trans., vol. 13, no. 4, Apr. 1928, pp. 573-588 and (discussion) 588-602, 18 figs. Results of tests made on various types of heat-treated alloy steels for reciprocating locomotive parts; many railroads are using normalized steel for their forgings; normalized forging steel tends to eliminate internal fissures and cracks, internal strains, ferritic segregation due to non-metallic impurities; if weight is important factor, however, such steels as vanadium or manganese are used so that sections may be safely reduced in size.

ALLOYS

ALUMINUM. *See Aluminum Alloys.*

BRONZE. *See Bronze.*

CAST, SHRINKAGE OF. Minute Shrinkage Cavities in Some Cast Alloys of Heterogeneous Structure, W. A. Cowan. Inst. of Metals—Advance Paper, no. 451, for mtg., Mar. 8-9, 1928, 6 pp., 7 figs.

COPPER. *See Copper Alloys.*

EQUILIBRIUM DIAGRAMS. Equilibrium Diagrams, W. Rosenhain. Foundry Trade Jl. (Lond.), vol. 38, no. 603, Mar. 8, 1928, pp. 169-173. Explanation of equilibrium diagrams; simple and duplex alloys; nature of micro-constituents; transitional phases; maintaining condition of balance between solid and liquid; principle of phase rule; energy potential and metastable alloys; thermal analysis; dilatometry; alloying and its results; age hardening; equilibrium and future developments. Presidential address to Inst. of Metals. See also Metal Industry (Lond.), vol. 32, nos. 10 and 11, Mar. 9 and 16, 1928, pp. 259-261 and 275-277.

ALUMINUM ALLOYS

EGALITE. Specially Processed Aluminum Alloy Marketed as "Egalite," P. M. Heldt. Automotive Industries, vol. 58, no. 10, Mar. 10, 1928, pp. 416-417. Alloy has been subjected to special process while in molten state; process said to give greater degree of uniformity of molecular structure and to increase tensile strength and elongation; process applicable to wide variety of compositions; recommended for casting cylinder heads; reduces maximum temperature; results of tests on engine with cast iron and Egalite metal heads; effect of process explained.

AMPLIFIERS

HIGH-FREQUENCY. Good Quality in H.-F. Amplifiers, C. C. Inglis. Experimental Wireless (Lond.), vol. 5, no. 54, Mar. 1928, pp. 132-133. Analysis made to arrive at width of resonance curve at large fraction of its height; results show that care must be taken not to use tube of too high impedance with tuned anode circuit, if good quality is to be maintained.

RADIO. High-Note Loss in Resistance Amplifiers, A. L. M. Sowerby. Wireless World (Lond.), vol. 22, no. 10, Mar. 7, 1928, pp. 251-253, 3 figs. Measurement of working impedances and capacities; working impedance of tube; working value of stray capacity; magnification factor and tubes capacity; high magnification tubes and distortion. (To be concluded.)

AQUEDUCTS

LOS ANGELES-COLORADO RIVER. The Proposed Los Angeles-Colorado River Aqueduct, H. A. Van Norman. Am. Soc. Civ. Engrs.—Proc., vol. 54, no. 4, Apr. 1928, pp. 1116-1122. Discusses need, in Southern California cities, for water from Colorado river; description of several of proposed routes that would ultimately divert 1,500 cu. ft. per sec.; two of these routes are unique in being gigantic pumping schemes; two others are unusual in that they entail driving of tunnels of heretofore undreamed-of lengths; various types of aqueduct construction and economic problems related thereto.

ASBESTOS MINES AND MINING

SOUTH AFRICA. Asbestos Developments in South Africa. S. African Min. and Eng. Jl. (Johannesburg), vol. 38, no. 1899, Feb. 18, 1928, p. 665, 1 fig. Conditions in blue asbestos fields; four horizons proved; shaft sinking cheaper than drilling; prospecting parties at work in Rhodesia; keen competition for Amianthus aerial-ropeway contract.

ASPHALT

MIXTURES. Asphalt Mixtures and Gradings, E. B. Hack. Commonwealth Engr. (Melbourne), vol. 15, no. 6, Jan. 2, 1928, pp. 230-233, 7 figs. Theory and practice; sands; aggregate grading; hot-mix proportions; black base; binder course; asphalt or bituminous concrete; stone-filled sheet asphalt (modified Topeka mix) for light traffic; stone-filled sheet asphalt (modified Topeka mix) for heavy traffic; sheet asphalt for light traffic; sheet asphalt for heavy traffic.

AUTOMOBILE ENGINES

DESIGN. Automotive Fuels and Engines (Brennstoffe und Motoren fuer Kraftwagen), A. Heller. V.D.I. Zeit. (Berlin), vol. 72, no. 10, Mar. 10, 1928, pp. 335-340, 13 figs. Development of gasoline substitutes; cracking process; anti-knock fuels; selection of dimensions and number of cylinders of automotive engines; simplified construction; Rushmore method of cooling by steam condensation; electric equipment of automotive vehicles.

DETONATION. Mechanical Design in Relation to Detonation, H. R. Ricardo. Instn. Petroleum Technologists—Jl. (Lond.), vol. 14, no. 66, Feb. 1928, pp. 2-10 and (discussion) 10-26. It will not pay, at all events for automobile engines, to employ higher compression when to do so necessitates adding any extra weight to reciprocating parts; turbulence; effect of cylinder size on detonation.

DIFFERENTIAL-STROKE (Andreau). The Kinematics of the Andreau Differential-Stroke Engine, S. J. Davies. Engineering (Lond.), vol. 125, no. 3243, Mar. 9, 1928, p. 277, 4 figs. This engine of Citroën Gear Co., working on Atkinson cycle, gives extraordinarily low gasoline consumption of 0.379 lb. per b.h.p. per hr., equivalent to overall or brake thermal efficiency of about 36 per cent; investigation into kinematics of type of mechanism used in engine; includes curves showing displacement, velocity and acceleration.

GASOLINE, DETONATION OF. Results of Two Detonation Surveys, H. K. Cummings. Soc. Automotive Engrs.—Jl., vol. 22, no. 4, Apr. 1928, pp. 448-457, 7 figs. First is survey of current methods of measuring anti-detonation qualities of motor fuels; second is survey of relative detonation characteristics of available fuels as determined by routine method of fuel testing now employed by Bureau of Standards; comparative data on apparatus and methods presented in tabulation which includes 20 laboratories; knock ratings for British and American gasolines.

AUTOMOBILE PLANTS

MAINTENANCE DEPARTMENT (FORD). Maintenance Practices at the Fordson Plant, F. L. Faurote. Indus. Eng., vol. 86, no. 3, Mar. 1928, pp. 106-110 and 149, 9 figs. Work of maintenance department at Fordson plant, and manner in which it is planned and carried out; rough or semi-finished sketches; sufficient skilled workers; fabricating shop and equipment; small maintenance departments; installations of balconies and conveyors; steam fitting; reclamation of material from Government ships; care of electric motors.

B

BAFFLE PIERS

HYDRAULIC MODELS. Baffle Pier Experiments on Models of Pit River Dams. Am. Soc. Civ. Engrs.—Proc., vol. 54, no. 4, Apr. 1928, pp. 1225-1233, 4 figs. Discussion of paper by I. C. Steele and R. A. Monroe continued from Mar. 1928 issue of Proceedings; writer obtained data relative to baffle piers at toe of high overfall dams; this information is presented; experiments made at hydraulic laboratory of Cornell University indicated that relative height of tail water is of great, even of controlling, importance.

BAKELITE

MACHINING. Bakelite and How It Is Machined, P. Hagen. Machy (N.Y.), vol. 34, no. 8, Apr. 1928, pp. 622-623. Properties of bakelite; machining operation; method of turning; practice in drilling; sawing and punching bakelite; threading and milling; polishing.

BALANCING

ROTORS. The Static Balancing of Rotors, B. P. Haigh. Engineer (Lond.), vol. 145, no. 3767, Mar. 23, 1928, pp. 310-312, 7 figs.

BALLAST (RAILROADS)

DISCUSSION OF. Railway Engineers Discuss Ballast. Rock Products, vol. 31, no. 6, Mar. 17, 1928, p. 90. Report of Am. Ry. Assn. Committee on Ballast covering revision of manual; digest as to materials used on 47 railroads; comparative value of materials; pumping joints and maintenance costs; shrinkage of ballast and practice of measuring or weighing when bought.

BEAMS, REINFORCED CONCRETE

STEEL CALCULATION. Calculation of Steel Section of Reinforced Concrete Beams with Double Reinforcement Under Simple Bending (Calcul des sections d'aciers des poutres en béton arms, à double armature, soumises à la flexion simple). J. Tastet. Génie Civil (Paris), vol. 92, no. 10, Mar. 10, 1928, pp. 233-236, 2 figs. Different shapes of steel reimforcement are treated and tables of values of variables in formulas.

BEARINGS, BALL

STANDARDIZATION. Ball-Bearing Standardization. Soc. Automotive Engrs.—Jl., vol. 22, no. 4, Apr. 1928, pp. 481-483, 1 fig. Proposals for uniform world-wide standards for ball bearings discussed at International Conference on Ball Bearing Standardization; international uniformity of annular type nearly attained; others being considered; near agreement of metric thrust-bearing tables; gauging; tolerances; tolerances on widths; eccentricity; inch-dimension bearings; corner radii; roller bearings; adapter-sleeve bearings.

BEARINGS, ROLLER

UTILIZATION BY RAILROADS. Roller Bearings for Railway Equipment, W. C. Sanders. Ry. Club of Pittsburgh—Proc., vol. 27, no. 4, Feb. 23, 1928, pp. 81-92 and (discussion) 93-101, 12 figs.

BOILER FEEDWATER

SOFTENING. Lime and Soda Treatment of Feedwater, E. M. Partridge. Power, vol. 67, no. 12, Mar. 20, 1928, pp. 507-509. Result obtained by lime-soda softeners on division of Mid-Western railway; accompanying tables of analyses support statement that water may be made actually more corrosive in character by partial softening with lime and soda and that lime-soda softening does not insure formation of soft sludge in boiler unless treatment be complete.

BOILER PLATE

EMBRITTLEMENT. Embrittlement of Boiler Plate, S. W. Parr and G. F. Straub. Power Plant Eng., vol. 32, no. 7, Apr. 1, 1928, pp. 414-417. Causes and descriptions of cracks due to embrittlement and methods of inhibition; material has not been found to be at fault; design of boiler is not primary cause; operation is not to blame; sodium hydroxide is only material encountered in boiler which embrittles stressed steel; increased sulphate has been effective in stopping this trouble; new inhibiting agents have been developed. Abstract of paper presented at Mid-West Power Conference.

NICKEL-STEEL. Alloy Steel for Boiler Construction, C. McKnight. Am. Soc. Steel Treating—Trans., vol. 13, no. 4, Apr. 1928, pp. 638-657 and (discussion) 657-658, 10 figs.

BOILERS

HEAT TRANSMISSION IN. Heat Transmission in Modern Boilers, Roszak and Veron. Power Engr. (Lond.), vol. 23, no. 265, Apr. 1928, p. 152. Discusses factors influencing heat transmission, with special reference to their bearing on design of modern boilers and possibilities of further improvements; methods of increasing heat transfer by radiation and convection; typical data concerning heat absorption per unit area of heating surface under different conditions. Abstract translated from Société des Ingénieurs Civils.

MARINE, PULVERIZED COAL. Test of Pulverized Coal as Applied to Scotch Marine Boilers, C. E. Jefferson and J. S. Evans. Mar. Engr. and Motorship Bldr. (Lond.), vol. 51, no. 607, Mar. 1928, pp. 101-102, 1 fig. Report of 240-hr. test of system finally developed and installed in 9,700-ton freighter "Mercer" in order to determine by actual operation real merits of pulverized fuel when applied to existing types of cargo vessels fitted with Scotch boilers.

STEAM-HEATING. Relation Between Output and Operating Characteristics of Low-Pressure Steam-Heating Boilers, P. Nicholls. Am. Soc. Heat. and Vent. Engrs.—Jl., vol. 34, no. 3, Mar. 1928, pp. 175-188, 7 figs. Discusses relations which exist between some of the operating characteristics of low-pressure steam-heating boilers, and gives results of tests.

BRIDGES

ARCH, HIGHWAY. Highest Bridge in World Being Built Over Colorado River, N. C. Lilley. Eng. World, vol. 32, no. 3, Mar. 1928, pp. 123-124, 1 fig. Bridge 130 miles north of Flagstaff, Ariz., will be 467 ft. from low-water to roadway grade; total length 833 ft., main span being deck arch of 618 ft., end pins resting upon granite walls of canyon; arch is of usual three-hinge type, with battered trusses designed with reversal stresses for cantilever erection.

COMBINED. Conversion of Mission Bridge, Canadian Pacific Railway. Can. Ry. and Mar. World, no. 361, Mar. 1928, p. 123, 2 figs. Conversion of Canadian Pacific Ry. bridge into combined railway and highway bridge; no changes were necessary in steel part of structure; to signal system for control of trains and boats was added device for control of highway traffic.

CONCRETE, DESIGN. Steel Plates Transfer Stress in Concrete Bridge Truss. Eng. News-Rec., vol. 100, no. 11, Mar. 15, 1928, pp. 440-441, 2 figs. Seattle street carried across ravine on bridge built to half ultimate width; novel panel-connection details; points of special interest involved are design of truss and use of curved steel plates to transfer stress to and from embedded steel bars at panel-point connections.

CONSTRUCTION, ELECTRIC WELDING. Electric Welding Cuts Steel Bridge Tonnage One-Third. Elec. World, vol. 91, no. 14, Apr. 7, 1928, p. 707, 1 fig. By use of electric welding amount of steel required in Boston and Maine Railroad bridge, 175 ft. long, being built at Chicopee Falls, Mass., has been reduced at least 33.3 per cent; more than half saving is in reduction of connection material.

HIGHWAY, NEW YORK CITY. New York City Bridges, Present and Proposed, D. B. Steinman. Professional Engr., vol. 13, no. 3, Mar. 1928, pp. 9-10, 1 fig. Williamsburg Bridge, Manhattan Bridge and Queensboro Bridge; Brooklyn Bridge was opened to traffic 45 years ago; proposed bridge known as Triborough Bridge; bridge has been proposed to span Narrows between Brooklyn and Staten Island to be known as Liberty Bridge.

MOVABLE, WELLAND SHIP CANAL. Bridges Over the Welland Ship Canal, M. B. Atkinson. Eng. Jl. (Montreal), vol. 11, no. 2, Feb. 1928, pp. 73-100, 43 figs. Outline of preliminary investigations, specifications and designs and construction features of substructures and superstructures of various bridges, of which there will be two swing, seven rolling-lift and twelve vertical-lift bridges.

PIERS, SINKING. Pneumatic Caissons Sealed at Record Depths, Using Quick-Hardening Cement, C. K. Allen. Eng. News-Rec., vol. 100, no. 12, Mar. 22, 1928, pp. 484-487, 7 figs. Quick-hardening cement decided factor in rapid founding under air of Kennebec river bridge piers; caissons sealed at maximum water depths of 125 ft. on rough rock bottom; piers were sunk by pneumatic process; rapidity of construction under very difficult conditions sets precedent of interest; concrete under pressure; material supply; caissons.

RAILROAD, ARC WELDING. First All-Welded Truss Railroad Bridge Is Put in Service. Ry. Age, vol. 84, no. 12, Mar. 24, 1928, pp. 664-667, 10 figs. New bridge on Boston and Maine, built over power canal at Chicopee Falls, Mass., on important industry spur serving Westinghouse Electric Co.'s plant at that point; 72-deg. skew, length of each truss is 134 ft. 8 in.; unit stresses allowed; details of more important connections; floor system of unusual design.

RAILROAD, VIBRATION. Oscillations in a Bridge Caused by the Passage of a Locomotive, C. E. Inglis. Roy. Soc.—Proc. (Lond.), vol. 118, no. A779, Mar. 1, 1928, pp. 60-96, 18 figs. Natural periods of vibration for unloaded girder freely supported at its ends; oscillation produced by concentrated pulsating force moving at uniform speed along girder; impact effects due to hammer blow, taking into account mass of moving load and bridge damping.

SECONDARY STRESSES. Secondary Stresses. Engineering (Lond.), vol. 125, no. 3242, Mar. 2, 1928, pp. 261-262. Editorial treatment, referring to recent works on subject; it is not that secondary stresses are small, but experience has proved them to be negligible in ordinary bridge work; not a single instance has yet been brought forward to show that any bridge disaster has ever been due to these stresses; experiments are now being made by Ministry of Transport in order to determine by direct measurement stresses existing in railway bridges.

STEEL, ARCH—AUSTRALIA. Early Stages of Construction on 1,650-Ft. Arch Bridge at Sydney, Australia. Eng. News-Rec., vol. 100, no. 14, Apr. 5, 1928, pp. 538-540, 7 figs. Steel arch span to carry railway and street traffic across harbour; foundations and construction ot end bearings; travellers for arch erection; foundations; end bearings; masonry.

STEEL, WELDING. Railroad Bridge Made by Arc Welding, A. G. Bissell. Iron Age, vol. 121, no. 15, Apr. 12, 1928, p. 1013, 2 figs. Skew bridge at Turtle Creek, Pa., for heavy freight movement built of plates and standard I-beams without use of rivets; two main girders, 4 ft. 9¼ in. deep and 53 ft. 9 in. long, constructed outdoors at plant of Westinghouse Elec. & Mfg. Co.; cover plates carefully assembled on some long timbers, and edge-welded continuously on both sides.

SUSPENSION. Design of Mount Hope Wire-Cable Suspension Bridge. Eng. News-Rec., vol. 100, no. 15, Apr. 12, 1928, pp. 585-587, 3 figs. Toll structure with 1,200-ft. suspended span displaces highway ferry between Providence and Newport, R.I.; cable-bent piers and offshore anchorage necessary; silicon-steel truss chords; site and foundation conditions; general design; stiffening trusses.

SUSPENSIDN, EYE-BAR CABLE. The Eye-Bar Cable Suspension Bridge at Florianopolis, Brazil. Am. Soc. Civ. Engrs.—Proc., vol. 54, no. 4, Apr. 1928, pp. 1133-1152, 5 figs. Discussion of paper by D. B. Steinman and W. G. Grove continued from Feb. 1928 issue of Proceedings; bidding on Hudson river bridge wire design won by margin of $2,000,000, indicating that eye-bars cannot compete with wire cables for extremely long spans; Florianopolis design and its methods of erection may extend range of use of structures of suspension type.

SUSPENSION, PITTSBURGH. The Sixth, Seventh and Ninth Street Bridges, Pittsburgh, Pa., S. L. Roush. Am. Architect, vol. 133, no. 2538, Feb. 5, 1928, pp. 191-196, 8 figs. Architectural treatment of three bridges in Pittsburgh, all of suspension type; two with main span 430 ft., side spans 215, while third is 12 ft. and 6 ft. longer respectively; approaches have steep grades of 4.175 per cent.

TYPES. Suitability of the Various Types of Bridges for the Different Conditions Encountered at Crossings, J. A. L. Waddell. Assn. Chinese and Am. Engrs. —Jl. (Peking), vol. 9, no. 2, Feb. 1928, pp. 19-31. Erection methods; types of bridges; toll bridges; preliminary studies for proposed bridges; right-of-way. (Concluded.)

TOLL. Privately-Operated Toll Bridges Opposed on Economic Grounds, N. G. Shidle. Automotive Industries, vol. 58, no. 13, Mar. 31, 1928, pp. 503-505, 1 fig. Bridge profits made possible through location in relation to highways built with public funds should not be given over to private interests, highway experts say; at beginning of 1928, 233 toll bridges in operation in United States, 191 privately-owned; arguments against privately-owned toll bridge from standpoint of public interest.

WOODEN, CREOSOTING. Creosoted Timber Ideal for Highway Bridge Construction Purposes, J. F. Seiler. Wood Preserving News, vol. 6, no. 3, Mar. 1928, pp. 27-35, 3 figs. Economy vital issue; economical permanency; standard design; wearing surface; foundation problems; special methods; abutments; long life and low maintenance; high salvage value; practical construction.

BRONZE

GEAR. Developments in Gear Bronze, T. H. W. Jeacock. Can. Foundryman (Toronto), vol. 19, no. 3, Mar. 1928, pp. 30-31. Best bronze worm-gear blanks made with nickel content by process known as three-sided chill; inclusion of nickel in bronze alloy for gear blanks increases yield point considerably with but slight loss in elongation; outstanding advantages gained by inclusion of nickel are decreased pitting of wheel-teeth surface, increased wearing quality, lower operating temperatures.

BUILDINGS

FOUNDATIONS. A Foundation Job in Newark, N.J., M. H. Foley. Contractors' and Engrs'. Monthly, vol. 16, no. 3, Mar. 1928, pp. 187-190, 8 figs. Building is to be 22-storey structure with two basements; type of footing; underpinning; general excavation was done with steam shovels which were afterward converted into mobile steam cranes and used to support steam hammers and supply steam for driving sheeting; open-caisson method was used for excavating in 85 pier holes; water-proofing.

HEAT INSULATION. The Economic Thickness of Building, M. S. Wunderlich. Am. Soc. Heat. and Vent. Engrs.—Jl., vol. 34, no. 3, Mar. 1928, pp. 189-196, 2 figs. Economic thickness of insulation depends upon cost of fuel, seasonal demand, cost of insulation installed.

WIND PRESSURE. Wind Pressure Tests Made on Large Model Building, E. R. Dawley. Eng. News-Rec., vol. 100, no. 13, Mar. 29, 1928, pp. 508-510, 4 figs. Results of wind-tunnel test on largest model building ever tested indicate older formulas are too high; framework may offer greater resistance than covered building; effect of open windows; covered model, doors and windows closed; covered model, doors and windows open; wind pressure was found to vary with power of velocity slightly higher than square.

C

CABLES, HOISTING

STRESSES IN. Hoisting Cables, Stresses and Tests (Ansprueche an Foerderseile und ihre Pruefung), H. Herbst. V.D.I. Zeit. (Berlin), vol. 72, no. 10, Mar. 10, 1928, pp. 345-349, 10 figs. Great importance of effect of dynamic stresses, such as jerks and vibrations, at clip points of wire rope attachments; fatigue failures; desirability of large-diameter wires; rust protection by galvanization; standard tension, flexure and torsión tests; necessity of constant careful inspection.

CANALS

LOCK GATES, WELLAND SHIP CANAL. The Lock Gates of the Welland Ship Canal, F. E. Sterns. Eng. Jl. (Montreal), vol. 11, no. 2, Feb. 1928, pp. 101-124, 23 figs. Description of locking arrangements for canal, types of gates chosen, general features of gates, details of design, fabrication, erection and cost of steel gates, operating machinery and details and fabrication of timber gates.

CARS, ELECTRIC

GEARS AND GEARING. Attention to Gearing Reduces Maintenance of Entire Car, E. S. Sawtelle. Elec. Ry. Jl., vol. 71, no. 11, Mar. 17, 1928, pp. 444-446, 13 figs. Better maintenance of railway gears and pinions will give greater gear life, less noise and less trouble from bearings and associated parts; Am. Elec. Ry. Eng. Assn. adopted condemning gauges to show when gearing should be discarded for wear.

CAST IRON

PROPERTIES. Mechanical and Physical Properties of High-Grade Grey Cast Iron and Principles Underlying Its Production (Hochwertiger Grauguss, seine mechan.-physikal. Eigenschaften und die Grundlagen zu seiner Erzeugung), E. Zimmermann. Zeit. fuer die gesamte Giessereipraxis (Berlin), vol. 49, nos. 7, 8, 9 and 10, Feb. 12, 19, 26 and Mar. 4, 1928, pp. 64-65, 71-72, 78-80 and 91-93. Feb. 12: Structural constituents of alloys from 0 to 1.76 per cent. Feb. 19: Distribution of constituents in white and grey cast iron after solidification. Feb. 26: Iron-carbide system and iron-graphite system. Mar. 4: Lanz pearlitic cast iron. Mar. 11: Graphite eutectoid. Mar. 18: Cast iron according to Thyssen-Emmel process.

CEMENT KILNS

DESCRIPTION. Changes Undergone by Cement Materials Along the Length of Kiln, A. J. Blank and W. B. Williams. Rock Products, vol. 31, no. 6, Mar. 17, 1928, pp. 74-76, 1 fig. Breakdown of machinery gave opportunity to examine material in various positions throughout kiln and waste-heat plant; both raw material and fuel oil contain sulphur; notable rise in sulphur content found at one point in kiln; alkali content rises with distance from kiln.

CEMENT MORTAR

STEAM TREATMENT. Effect of Steam Treatment of Portland Cement Mortars on Their Resistance to Sulphate Action, T. Thorvaldson and V. A. Vigfusson. Eng. Jl. (Montreal), vol. 11, no. 3, Mar. 1928, pp. 174-179, 8 figs. Study as part of general investigation on action of sulphate waters on cements and concrete; effect of curing in hot water on sulphate resistance of mortar bars; action of sulphates on substances generally considered to be present in Portland cement clinker; effect of steam treatment on tensile strength of Portland cement mortars.

CEMENT

PORTLAND, STRENGTH. Influence of Low Temperature and Frost on the Strength of Super Cements, A. Gessner. Pit and Quarry, vol. 15, no. 12, Mar. 14, 1928, pp. 77-79. Tests indicated that frost delays, but does not destroy, setting power; tendency of sudden frost after initial set is to arrest further setting; salt may prevent freezing, but is regarded unfavorably, despite one high final strength test; conclusion is that super-cements are affected like other Portland cements, but high initial hardening is advantageous under favourable temperature conditions.

CITIES AND TOWNS

PLANNING, CANADA. Progress of Town Planning in Canada, C. Engler. Can. Engr. (Toronto), vol. 54, no. 13, Mar. 27, 1928, pp. 401-402. Niagara frontier-plan project; plan of Vancouver; influence of Vancouver spreading in western provinces; Ottawa federal district scheme; situation in Canada; British Columbia town-planning act. Report of town-planning committee presented at Dominion Land Surveyors' Assn., Ottawa.

COAL MINES AND MINING

ELECTRIFICATION. A Centralized Colliery Plant. Power Engr. (Lond.), vol. 23, no. 264, Mar. 1928, pp. 89-94, 8 figs. Describes instance of centralization of coal mine company's power plant in Scotland, whereby advantages of diversity of demand, higher quality of supervision and larger-scale operation are being obtained; details of boiler plant, switchgear, transmission lines and winding equipment; electrification scheme and central power plant recently put into commission by Fife Coal Co.

ROOF FALLS. Regulations and Inspection Prevent Accidents from Falls of Roof, J. W. Paul. Modern Mining, vol. 5, no. 3, Mar. 1928, pp. 63-64. Falls-of-roof accidents can and should be reduced; regular code of regulations on roof timbering and strict enforcement necessary; officials should not be overloaded.

SHAFT CEMENTATION. Application of Cement in Sinking of Shafts (Application de la cimentation dans le creusement d'un puits), M. H. Viatour. Annales des Mines de Belgique (Brussels), vol. 28, no. 4, 1927, pp. 1157-1162, 3 figs. Explains method used for lining shaft with cement as it was sunk, as applied to Boubier coal mine, Belgium.

VENTILATION. A Practical Solution of the High-Temperature Deep-Mining Problem by Natural Ventilation, A. Miller. Instn. Min. Engrs.—Trans. (Lond.), vol. 74, part 4, Jan. 1928, pp. 242-254 and (discussion) 254-260, 4 figs. partly on supp. plate. Natural ventilation was sufficient to provide maximum amount of comfort and efficiency; consequence of this change has been to reduce cost of production to such extent as to make it possible to continue working of coal mine as economic proposition.

COMBUSTION

CONTROL. Automatic Combustion Control. Sci. Instruments—Jl. (Lond.), vol. 5, no. 1, Jan. 1928, pp. 17-19, 5 figs.

COMPRESSED AIR

UTILIZATION IN MANUFACTURING PLANTS. Pneumatic Machine Tools and Equipment for Manufacturing Plants (Pressluftwerkzeugmaschine und Pressluftvorrichtung in der Fertigung), K. Bollinger. Maschinenbau (Berlin), vol. 7, no. 5, Mar. 1, 1928, pp. 215-218, 9 figs.

CONCRETE

ALKALI ACTION. The Condition of Field Specimens of Concrete Exposed to Alkali Soils and Waters Examined in December 1927. Eng. Jl. (Montreal), vol. 11, no. 3, Mar. 1928, pp. 184-192. Materials employed; preparation of concrete; inspection of field concretes; summary and conclusions; field investigation has indicated that with cement produced from any given clinker, durability as well as compressive strength increases as permeability decreases, up to some undetermined richness of mix, beyond which point durability in sulphates decreases rapidly. Appendix B of 1927 report of Committee on Deterioration of Concrete in Alkali Soils to council of Eng. Inst. of Canada.

DISINTEGRATION IN SALT WATER. Stability of Cements in Corrosive Waters, Haegermann. Pit and Quarry, vol. 15, no. 11, Feb. 29, 1928, pp. 67-69. All acids destroy concrete and all kinds of cement, all bases are without action, while salts are in part non-injurious, in part injurious; Portland cements with high silicic acid content (about 23 per cent and more), low alumina and oxide or iron content, with hydraulic modulus up to about 2.15, furnish concrete stable to salt water.

DURABILITY. The Requirements for a Durable Concrete as Observed from Structures in Service, R. B. Young. Eng. Jl. (Montreal), vol. 11, no. 3, Mar. 1928, pp. 161-173, 20 figs. Inquiry into question of what makes concrete good or poor based on consideration of conditions responsible for failure of existing concrete works; author shows characteristics of durable concrete are that it shall have low porosity and be made of sound ingredients; concrete shall be made of selected materials, properly proportioned, handled and placed without separation, and well cured.

PROBLEMS. American Concrete Institute Stresses Quality of Cement and Aggregates. Rock Products, vol. 31, no. 6, Mar. 17, 1928, pp. 60-65. Summaries of sessions of Am. Concrete Inst. at yearly meeting in Philadelphia, covering points of interest to producers of cement and aggregate and to manufacturers of cement products.

REINFORCED STEEL—STANDARDS. Adopts Standards for Reinforcing Steel. Iron Age, vol. 121, no. 13, Mar. 29, 1928, pp. 889-890. Concrete Reinforcing Steel Institute seeks better co-operation from mills and elimination of ruinous competitive methods; adoption of standard practices; fair profit urged; coming changes in industry.

STANDARD CODE. American Concrete Institute Adopts New Concrete Code. Concrete, vol. 32, no. 4, Apr. 1928, p. 21. New concrete code adopted at A.C.I. convention points way to construction economies; design and cost data for new code presented; skew-arch design; calculation of flat plates by elastic-web method.

STRENGTH. Influence of the Water-Cement Ratio on the Strength of Concrete. Engrs. and Eng., vol. 45, no. 2, Feb. 1928, pp. 46-47, 2 figs. Important part played by quantity of mixing water on strength of concrete; two groups of tests; in first group, quantity of water maintained constant through number of mixes; in second, mix was maintained constant with changing water content; control of water does not necessarily mean dry concrete, but means concrete of uniform strength and of any desired workability; explanation of tests.

TESTING. Some Methods of Measuring Workability of Concrete, G. A. Smith. Pit and Quarry, vol. 15, no. 12, Mar. 14, 1928, pp. 81-82. Addition of fine and coarse aggregates changes nature of cement paste; segregation of lubricating medium affects workability; penetration process, involving pulling ball through paste, gives best index of workability. Abstract of paper presented before Am. Concrete Inst.

Concrete Testing Pointed Toward Construction Problems. Eng. News-Rec., vol. 100, no. 12, Mar. 22, 1928, p. 481. A.C.I. papers record studies of crazing, hair cracking, dusting, concrete flow, bar anchors and field beam tests which hold practical interest to contractors; in group of six papers abstracted, two are on crazing and hair cracking, two other outline tests of direct usefulness to constructor, and one is on factory-floor construction.

TESTING INSTRUMENTS. Devices That Aid Laboratory Studies on Concrete. Eng. News-Rec., vol. 100, no. 11, Mar. 15, 1928, pp. 432-433, 5 figs. Permeability, plastic flow, volumetric changes and other characteristics observed with aid of novel devices; materials-testing laboratory of University of California.

CONCRETE CONSTRUCTION

ESTIMATING. Field Determination of Material Per Cu. Yd. of Concrete, D. V. Terrell. Eng. World, vol. 32, no. 3, Mar. 1928, pp. 129-130. Simple and reasonable procedure of estimating concrete work; method proposed for field use.

MECHANIZATION. Mechanical Power Instead of Manual Labour in Engineering Construction (Ersatz der Handarbeit durch Maschinenarbeit im Baugewerbe), G. Garbotz. V.D.I. Zeit. (Berlin), vol. 72, no. 8, Feb. 25, 1928, pp. 280-292, 36 figs. Economy and efficiency of machine methods in construction work, use of machinery in concrete construction and in erection of buildings; use of tractors, cranes, excavating machinery, well drilling rigs, dumping cars, scrapers, conveyors, etc.

REGULATIONS. Building Code Regulations for Concrete, F. R. McMillan. Contract Rec. (Toronto), vol. 42, no. 12, Mar. 21, 1928, pp. 312-313. Points out features of report recently adopted by Am. Concrete Inst. as tentative standard; many differences from previous reports; load tests; unit stresses; municipal authorities should take greater stock of their building codes.

REINFORCED MEMBERS, DESIGN. Design of Rectangular, Symmetrically Reinforced Members for Bending and Compression, H. Carpenter. Concrete and Constr. Eng. (Lond.), vol. 23, no. 3, Mar. 1928, pp. 235-242, 1 fig. Develops short, and, in its application, convenient, method for calculation of members with symmetrical reinforcement subjected to bending combined with compression.

CONDENSERS, STEAM

HEAT TRANSMISSION IN. Heat Transfer in Condensers, S. B. Jackson. Elec. Times (Lond.), vol. 73, no. 1897, Mar. 1, 1928, pp. 326-327, 1 fig. Determination of heat-transmission coefficient between steam and circulating water in design of turbo-alternator condensers; resistance of metal; the higher the coefficient of heat transmission which tube is designed for, the greater will be effect of heat-resisting material which may become deposited on tubes.

COPPER ALLOYS

HEAT TREATMENT. On the Quenching and Tempering of Brass, Bronze and "Aluminium-Bronze," T. Matsuda. Inst. of Metals—Advance Paper, no. 463, for mtg., Mar. 7-8, 1928, 42 pp., 20 figs.

CULVERTS, SYPHON

WELLAND CANAL. Chippewa Creek Syphon Culvert of Welland Ship Canal, A. J. Grant. Eng. and Contracting, vol. 67, no. 3, Mar. 1928, pp. 141-150, 13 figs. Deep open-pit excavation in soft-water bearing material; describes its design and construction; test borings; general description of culvert; culvert pit; steel-sheet pile cellular cofferdam; preassembly method of driving piles; braced pits; test pit; excavation; central concrete mixing plant.

Chippewa Creek Syphon Culvert of the Welland Ship Canal, A. J. Grant. Eng. Jl. (Montreal), vol. 11, no. 2, Feb. 1928, pp. 59-72, 18 figs. General description of canal; geology; test borings; aqueduct of second canal; aqueduct of third or present canal; proposed syphon in rock; general description of syphon culverts; culvert pit; steel-sheet pile cellular cofferdam; steel-sheet pile braced pits; test pit; central concrete mixing plant.

D

DAMS

FAILURES, ST. FRANCIS. St. Francis Dam Catastrophe—A Great Foundation Failure, N. A. Bowers. Eng. News-Rec., vol. 100, no. 12, Mar. 22, 1928, pp. 466-472, 12 figs. Telegraphed preliminary report by Pacific coast editor; wings of 205-ft. concrete dam washed out, but central section 100 ft. long remains; reservoir pours 38,000 acre-feet of water in torrent 100 feet deep, bringing death to hundreds; power house swept away; flood-water head bursts aqueduct below; dam and its foundations; rock face at abutment gone or covered by landslides; failure caused by sliding out rather than overturning; typical rock samples submerged in water were found to soften in short time.

FOUNDATION TESTING. Testing Rock Foundation at Dam Site. Water Works, vol. 66, no. 12, Dec. 1927, pp. 503-504, 1 fig. How core borings and hydraulic tests were made for O'Shaughnessy dam, Columbus, O.; 22 borings were made; drilling equipment; drilling; each hole was subjected to one or more hydraulic tests, water being applied under pressure equivalent to static head corresponding to elevation 860.

GRAVITY. Rational Dam Profiles (Das rationelle Profil der Staumauern), G. G. Kriwoschien. Bauingenieur (Berlin), vol. 9, no. 7, Feb. 17, 1928, pp. 107-113, 16 figs. Critical review of Levy method as used by French and Russian dam designers; analyses of trapezoidal and triangular dam profiles; author's original practical dam profile with crust profile in form of parallelogram or rectangle; numerical example.

UPLIFT PRESSURE. Uplift Pressures Under Dams: Experiments by the United States Bureau of Reclamation, E. I. Chandler. Am. Soc. Civ. Engrs.—Proc., vol. 54, no. 4, Apr. 1928, pp. 1349-1357, 3 figs. Discussion of paper by J. Hinds published in Mar. 1928 issue of Proceedings; writer offers data from his own observations on Pinhook dam at Maquoketa, Ia.; installations of apparatus of nature described by author can be accomplished at very little cost at time of construction, and are advocated as serving two worthy purposes.

UPWARD PRESSURE. Theory of Equilibrium of Heavy Walls Submitted to Under Pressure and Its Application to Stability of Dams and Embankments (La théorie de l'equilibre des massifs pésants soumis à des sous-pressins, et son application a la stabilité des barrages et des talus), E. Baticle. Génie Civil (Paris), vol. 92, no. 10, Mar. 10, 1928, p. 243. Abstract of paper presented to Académie des Sciences and printed in Comptes Rendus, Feb. 27, 1928; includes remarks by M. Mesnager.

DAMS, ARCH

DESIGN. Analysis of Arch Dams by the Trial Load Method. Am. Soc. Civ. Engrs.—Proc., vol. 54, no. 4, Apr. 1928, pp. 1311-1318, 1 fig. Discussion of paper by C. H. Howell and A. C. Jacquith published in Jan. 1928 issue of Proceedings.

TESTING. Stevenson Creek Arch Dam Experiments, F. A. Noetzli. Can. Engr. (Toronto), vol. 54, no. 13, Mar. 27, 1928, pp. 395-397, 6 figs. First series of tests on experimental dam undertaken by committee appointed by Engineering Foundation of New York; withstands flood strain; built in spring of 1926 in remote canyon in high Sierra in California; several hundred instruments were placed in concrete during construction; readings were taken at frequent intervals for determining strains, temperatures and defections on dam.

DIES

DRAWING, FOR SHEET METAL. Typical Drawing Dies for Sheet Metal. Am. Mach., vol. 68, nos. 13 and 14, Mar. 29 and Apr. 5, 1928, p. 549, 5 figs., and p. 589, 4 figs.

Producing Transformer Laminations. Machy. (Lond.), vol. 31, no. 804, Mar. 8, 1928, pp. 734-735, 4 figs. Dieing machines used in place of hand-fed machines to increase production 169 per cent; life of dies was increased 59.1 per cent; machines are equipped with double roll automatic feed; simple square-cornered transformer laminations are made; no lubricant required.

DIESEL ENGINES

AUTOMOTIVE (GERMAN). Modern Automotive Diesel Engines (Der Huetige Fahrzeugdiesel), E. Aster. Allgemeine Automobil-Zeitung (Berlin), vol. 29, no. 10, Mar. 10, 1928, pp. 29-31, 7 figs. Details of automotive Diesel engines by M.A.N. Junkers (45 h.p.), Maybach (150-h.p., six-cylinder), Mercedes-Benz, etc.

FUELS. Diesel Engine Performance on Oils Obtained from Low-Temperature Carbonization of Coal, J. S. Brown. Roy. Tech. Soc.—Jl., no. 4, Dec. 1927, pp. 76-84, 1 fig. Also Engineer (Lond.), vol. 145, no. 3765, Mar. 9, 1928, p. 274.

SUPERCHARGING. Proposed Method of Supercharging Diesel Engines. Mar. Engr. and Motorship Bldr. (Lond.), vol. 51, no. 607, Mar. 1928, pp. 103-104, 1 fig. Method of supercharging is examined in order to show how it meets conditions laid down, viz.. no increase in compression pressure, reduction in compression and combustion temperatures and jacket losses, with increase in thermal efficiency, while at same time increasing indicated mean pressure.

E

EARTH PRESSURE

THEORY. Some Earth Pressure Theories in Relation to Engineering Practice, J. Mitchell. Structural Engr. (Lond.), vol. 6, no. 3, Mar. 1928, pp. 59-84, 24 figs. Earth pressure theories referred to Coulomb, Poncelet, Rankine, Resal, Langtry, Bell; nearly all theories of earth pressure put forward so far can be expressed in very simple little equation in which thrust is equal to coefficient multiplied by weight per unit of volume of earth filling multiplied by square of height of wall; value of coefficient is great difficulty; author thinks that for practical engineering purposes Poncelet theory is probably most satisfactory.

ECONOMIZERS

EFFICIENCY. Economizers, W. F. Keenan, Jr. Engrs'. Soc. West. Pa.—Proc., vol. 43, no. 8, Nov. 1927, pp. 368-383 and (discussion) 383-388, 7 figs. Unit steel tube with extended surface is most modern type of economizer; important design requirements for this type of economizer are discussed; unit setting; design of casing; extended surface; typical examples of comparative air-heater and economizer; performances.

ELECTRIC CABLES

HIGH-TENSION. Loaded High-Voltage Cables, A. F. Puchstein. Elec. World, vol. 91, no. 14, Apr. 7. 1928, pp. 697-699, 3 figs. Calculations on 132,000-volt cable for long-distance transmission; shunt vs. series loading considered and method of calculation outlined.

INSULATION. Void Formation in Cables, W. N. Eddy. Elec. World, vol. 91, no. 14, Apr. 7, 1928, pp. 701-705, 8 figs. Shows influence on void formation of viscosity-contraction-temperature characteristics of impregnating compound and suggests that insulation quality of cables for 25- to 75-kv. working pressure can be materially improved by more general application of these fundamental relations.

SKIN EFFECT. Proximity Effect in a Seven-Strand Cable, J. E. L. Tweeddale. Am. Inst. Elec. Engrs.—Jl., vol. 47, no. 4, Apr. 1928, pp. 290-294, 5 figs. Checks calculations with tests for type of calculation recently developed, covering losses in several round wires connected in parallel, of which arrangement is such that unequal currents flow in different wires.

ELECTRIC CONDUCTORS

DIRECT CURRENT ARMATURE. Heat Losses in D.C. Armature Conductors, W. V. Lyon, E. Wayne and M. L. Henderson. Am. Inst. Elec. Engrs.—Jl., vol. 47, no. 4, Apr. 1928, pp. 286-289, 7 figs. It is generally believed that there are extra losses in armature coil of d.c. machine when it is undergoing commutation, but that during major portion of time loss in coil is correctly computed by squaring value of current and multiplying by true or ohmic resistance of coil; this view is not correct; disturbance in coil current produced by process of commutation persists throughout cycle so that at no time is current uniformly distributed over cross-section of conductor; extra losses are present at all times.

ELECTRIC EQUIPMENT

WESTINGHOUSE CO. A.I. & S.E.E. Inspection Trip. Iron and Steel Engr., vol. 5, no. 3, Mar. 1928, pp. 134-142, 9 figs. Various exhibits at Westinghouse Electric Mfg. Co. seen during inspection trip; photoelectric cell; time-limit control of motors; photo-stress analysis; grid glow tube; photosensitive cell; high-frequency testing of motor coils; induction furnaces; televox; rectox; carbon-brush xylophone; radio power transmission; absorbing vibration of machines; exponential radio and phonograph horn; chromium plating; cobalt-steel magnets; crystal control of frequency.

ELECTRIC GENERATORS

DIRECT-CURRENT, INTERPOLE. Operating Commutating-Pole Generators in Parallel, H. N. Blackman. Power, vol. 67, no. 13, Mar. 27, 1928, pp. 558-561, 6 figs. With brushes set on neutral, conditions for shunt-machine parallel operation remain as for non-interpole machines; with brushes on neutral of compound generators, additional requirement to those previously given is that equalizer lead must be connected outside interpole winding; brush lead against rotation tends to raise voltage with increased load; in direction of rotation it tends to lower voltage with increased load.

STARTING. Procedure in Starting Up a New Generator, C. O. von Dannenberg. Power Plant Eng., vol. 32, no. 7, Apr. 1, 1928, pp. 427-428. Discusses article of M. Phillips ni Feb. 15 issue of same journal, showing certain diagrams of methods for synchronizing and phasing out generators; present author described method of testing polarity of potential transformers.

ELECTRIC LINES

AERIAL SURVEYING. Seaplane Aids Line Right-of-Way Survey. Elec. World, vol. 91, no. 11, Mar. 17, 1928, p. 558. In surveying right-of-way for its 200-mi., 22,000-volt transmission line from Ottawa river to Toronto, Ontario Hydro-Electric Power Commission used speedly seaplane; aerial survey was adopted, in preference to preliminary field survey, because it was considered cheaper and quicker, and more readily assured best possible location of line.

CONSTRUCTION. Construction of Great Falls-Winnipeg 110-Kv. Transmission Line, J. C. D. Taylor. Elec. News (Toronto), vol. 36, no. 5, Mar. 1, 1928, pp. 31-33, 7 figs. Details of well-planned organization for distributing men and materials, which is important economic factor in long-distance line construction; line consists of galvanized-steel self-supporting towers 81 ft. high carrying two circuits, one on each side of tower, attached by suspension strings of 5 insulators; distribution problem; value of haulage tractor; narrow-gauge log track.

LIGHTNING PROTECTION. Apparatus for Transmission Systems, A. C. Monteith. Power Plant Eng., vol. 32, no. 7, Apr. 1, 1928, pp. 408-409. Development of klydonograph by J. F. Peters in 1923 made possible for first time measurement of lightning voltages with reasonable degree of accuracy; K. B. McEachron introduced into lightning-arrester research DuFour cathode-ray oscillograph, developed in France, which makes possible laboratory studies of performance of protective devices with as much certainty and precision as can be obtained with vibrator type of oscillograph. Abstract of paper presented at Mid-West Power Conference.

OVERHEAD. Inclined Catenary on the Great Northern, A. M. Wright. Ry. Elec. Engr., vol. 19, no. 4. Apr. 1928, pp. 112-116, 7 figs. Installation represents application of much-discussed type of overhead construction; 6,600-volt, three-phase system has been replaced by 11,000-volt, single-phase with overhead catenary contact system; overhead in snowsheds and tunnels; pole construction on curved track; design requirements; all catenary systems should be completely designed and special work taken into account before erection is begun.

POLES, REINFORCED CONCRETE. Reinforced Concrete Transmission-Line Poles. Concrete and Constr. Eng. (Lond.), vol. 23, no. 3, Mar. 1928, pp. 263-265, 1 fig. Reinforced concrete is not novelty; design; circular poles; permissible pressure of side of pole against earth; centrifugal or hollow-spun pole is in use in majority of Continental countries.

ELECTRIC FURNACES

ANNEALING. Annealing of Non-Ferrous Metals in the Electric Furnace, R. M. Keeney. Am. Electrochem. Soc.—Advance Paper, no. 8, for mtg., Apr. 26-28, 1928, pp. 59-68.

CARBURIZING. Large Carburizing Furnace Secures Recuperative Economies, W. J. Diederichs. Elec. World, vol. 91, no. 13, Mar. 31, 1928, pp. 667-668, 1 fig.

IRON-FOUNDING. Electric Furnace Iron. Iron Age, vol. 121, no. 14, Apr. 5, 1928, p. 955. Results of extended experiments show practicability, advantages and costs; electric furnace used in conjunction with cupola; possibility of producing electric furnace cast iron from cheap grades of ferrous scrap; one electric furnace can be used to produce both iron and steel; electric iron stronger.

ELECTRIC LOCOMOTIVES

COMBINED BATTERY AND TROLLEY. Dual Electric Locomotives on "North Shore" Line. Ry. Age, vol. 84, no. 12, Mar. 24, 1928, p. 668, 1 fig. Trolley is used on main line and all other trackage where overhead power connections are afforded; storage battery used for moving freight on industrial sidings and switch tracks without trolley connections; locomotive weighs 65 tons; equipped with four 205-h.p. motors and battery of 192 cells, rated 600 amp.-h.p. and capable of delivering 260 kw.-hr. on one charge.

ELECTRIC METERS

TYPES. Electric Meter History, R. C. Lanphier. Instruments, vol. 1, no. 3, Mar. 1928, pp. 151-162, 21 figs. Early types of meters; d.c. meters first developed; early types of a.c. meters; commutator-motor meters; development of mercury-motor meter; clockwork type, oscillating type and electrolytic meters; development of induction type meter; induction-meter art now standardized.

ELECTRIC MOTORS

CONDENSER. Single-Phase Condenser Motor, B. F. Bailey. Elec. World, vol. 91, no. 13, Mar. 31, 1928, pp. 647-652, 18 figs. Design, performance and operation of fractional-horse power, single-phase condenser motors; comparison of 2-phase and condenser motors; change of performance with capacitance. (Concluded.)

Single-Phase Condenser Motor, B. F. Bailey. Elec. World, vol. 91, no. 12, Mar. 24, 1928, pp. 597-599, 6 figs. Fractional-horse power motor characteristics; effect on economy of operation; application requirements; condenser-motor theory and operation; type of motor described is quieter than usual single-phase motor and causes less interference with radio reception.

ELECTRIC NETWORKS

SYNCHRONIZING. Maintaining Exact Synchronism Between Independent Power Systems, J. T. Lawson. Elec. Light and Power, vol. 6, no. 3, Mar. 1928, pp. 30 and 32, 3 figs. Adirondack Power and Light Corp. of N.Y. and Public Service Elec. and Gas Co. of N.J. requested to hold their system frequencies exactly at 60 cycles from 10 to 11 p.m.; on one day, experiment of attempting to hold exactly same frequency, without being connected.

ELECTRIC RECTIFIERS

MERCURY-ARC. Mercury-Arc Rectifiers. Power Engr. (Lond.), vol. 23, no. 264, Mar. 1928, pp. 87-88. Describes system of automatic control; regulation problem; transformer tapping switch; load relays; substation service control; unit starters.

ELECTRIC TRANSFORMERS

TESTING. Analysis of Current Transformer Test, E. C. Goodale. Elec. West, vol. 60, no. 3, Mar. 1928, pp. 150-152, 2 figs. Discussion of meter connections; standard well-known method of metering 3-phase, 3-wire circuit; in any a.c. watt-meter or watt-hour meter registration of each element is equal to voltage multiplied by "power component" of current multiplied again by transformation ratio. (Continuation of serial.)

ELECTRIC TRANSMISSION AND DISTRIBUTION

Buffalo. New Buffalo Unit Feeds 22-Kv. System Directly, C. MacIntosh. Elec. World, vol. 91, no. 11, Mar. 17, 1928, pp. 557-558, 3 figs. New turbo-generator feeds 22,000-volt system directly; it was designed for operation in conjunction with 3-phase auto-transformer, rated 66,667 kva., 12,000 to 22,500 volts, 25 cycles; transformer was constructed in single unit and is one of largest-capacity transformers ever built; system is equipped throughout with induction relays of usual type and ground relays which trip instantaneously on ground current.

ELECTRIC WELDING

Joint Testing. Static and Impact Tests of Electrically Welded Joints, R. J. Roark. Amer. Welding Society—Jl., vol. 7, no. 2, Feb. 1928, pp. 57-64, 9 figs. Tests were intended to form part of more extensive study of structural welding; results of these tests are presented in condensed form; purpose and method of testing; results.

Progress in. Progress in Electric Welding Practice (Fortschritte im elektrischen Schweissen). Elektrotechnische Zeit. (Berlin), vol. 49, no. 10, Mar. 8, 1928, pp. 381-382. Reviews recent progress in construction of spot, seam and butt-welding outfits; electric arc welding and its applications.

Spot. Spot Welding of Aluminum and Its Alloys, W. M. Dunlap. Am. Welding Soc.—Jl., vol. 7, no. 2, Feb. 1928, pp. 27-38, 7 figs. Spot-welding aluminum has been quite extensively studied in laboratories of Aluminum Co. of America.

ELECTRICITY SUPPLY

Rural, Ontario. Developments in Rural Distribution, R. E. Jones. Elec. News (Toronto), vol. 36, no. 5, Mar. 1, 1928, pp. 34-38, 9 figs. Choice of suitable voltage for rural distribution depends upon service and load requirements; Hydro-Electric Power Commission of Ontario effects economy by installing 8,000/4,000-volt, 3-phase lines; cost of available voltages compared; economical voltage for primary distribution; type of poles, 250-ft. span; measuring sag; 160-ft. span; secondaries.

Voltage Standardization. The Trend Toward 115 Volts. Elec. World, vol. 91, no. 14, Apr. 7, 1928, p. 743, 4 figs. Complete unification has not yet arrived, but strong trend toward standardization is evident from comparison of data on distribution voltages for 1928 with corresponding figures for 1923; entire state of New Jersey is served at 115 volts, with exception of four small communities.

F

FACTORY BUILDINGS

Welded Steel. Thousand-Ton Structure Welded. Iron Age, vol. 121, no. 12, Mar. 22, 1928, pp. 804-805, 5 figs. Large manufacturing building erected by General Electric Co.; structural steel fabricated and erection joints made by means of metallic arc welding; simplicity of joints in trusses and in erection details eliminates several thousand gusset plates and short angles; 11 per cent saving in steel effected; verifying skill of workmen; completed structure; five welders did work, each using single-operator motor-generator set. See also Iron Trade Rev., vol. 82, no. 12, Mar. 22, 1928, p. 780.

FLOOD CONTROL

Mississippi River. Flood Protection for the Mississippi Valley. Mech. Eng., vol. 50, no. 4, Apr. 1928, p. 333. Findings and recommendations of committee appointed by American Engineering Council to consider problems arising from Mississippi river floods.

FLOOD DISCHARGE

Discussion of. Maximum Flood Discharge in San Joaquin Valley, California, C. H. Lee. Am. Soc. Civ. Engrs.—Proc., vol. 54, no. 4, Apr. 1928, pp. 1235-1242, 1 fig. Discussion of paper by O. Reed continued from Feb. 1928 issue of Proceedings; writer's experience in estimating flood discharges from formulæ has led him to favour rational method rather than stream-group method; flood discharge depends on intensity of rainfall and amount of run-off finding its way immediately into drainage channels; rational method of estimating flood discharge was originally used in estimating maximum run-off from urban and suburban areas in connection with storm-sewer design.

FLOW OF STREAM

Orifices. Measuring Stream Flow in Pipes by Means of Ring Diaphragms (Beitrag zur Mengenmessung stroemenden Dampfes mittels Stauringen), W. Pflaum. Forschungsargeiten auf dem Gebiete des Ingenieurwesens (Berlin), no. 298, 1928, 41 pp., 59 figs. Report from mechanical laboratory of Danzig Institute of Technology on experiments for determination of discharge coefficient of steam flowing through orifices of pipe diaphragms, using ethylene bromide as pressure-indicating liquid and employing pressures from 3 to 11 atmos.; compares with results of earlier experiments, including Brandis, Spitzglass, Reschke, etc.

FLUMES

Transitions, Design. The Hydraulic Design of Flume and Syphon Transitions. Am. Soc. Civ. Engrs.—Proc., vol. 54, no. 4, Apr. 1928, pp. 1195-1215, 14 figs. Discussion of paper by J. Hinds continued from Dec. 1927 issue of Proceedings; flow of water through more common types of transition sections can be calculated quite accurately by methods which author discussed; tests were made in Hydraulic Laboratory of Technische Hochschule in Karlsruhe on two models of inlet transitions, two models of outlet transitions and three combined models of inlet and outlet connected by short piece of tunnel.

FORGING

Behaviour of Metal. The Behaviour of Metals and Alloys During Hot-Forging, W. L. Kent. Inst. of Metals—Advance Paper, no. 462, for mtg., Mar. 7-8, 1928, 18 pp., 6 figs. Also Engineering (Lond.), vol. 125, no. 3244, Mar. 16, 1928, pp. 331-333, 6 figs.

FOUNDATIONS

Theory. The Science of Foundations—Its Present and Future, W. S. Housel and F. S. Bailey. Am. Soc. Civ. Engrs.—Proc., vol. 54, no. 4, Apr. 1928, pp. 1243-1252, 3 figs. Discussion of paper by C. Terzaghi continued from Mar. 1928 issue of Proceedings; Housel describes tests to determine bearing value of soils; work done under conditions governing actual construction; every effort made to keep accuracy of data comparable to what might be obtained with similar set-up in laboratory; tests on piles and combinations of bearing plates and piles; measurements of lateral pressure and study of general phenomena of transmission of pressure in soils.

FURNACES

Electric. *See Electric Furnaces.*

Heat-Treating. Automatic Furnaces for Annealing and Heat-Treating. Am. Mach., vol. 68, no. 12, Mar. 22, 1928, p. 492, 4 figs. Four half-tones furnished by Warner Gear Co.; conveyor so timed as to maintain proper heat; hump furnaces used in heat-treating gears; each half-tone accompanied by brief description.

Forging and Heat-Treating of Long Cylinders, J. B. Nealey. Iron Age, vol. 121, no. 14, Apr. 5, 1928, p. 942, 2 figs. Special equipment installed at Miehle Printing Press & Mfg. Co.; vertical furnace to case-harden rollers and shafts; parts lowered into vertical retorts charged with small amount of carbonizing material; three-high furnace; upper chamber gets first impact of gas flame, and waste heat from it is passed down into other two; two halve hammers are used for swaging ends on press rollers.

Spring Heat-Treating Furnaces Automatically Controlled, F. Stones. Fuels and Furnaces, vol. 6, no. 3, Mar. 1928, pp. 373-376, 6 figs. Automobile spring heat-treating unit consists of hardening and tempering furnaces which are fired with oil and have temperature automatically controlled; cambering and hardening furnace of continuous type; hardening furnace of over-fired type; drawing furnace; tempering furnace of continuous type; each furnace is equipped with two controlling pyrometers and valves.

G

GAUGES

Dial Indicating. Dial Indicating Gauges. Iron Age, vol. 121, no. 13, Mar. 29, 1928, pp. 880-881 and 917, 5 figs. Devices designated as Mikrotasts for shop and inspection use show variations up to 0.00004 in. from master; used for measuring external and internal diameters and tapers; used for thread gauging; saddle gauges for checking rolls; gauges can be used on wet grinding operations; external taper gauging; checking internal tapers; pitch and root diameters of external threads checked; brought out by F. Krupp Corp., Germany.

GAS TANKS

Arc Welding. All-Welded Gas Holder Takes 258 Tons of Plates and Shapes, F. H. Beebe. Iron Age, vol. 121, no. 14, Apr. 5, 1928, pp. 941-942, 2 figs. Gas holder of 300,000 cu. ft. capacity, erected at Albion, Mich., believed to be largest all-welded low-pressure gas holder built; plates are erected with narrow overlap and held with bolts at wide spacing until welder completes seam; 4 tons of welding rod used; cups and grips were fabricated in shop, assembled in sections on ground and welded in place.

GASOLINE ENGINES

Lubrication. Petrol Engine Lubricants and Lubrication, C. I. Kelly. Instn. Petroleum Technologists—Jl. (Lond.), vol. 14, no. 66, Feb. 1928, pp. 115-132, 8 figs. There are two types of lubrication, boundary and fluid lubrication; temperature-friction curves for cylindrical bearing; most suitable oil crank-case work is one having best viscosity ratio, low carbon-forming tendencies, coupled with comparative freedom from sulphur and minimum susceptibility to oxidation.

GEARS

Involute, Tooth-Thickness Measurement. Measurement of the Thickness of Involute Gear Teeth, A. H. Candee. Am. Mach., vol. 68, nos. 11 and 14, Mar. 15 and Apr. 5, 1928, pp. 463-467, 7 figs., and 573-576, 2 figs.

Sheet-Metal, Pressed. Production of Gears, Segments and Sprockets from Sheet-Metal. Am. Mach., vol. 68, no. 14, Apr. 5, 1928, pp. 559-562, 6 figs. Gears made in pressed tools and types of dies employed; sheet-metal gears cannot be used when transmission of much power is necessary; selection of materials; limitations of sheet-metal gears; broaching internal-gear dies; producing segment gear; type-wheel segments have their teeth formed in three dies; shaving teeth handled in die; inspection gauges for punched gears.

GRINDING MACHINES

Surface. A New Heavy Surface Grinding Machine (Eine neue schwere Flaechenschleifmaschine), C. Krug. Maschinenbau (Berlin), vol. 7, no. 5, Mar. 1, 1928, pp. 224-226, 9 figs. Horizontal-shaft and vertical-shaft types of grinding machines; construction, drawings and description of new vertical-shaft grinding machine constructed by Diskus-Werke of Frankfurt, its outstanding features.

H

HACK SAWS

High-Speed Steel. Development of High-Speed Steel Hack Saws or Cutting-Off Saws, H. B. Allen. Am. Soc. Steel Treating—Trans., vol. 13, no. 4, Apr. 1928, pp. 603-613 and (discussion) 613-616 and 637, 1 fig.

HEAT TRANSMISSION

Solid to Fluid. Heat Transfer from a Hot Body Immersed in a Fluid in Motion (Waermeabgabe eines heissen Koerpers in bewegter Fluessigkeit), J. Schmekel. Zeit. fuer technische Physik (Leipzig), vol. 9, no. 2, 1928, pp. 49-57, 3 figs. Derives formula expressing effect of free cooling upon forced cooling; formula is confirmed by experiments; discrepancies between experiment and theory are accounted for by hydrodynamic factors.

Theory. Heat Transfer (Waermeuebertragung), M. Jakob. V.D.I. Zeit. (Berlin), vol. 72, no. 10, Mar. 10, 1928, pp. 341-344, 1 fig. Review of theories and experiments on heat transfer by natural convection with and without change of state, also by conduction and radiation; heat-radiation spectra; brief mention and abstracts of studies by leading German and non-German scientists.

Walls. Standard Test Code for Heat Transmission Through Walls, A. P. Kratz. Am. Soc. Heat. and Vent. Engrs.—Jl., vol. 34, no. 1, Jan. 1928, pp. 63-65. Code has been framed for purpose of defining certain standards, application of which, it is hoped, will bring results of different investigations into better conformity than is found at present time See also discussion in no. 3, Mar. 1928, pp. 267-280.

HYDRO-ELECTRIC POWER DEVELOPMENTS

Canada. The Water Powers of Western Canada, E. L. Chicanot. Water and Water Eng. (Lond.), vol. 30, no. 351, Mar. 20, 1928, pp. 117, 119-121, 3 figs. In four western provinces of Manitoba, Saskatchewan, Alberta and British Columbia, water powers with total of 6,190,395 h.p. available at ordinary minimum flow, 34 per cent of Dominion's total; Manitoba most abundantly endowed with water power resources; Alberta has within its boundaries coal reserves and important water powers; 400,000 h.p. already developed in British Columbia.

Quebec. Hydraulic Power Developments in Quebec. Engineer (Lond.), vol. 145, no. 3767, Mar. 23, 1928, pp. 313-314, 5 figs., partly on p. 322. Total water power resources is estimated to be 8,459,000 h.p. under conditions of ordinary minimum flow, or 13,064,000 h.p. available for six months of year; St. Lawrence is outstanding power river with 2 to 2½ million h.p. available; Ottawa river and its Quebec tributaries provide power possibilities of 1,000,000 to 1,600,000 h.p.; Saguenay, with its tributaries, has total of 1,260,000 h.p. to 1,530,000 h.p.; St. Maurice river is largest present source of power in province.

I

ICE PLANTS

Oil-Engine Drive. Addition to an Ice Plant Returns 100 Per Cent Profit, E. J. Kates. Power, vol. 67, no. 12, Mar. 20, 1928, pp. 516-518, 4 figs. Describes extension to oil-engine plant built in 1926 by Nassau Consumers' Ice Co. at East Rockaway, N.Y.; combined compressor-generator unit was installed; this is 60-h.p. Diesel, direct-connected both to 40-kw. generator and through flexible coupling to two-cylinder vertical single-acting Carbondale compressor of 32-ton refrigerating capacity.

INDUSTRIAL MANAGEMENT

PROSPERITY PLANNING. Must Prosperity Be Planned? H. B. Brougham. Taylor Soc.—Bul., vol. 13, no. 1, Feb. 1928, pp. 2-8 and (discussion) 12-22. Discusses problem as to whether effective demand can be adapted, controlled and graduated in step with constant increases in productive capacity; analysis indicates that savings in process, whether by superior force or organization or by improved machinery, tend to accumulate in form of unused facilities; outlets into "non-productive" public works; outside field of non-productive public work lies domain of new and productive private industries.

REORGANIZATION. More Thinking Needed at the Top, S. Norvell. Iron Age, vol. 121, no. 12, Mar. 22, 1928, pp. 797-798. Methods of manufacturer in reorganizing to cut costs; sales department reorganized with eye to profits; conservative factory superintendent blocked changes, and engineer was hired to introduce new methods; success of large companies due to emphasis on getting results; lack of thinking at top main weakness of business; competition that proved mythical.

INSULATION (ELECTRIC)

MEASUREMENT. Instruments for the Measurement of Electrical Insulation, A. Watson. Instruments, vol. 1, no. 3, Mar. 1928, pp. 141-145, 1 fig. Measurement of true insulation qualities regarding life of material; leakage over surface and through material; insulation value measured by Wheatstone bridge method, high resistance galvanometer method and by megohmmeter, which reads directly in megohms; testing high-tension cables by kenotron tube with transformers; selection of test potentials. (Concluded.)

INTERNAL-COMBUSTION ENGINES

See Airplane Engines; Automobile Engines; Diesel Engines; Gasoline Engines; Oil Engines.

IRON CASTINGS

DEFECTS. Hidden Defects in Iron Castings, P. R. Ramp. Iron Age, vol. 121, no. 12, Mar. 22, 1928, pp. 791-793 and 841, 4 figs. Method of localizing shrink cavities and blowholes to places where they can do no real harm to casting; locating hidden defects; insufficient metal pressure on surface of moulds and cores is cause; dense and strong metal occurs naturally at lowest point; where gases go; defects caused by chaplets; other types of hidden defects.

IRON ORE

ONTARIO. Is Ontario Iron Ore a Marketable Product? H. C. Braund. Can. Machy. (Toronto), vol. 39, no. 5, Mar. 8, 1928, pp. 29-31 and 65, 1 fig. Highly probable that Ontario will supply raw material for central Canadian iron and steel industry of future; Canada consumes roughly 1,500,000 tons of iron ore annually; Ontario's developed iron-ore mines; effort must be concentrated on known bodies of ore; greatest progress has been made in sintering; many reasons why iron-ore mining should be fostered in Ontario.

IRRIGATION

WATER RECOVERY. Return Water and Drainage Recovery from Irrigation. A Symposium. Am. Soc. Civ. Engrs.—Proc., vol. 54, no. 4, Apr. 1928, pp. 1097-1107, 3 figs. Contains following contributions: Return Water, North Platte River, Nebraska, R. H. Willis: To determine quantity of return water in any irrigated area, it is necessary that full co-operation be maintained between State Department and managers of those projects diverting water from stream. Drainage Recovery from Irrigations, D. W. Murphy: Quantity that can be recovered depends largely on character of underground formation; feasibility of recovering irrigation wastes through drainage.

L

LATHES

CUTTING-TIME CHARTS. Graphical Cutting-Time Charts for Lathes (Graphische Laufzeittafel fuer Drehbaenke in Verbindung mit AWF-Richtwerten), L. Boettcher. Maschinenbau (Berlin), vol. 7, no. 5, Mar. 1, 1928, pp. 227-229, 2 figs. Presents charts, based on standards adopted by German AWF (Committee on Economic Production), giving directly time of running of lathe for various materials and types of cutting; illustrative examples.

LEVELING

ANEROID. Leveling with an Aneroid, G. Hearn. Engineer (Lond.), vol. 145, nos. 3765, 3766 and 3767, Mar. 9, 16 and 23, 1928, pp. 270-271, 296-297 and 324-325, 1 fig. Mar. 9: In aneroid, pressure-gauge mercury column is replaced by chamber, usually of aluminum corrugated for greater strength and exhausted of air; specification of aneroid chosen by writer. Mar. 16: Theory of calculation of heights from differences of pressure, corrected for temperature. Mar. 23: Methods of carrying out ground survey with aneroid are summed up; aneroids procured should have open scale, extending at least inch on either side of pressures anticipated.

LIMESTONE

CONCRETE AGGREGATE. Usefulness of Petrology in the Selection of Limestone, G. F. Loughlin. Rock Products, vol. 31, no. 6, Mar. 17, 1928, pp. 50-59, 15 figs. Attention to petrology would save much money spent on misdirected quarrying; clayey limestone, used as coarse aggregate in concrete, considered unsound from standpoint of weathering; clayey character sometimes not recognized by physical tests and ordinary methods of inspection; long-time tests are essential to prove quality of stone.

LIQUIDS

FRICTION OF. A New Theory of Liquid Friction (Nuova Teoria dell'Attrito dei Liquidi), C. F. Mancini. Industria (Milan), vol. 42, no. 3, Feb. 15, 1928, pp. 66-70, 3 figs. Theoretical mathematical analysis; first chapter treats of principles of hydrodynamics bearing on this analysis. (To be continued.)

LOCOMOTIVES

BATTERY-OIL-ELECTRIC. Battery-Oil-Electric Locomotive. Ry. Elec. Engr., vol. 19, no. 3, Mar. 1928, pp. 78-80, 4 figs. Novel type of power is being tried by New York Central for service on West Side lines in New York City; since locomotive will be used mainly in yards that are not electrified, a 300-h.p. oil engine direct-connected to a 200-kw. generator is provided for charging battery; as locomotive will be called on at times to operate over tracks which are electrified, third-rail shoes are provided and also overhead collector; mechanical design; traction motors; control; battery; meters; engine and generator; weights and dimensions.

DIESEL. Diesel Engines for Railroad Traction, D. L. Bacon. Ry. Age, vol. 84, no. 11, Mar. 17, 1928, pp. 635-638. Discussion of adaptability, weight and cost per horse power and types of transmissions; Kitson-Still engine incorporates steam and Diesel cycles at opposite ends of double-acting cylinders; clutch and gear drive transmission; comments on shape of tractive-force curve. Abstract of paper presented before New England Railroad Club.

ELECTRIC. *See Electric Locomotives.*

HIGH-PRESSURE. Advancement and Advantages of High Boiler Pressures, W. G. Tawse. Ry. and Locomotive Eng., vol. 41, no. 1, Jan. 1928, pp. 5-7, 1 fig. Compounding either 2, 3 and 4 cylinders employed to secure full advantage of higher pressures; salient features of some high-pressure boilers; Berlin Machine Works, Germany, are developing 2,500-h.p. locomotive on Loeffler system with steam at 1,450 lb.; 2,000-h.p. Ljungstrom turbine locomotive for London, Midland and Scottish Ry.; Krupp Works of Germany have built 2,800-h.p. turbo-locomotive using Zoelly-type turbine.

OIL-BURNING. Furnace Conditions in Oil-Burning Locomotives, G. M. Bean. Ry. and Locomotive Eng., vol. 41, no. 1, Jan. 1928, pp. 7-9.

PULVERIZED COAL. The A.E.G. Pulverized Coal Locomotive (Die AEG-Kohlenstaub-Lokomotive), D. W. Kleinow. Glasers Annalen (Berlin), vol. 102, no. 5, Mar. 1, 1928, pp. 59-62 and (discussion) 62-70, 11 figs. Report on trial trips of first A.E.G. pulverized coal locomotive; merits of firing of locomotives with pulverized coal, economy and costs; discussion by Hinz and Landsberg. (Concluded.)

LUBRICANTS

VISCOSITY. The Viscosity of Lubricants at High Pressure. Engineering (Lond.), vol. 125, no. 3243, Mar. 9, 1928, p. 281. Review of investigation by National Physical Laboratory in hope that light might be thrown upon reason for relative inferiority of mineral lubricants, as compared with those of animal and vegetable origin; contrary to expectation, viscosity of mineral oils was found to increase more rapidly than that of their rivals.

M

MACHINE-SHOP PRACTICE

AMERICAN. American Machining Methods, J. G. Young. Automobile Engr. (Lond.), vol. 18, no. 239, Mar. 1928, pp. 93-96, 5 figs. Observations on modern machining practice with particular reference to broaching and honing; broaching small quantities; special broaching operations; hydraulic broaching; honing or grinding; possibilities of new method of grinding. Abstract of paper presented to Inst. Production Engrs.

MACHINE TOOLS

ALIGNMENT. Accuracy in Large Machine Tools, H. K. Smith and W. C. Wais. Am. Mach., vol. 68, no. 14, Apr. 5, 1928, pp. 581-583, 11 figs.

CHARTS FOR. Charts for Metal-Cutting Machine Tools (Maschinenkarten fuer spanabhebende Metallbearbeitung), F. Kresta. Sparwirtschaft (Vienna), no. 2, Feb. 1928, pp. 80-87, 12 figs. Criticizes machine charts published by German AWF (Committee for Economic Production) and offers series of original alignment charts for operation of shapers, planers and other machine tools.

ELECTRIC FEED. Modern Feed Regulation of Machine-Tools (Neuzeitliche Steuerungen fuer Werkzeugmaschinen-Antriebe), O. Pollok. Elektrotechnik und Maschinenbau (Vienna), vol. 46, no. 10, Mar. 4, 1928, pp. 215-218, 8 figs. Describes and discusses special use of A.E.G. motors for feed regulation of planers and lathes.

FINISHING BY GRINDING. Finishing by Machine Supersedes Costly Scraping by Hand, L. Sichel. Iron Trade Rev., vol. 82, no. 11, Mar. 15, 1928, pp. 685-686, 3 figs.

MANUFACTURE. Accuracy in Large Machine Tools, H. K. Smyth and W. C. Wais. Am. Mach., vol. 68, no. 13, Mar. 29, 1928, pp. 527-530, 10 figs. Methods used in Niles plant for securing accuracy in large machine tools; constant temperature maintained in room where standard gauges are kept; long measuring machine; aligning large machine tools; all cylindrical work finished by grinding; system of rigid tool inspection; all reamers are of inserted-blade type; reaming machine.

MASS PRODUCTION. Special Mass Production Machines. Am. Mach., vol. 68, no. 12, Mar. 22, 1928, p. 504, 4 figs. Details of special machine tools for mass production illustrated by 4 half-tones, each accompanied by short description; device for feeding steel tubes into centreless grinder; machine that makes wooden spoolheads from blocks containing number of holes; attachment from feeding hard rubber tubes into centreless grinder.

PNEUMATIC OPERATION. Pneumatic Machine Tools and Equipment for Manufacturing Plants (Pressluftwerkzeugmaschine und Pressluftvorrichtung in der Fertigung), K. Bollinger. Maschinenbau (Berlin), vol. 7, no. 5, Mar. 1, 1928, pp. 215-218, 9 figs.

MACHINERY

LEIPZIG EXHIBITION. The Leipzig Fair. Engineering (Lond.), vol. 125, no. 3243, Mar. 9, 1928, pp. 282-286, 23 figs., partly on supp. plates. Comparison of British Industries Fair with Leipzig Fair; main object of both is to market well-established products; this is why appeal is rather to non-expert user than to expert producer; in organization of means to attain this end, Leipzig is superior to Birmingham; permanency is keynote; most impressive section of Technical Fair is large building known as Hall 9, organized by German Assn. of Machine Tool Mfrs.; review of machine-tool exhibits and other machinery, including internal-combustion engines, concrete mixers, etc.

The Technical Fair at Leipzig. Engineer (Lond.), vol. 145, no. 3766, Mar. 16, 1928, pp. 284, 286, 10 figs. Fair is marked chiefly by construction of new hall for exhibtion of commercial road vehicles; predominant type of motor vehicles appear to be single-deck motor buses, though trucks, tipping wagons, fire-service vehicles, tradesmen's delivery tricycles, etc., were represented; bulk of exhibits were German; review of machine-tool exhibits; and exhibits of Committee for Economic Production, consisting of collection of examples of special mechanical motions.

MALLEABLE IRON

MANUFACTURE. Manufacture of Malleable Iron, D. A. E. White. Can. Foundryman (Toronto), vol. 19, no. 3, Mar. 1928, pp. 11-14, 20 figs. Composition, physical properties and structural constituents; time required to produce equilibrium in iron-carbon alloys used in making malleable cast iron varies from 4 hours at 1,800 deg. Fahr. with high-silicon alloys to 275 hours at 1,400 deg. Fahr. for medium-silicon alloys and longer for low-silicon alloys; combined carbon for equilibrium conditions; maximum cooling rate compatible with successive maintenance of equilibrium found.

METAL MINING GEOLOGY

BRITISH COLUMBIA. Silver-Lead-Zinc Veins at Atlin, B.C., H. E. McKinstry. Eng. and Min. Jl., vol. 125, no. 12, Mar. 24, 1928, pp. 495-497, 2 figs. Deposits on Vaughan mountain, 14 miles west of Atlin, B.C.; fissure veins along walls of dikes in granite or quartz monzonite; chief value of ore in silver; lead and zinc; with some gold; Prof. Berkey cited as to relative ages of some ore minerals; ruby silver conspicuous in one orebody recently opened.

MANITOBA. Copper-Zinc and Gold Mineralization in Manitoba, R. C. Wallace. Am. Zinc Inst.—Bul., vol. 11, nos. 3-4, Mar.-Apr. 1928, pp. 43-47 and 52 and 61. Reprint from Can. Min. and Met.—Bul., Feb. 1928, pp. 264-273. See also editorial and sketch map in Min. Mag., Mar. 1928, pp. 130-131. See Eng. Index card no. 28-5680.

MILLING

LARGE-RADIUS ARCS. Milling Arcs of Large Radii, E. V. Erickson. Machy. (N.Y.), vol. 34, no. 8, Apr. 1928, p. 585, 1 fig. Method of cutting arc of large radius with milling cutter of ordinary dimensions; basis for method lies in fact that portions of perimeter of ellipse approximate very closely arc of circle; if work and cutter assume some intermediate position, arc of ellipse will be cut; definite relation exists between intermediate position and radius of portion of perimeter of ellipse.

MINERALS

PRODUCTION STATISTICS, CANADA. Mineral Production of Canada During 1927. Can. Min. Jl. (Gardenvale, Que.), vol. 49, no. 11, Mar. 16, 1928, pp. 232-233. Comparative figures for 1927 and 1926, provided by Dominion Bureau of Statistics; details for provinces; total values, $244,520,098, show increase over $4,000,000 compared with record production of 1926; coal is largest single item of value, amounting to $61,809,672, showing increase of nearly $2,000,000.

MOULDING MACHINES

SAND PROJECTION. A New Machine for Moulding by Projection of Sand (Une nouvelle machine à mouler par projection de sable). Pratique des Industries Mécanique (Paris), vol. 10, no. 12, Mar. 1928, p. 515, 1 fig. Describes machine which projects sand into moulds by means of compressed air; does away with hand tamping of sand in mould.

MUNICIPAL BUILDINGS

CONSTRUCTION. Handling a City Hall Job, S. Fullerton. Contractors' and Engrs'. Monthly, vol. 16, no. 3, Mar. 1928, pp. 173-175, 6 figs. In new city hall of Columbus, Ohio, walls are of buff Bedford Indiana limestone, backed up with brick; preparation and construction of foundations; stiff-leg derricks cut labour costs; concrete plant; brick laying terrace pavement; setting stone columns; self-supporting stairway.

N

NICKEL METALLURGY

HISTORY OF. Nickel, Its Metallurgy and Its Applications (Le nickel, sa metallurgie et ses applications). Revue Générale de l'Electricité (Paris), vol. 23, no. 10, Mar. 10, 1928, pp. 455-461. History of nickel; principles of nickel metallurgy; nickel from New Caledonia and from Canada; applications of nickel, casting, alloys, plating. Review of papers presented at Conservatoire National des Arts et Métiers during "Nickel Week" in Paris.

O

OFFICE BUILDINGS

FOUNDATIONS. The Foundations for the New Building of the Royal Bank of Canada, Montreal, C. S. Proctor. Eng. Jl. (Montreal), vol. 11, no. 2, Feb. 1928, pp. 133-139, 11 figs. General discussion of features of design and methods adopted for foundations of this building; choice of type of substructure design; foundation materials; types of foundation settlement in yielding material; governing features of design.

OIL ENGINES

HEAVY-OIL. Heavy-Oil Engine Working Costs. Engineer (Lond.), vol. 145, no. 3764, Mar. 2, 1928, pp. 246-247. Summary of report to Diesel Engine Users' Assn.; average total engine cost of 41 home stations with total output of 44,000,000 units and average annual plant load factor of 14.7 per cent was 0.713 pence per unit generated, which compares favorably with corresponding figure of 0.799 pence for previous year.

OPEN-HEARTH FURNACES

GAS FLOW. Gas Flow in Open-Hearth Furnaces, K. Feller. Blast Furnace and Steel Plant, vol. 16, no. 3, Mar. 1928, pp. 373-375, 1 fig. Abstract of studies made on flow of gas and gas composition in various types of open-hearth furnaces; conditions of combustion and location of flame; tilting furnace; experiments on models; as result of temperature-variations during gas period, composition of gas in port alters as function of preheating temperature.

HEAT LOSSES. Certain Relations Between Refractory Service, Insulation and the Flow of Heat in the Open-Hearth Furnace, B. M. Larsen and A. Grodner. Min. and Met. Investigations—Bul., no. 32, 20 pp., 12 figs. Irrespective of how much heat is lost through walls of open-hearth, inner surface temperatures must remain about same to make possible given rate of steel production; inner wall and bath temperatures are controlled essentially from within furnace.

ORE REDUCTION

PROCESS FOR. A Process for the Extraction of Zinc and Other Metals from Ores, H. E. Coley. Am. Zinc Inst.—Bul., vol. 11, nos. 3-4, Mar.-Apr. 1928, pp. 30-40 and 60. Reprint from Instn. of Min. and Met.—Bul, Jan. 1928, pp. 1-11, and editorial from Min. Mag. citing Dec. 1926 issue. See Eng. Index Card No. 28-2983.

OXY-ACETYLENE CUTTING

REPAIR WORK WITH. Emergency Repairs to Sheet Mill Drive Made by Cutting Blow Pipe and Oxygen Lance, W. I. Gaston. Iron Age, vol. 121, no. 11, Mar. 15, 1928, p. 735, 1 fig. Manner in which cutting blow pipe saved $1,900 in repairing main drive gear; 470 cu. in. of cast steel cut away in order to renew grip on shaft; required 14 hrs. for five men to remove bolts and do this job of cutting; cost amounted to about $110; section cut was 3 ft. 11 in. in length and 15½ in. in breadth; how shaft was protected and work done.

P

PIERS

RECONSTRUCTION. Reconstruction of New Holland Pier (England). Engineer (Lond.). vol. 145, no. 3764, Mar. 2, 1928, pp. 228-230, 8 figs. Pier, which is 1,370 ft. long and 35 ft. 6 in. wide, was originally constructed of timber, and consisted of 27 bays; reconstruction work was carried out under three contracts in 1922, 1924 and 1925, and included sinking of 44 steel and cast-iron cylinders as additional support, building of new superstructure and reconstruction of substructure.

PIPE

WELDED, MANUFACTURE OF. Modern Methods of Manufacturing Welded and Seamless Pipes (Die Neuzeitliche Fabrikation von geschweissten und nahtlosen Roehren), H. Schumacher. Werkstattstechnik, vol. 22, no. 3, Feb. 1, 1928, pp. 61-66, 17 figs. Description of modern Berman machines and processes for rolling, drawing, cutting, trimming, welding, thread cutting, etc., of metal pipes and tubes for gas and water supply.

PIPE BENDS

NEW PROCESS. Pipe Bends Made by New Process. Iron Age, vol. 121, no. 14, Apr. 5, 1928, pp. 933-934, 3 figs. Forcing hot pipe over horn-shaped mandrel produces short-radius bends without buckling at inside of turn or excessive thinning at outer diameter; methods of Pipe Bending Process Co.; manufacturers believe definite series of bends with long and short radius will take care of practically every requirement in way of fitting for welded piping; steel, copper, brass, aluminum and special alloys successfully formed into short-radius bends; equipment consists of gas furnace, special mandrels and hydraulic press.

PIPING

POWER PLANTS, WELDING. Welding of Power Plant Piping, A. W. Moulder. Am. Welding Soc.—Jl., vol. 7, no. 2, Feb. 1928, pp. 8-20, 16 figs. Presentation is intended to cover subject as it relates to fusion welding of power plant piping only and is not intended to relate to forge or hammer-welding process; discussion is based upon use of oxy-acetylene rather than electric-arc process; primarily for reason that former process is one which has been found most practical for work of this kind; advantages of welding power-plant piping.

POWER FACTOR

IMPROVEMENT. The Reactive Component in A.C. Circuit, V. E. Johnson. Power Plant Eng., vol. 32, no. 7, Apr. 1, 1928, pp. 405-408, 2 figs. General principles governing power-factor improvement; correction by rearrangement or changing of motors, by external sources of wattless current, and by addition of loads with high power factor. (Continuation of serial.)

POWER PLANTS, ELECTRIC

SUBSTATIONS. Extend Sub-Station System in Toronto. Power House (Toronto), vol. 22, no. 3, Feb. 5, 1928, pp. 25 and 44, 2 figs. Two substations are being added to Toronto Hydro-Electric System; at Parkdale substation single-phase, 1,000-kva. transformers are installed; John St. station has five transformers, water-cooled, 13,200- to 2,400-volt, 3-phase, each of 1,500 kva.; station will be remote-controlled by means of supervisory control system developed by Toronto Hydro-Electric System.

Automatic Power Supply for Cincinnati Railway. Elec. Ry. Jl., vol. 71, no. 11, Mar. 17, 1928, p. 443. Automatic substation system distributes power to trolleys by means of 19 automatic substations, without attendants; superimposed over automatic operation of these stations will be central dispatcher; each station functions in automatic sequence.

POWER PLANTS, HYDRO-ELECTRIC

IRELAND. The Shannon Power Plant. Engineer (Lond.), vol. 145, no. 3767, Mar. 23, 1928, pp. 318-320, 10 figs. Describes plant that is to be erected in generating station at Ardnacrusha; at outset there are to be three turbines, each capable of giving maximum output fo 38,600 h.p., two of which are being supplied by J. E. Escher, Wyss and Co., of Zurich; useful head of water at power station will depend on ebb and flow of tide in lower part of Shannon, and head will vary from 86.7 to 110.6 ft.

LOUISVILLE, KY. The New Ohio River Power Plant of Louisville Hydro-Electric Co. Water Works, vol. 67, no. 3, Mar. 1928, pp. 123-125, 5 figs. 100,000-kw. hydro-electric station under automatic control; present installation consists of eight 12,500-kva., vertical-shaft generators operating on terminal voltage of 14,000; principal unique feature of station is electrical layout; interesting engineering feature of station; advantages of automatic switching.

POWER PLANTS, STEAM

CHEMICAL PLANTS. A Power Station for a Chemical Works. Engineer (Lond.), vol. 145. no. 3766, Mar. 16, 1928, p. 299. Particulars of contract secured for plant of new power house by Metropolitan-Vickers Electrical Co.; contract is for 9 turbo-alternator sets, with aggregate output capacity of 93,000-kw. to form equipment of new power station for large chemical works under construction for Synthetic Ammonia and Nitrates, Ltd., at Billingham; combined power and process systems will be applied on unusually large scale.

DETROIT, MICH. The Trenton Channel Station, Detroit, Michigan, U.S.A. Engineering (Lond.), vol. 125, nos. 3245 and 3246, Mar. 23 and 30, 1928, pp. 342-345 and 369-371, 17 figs. Mar. 23: Whole of output of Trenton Channel is delivered to 120,000-volt system, mainly through two substations about equidistant from plant; output voltage is so regulated as to provide required voltage at these substations; this feature has had considerable influence on design of plant. Mar. 30: Coal unloading arrangements.

RECORDING INSTRUMENTS. RECORD STRIPS FOR. Standardized Record Strips for Boiler Instruments, H. Doevenspeck. Eng. and Boiler House Rev. (Lond.), vol. 41, no. 9, Mar. 1928, p. 447. According to form of record, recording instruments may be classified as disk, drum and continuous recorders; charts with standardized ruling can be produced more cheaply and used to greater advantage than variety of papers; author reproduces standard rulings recommended by German Industrial Standards Assn., together with particulars of rates of paper feed recommended for various purposes. Abstract translated from Waerme, Dec. 31, 1927, p. 875.

PULVERIZED COAL

COMBUSTION. Heat-Power Research (Versuche aus dem Gebiete der Waermekraftforschung), M. Jakob. V.D.I. Zeit. (Berlin), vol. 72, no. 11, Mar. 17, 1928, pp. 379-380, 1 fig. Report on papers and discussions at fourth conference of German commission for research in heat engineering; review of papers on steam-discharge measurements, specific heat of superheated high-pressure steam, combustion phenomena in engines, combustion of pulverized coal under compression, etc.

PUMPS, CENTRIFUGAL

DRAINAGE. Turbine Pumps Solve Drainage Problems of Merced Irrigation District, California, J. H. McCormick. Hydraulic Eng., vol. 4, no. 3, Mar. 1928, pp. 131-133 and 181, 5 figs. Prolonged irrigation raised water table which was successfully lowered by installation of turbine pumping equipment; type of soils; open ditch drainage; test wells; pumps are self-priming and are equipped with automatic control devices to start them; method of drainage; this system does away with waste ground and unsightly spoil banks of open ditches.

LOSSES. A New Method of Separating the Hydraulic Losses in a Centrifugal Pump, M. D. Aisenstein. Hydraulics (A.S.M.E. Trans.), vol. 50, no. 3, Jan.-Apr. 1928, 4 pp. and (discussion) pp. 4-7, 9 figs. Particulars of method by means of which friction and shock losses of given pump may be determined separately from its head-capacity curve, together with illustrative example.

PERFORMANCE. A Method of Analyzing the Performance Curves of Centrifugal Pumps, J. Lichtenstein. Hydraulics (A.S.M.E. Trans), vol. 50, no. 3, Jan.-Apr. 1928, 12 pp. and (discussion) pp. 12-16, 25 figs. Development of analytical and graphical methods of determining correction factors from test curves for use in bringing theoretical pump equations into harmony with practice; author uses five correction factors which are to be deduced from ordinary performance curves; graphical analysis of 10-in. Bethlehem centrifugal pump tested at 1,150 r.p.m., based mainly on b.h.p. curve; only curves obtained by direct measurement of b.h.p. through torsion or electrical dynamometers should be used.

R

RACKS, TRASH

ELECTRIC HEATING. Heating Trash Rack Bars Electrically, C. R. Reid. Elec. News (Toronto), vol. 36, no. 6, Mar. 15, 1928, pp. 29-32, 9 figs. Severe frazil-ice conditions successfully combated at Shawinigan Falls by using 227.1 watts per cu. ft. of water passing per sec.; details of installation and empirical formula; electric heating of racks is of particular value in locations where frazil ice trouble develops quickly and is not of long duration. Abstract of paper presented at Eng. Inst. Can.

RADIO ANTENNAS

CALCULATION. Methods, Formulæ and Tables for the Calculation of Antenna Capacity, F. W. Grover. U.S. Bur. of Standards—Sci. Papers, no. 568, Jan. 9, 1928, pp. 569-629, 13 figs. Antenna and resulting potential is calculated; formulæ are given for common types of single- and multiple-wire antennas in form convenient for numerical computation, together with tables of constants which will be found useful in such calculations; tables of capacities of both horizontal and vertical single-wire and horizontal two-wire antennas have been included.

RADIO

CHOKE COILS. The Measurement of Choke Coil Inductance. C. A. Wright and F. T. Bowditch. Inst. Radio Engrs.—Proc., vol. 16, no. 3, Mar. 1928, pp. 373-384, 6 figs. Study undertaken in order to develop reliable method suitable for comparative rating of such coils; presents modifications of such method, together with series of measurements exemplifying them; first, modification of ammeter-voltmeter method of measurement; second, modification of voltmeter-ammeter method of measurement; third, modification of ammeter-voltmeter method of inductance measurement.

RECEIVING APPARATUS. Direct-Coupled Detector and Amplifiers with Automatic Grid Bias, E. H. Loftin and S. Y. White. Inst. Radio Engrs.—Proc., vol. 16, no. 3, Mar. 1928, pp. 281-286, 6 figs. System for direct-coupling of vacuum tubes to give composite detection and amplification; unique method of automatically regulating system to be responsive to carrier currents of different intensities; includes extension of automatic effect to volume control.

RAILROADS

GRAIN TRANSPORTATION, CANADA. Moving the Canadian Grain Crop. Ry. Age, vol. 84, no. 11, Mar. 17, 1928, pp. 621-628, 8 figs. Efficient operating methods and expenditure of millions for facilities aid Canadian Pacific; car-distribution problem; distribution of locomotives; operations on grain divisions; concentration points used; methods of securing extra men; Transcona yard operations; operations at Fort William-Port Arthur. (To be concluded.)

TERMINALS, FOUNDATIONS. Deepest Open-Pit Foundations for Cleveland Union Terminal, F. W. Skinner. Bldg. Age, vol. 50, no. 3, Mar. 1928, pp. 134-135, 4 figs. Foundations were carried down 260 ft. below curb; pilot holes of small diameter were driven by earth augers in bottoms of wells in advance of their excavation.

TERMINALS, REINFORCED CONCRETE. French Railway Station Built of Reinforced Concrete, A. M. Roos. Eng. News-Rec., vol. 100, no. 11, Mar. 15, 1928, pp. 447-448, 4 figs. Paris-Orléans Railroad incorporates massive arches and beams in its new terminal at Limoges; terminal is 310 ft. by 260 ft. in plan and is built over ten tracks; illustrations giving idea of extent and character of details of structure.

TIES, CONCRETE. Concrete Ties on the Pennsylvania Railroad, F. S. Bowden. Cornell Civ. Engr., vol. 36, no. 6, Mar. 1928, pp. 145-147 and 165, 5 figs. Construction of tie is shown; designed to carry locomotive wheel of 127,200 lb.; casting ties, gang-type moulds were used, each gang consisting of about 100 moulds; railroad men have expressed various opinions about probable utility of this new type of tie.

Concrete Sleepers, R. N. Stroyer. Concrete and Constr. Eng. (Lond.), vol. 23, no. 3, Mar. 1928, pp. 256-262, 16 figs. None of usual forms of concrete ties seems to have allowed for special dynamic application of forces that occur in this kind of structural member; set of curves shown illustrates shock action on deflection of test beam; latest forms of concrete ties endeavour to embody principles of correct weight distribution and shock absorption, and do away with weak centre portion; Stent tie embodying some of these principles now being experimented with by London & North Eastern Ry.

TIES, STEEL. Steel Ties in Beam Type Base, C. A. Smith. Elec. Traction, vol. 24, no. 3, Mar. 1928, pp. 143-144, 3 figs. Georgia Power Co. constructs track, using steel ties in beam construction, designed to eliminate rail corrugation; construction is very similar to timber-tie construction, steel ties being spaced approximately 6 ft. apart, centre to centre, first steel tie construction was built about one year ago, and so far very little corrugation has developed.

TRACKS, WEEDING. Mowing Weeds by Electric Power, E. P. Roundey. Elec. Traction, vol. 24, no. 3, Mar. 1928, p. 144, 1 fig. Utica division of N.Y. State Rys. constructs power mower from bonding car; 50 miles of track to be mowed; use bonding machine for power; two standard mowing knives were purchased and rigged to car; one knife, over 5 ft. long, was used on side of car; knife 9 ft. long was fastened across front of car to cut between rails of track; heaters furnish resistance.

RAILWAY MOTOR-CARS

GASOLINE-ELECTRIC. Gas-Electric Car of the Toronto, Hamilton and Buffalo. Ry. and Locomotive Eng., vol. 41, no. 2, Feb. 1928, pp. 33-34, 2 figs. Power is supplied by Winton 6-cylinder, 275 h.p. gasoline engine; at 1,050 r.p.m. generator has continuous rating of 420 amperes at 440 volts; power plant is mounted crosswise of car, with generator directly behind operator; gearing is suitable for maximum operating speed of 60 m.p.h.

What the Gas-Electric Car Means to the Railroads, W. R. Stinemetz. Ry. Age, vol. 84, no. 13, Mar. 31, 1928, pp. 753-755, 2 figs. Typical example of average month's operation of motor car and trailer, actually substituted for branch-line steam train; multiple-unit gas-electric trains; fuel costs as compared to steam locomotives are less; provides more flexible means of handling varying crowds of traffic by always having full powered train irrespective of size.

STORAGE-BATTERY. Edison Storage-Battery Rail Car Successful in Canterbury District (N.Z.). New Zealand Rys. Mag. (Wellington), vol. 2, no. 10, Feb. 1, 1928, pp. 10-11, 1 fig. Careful consideration was given to question of comparative cost as between rail car and steam driven train before experiment was launched; car can run approximately 100 miles on one battery.

RAILWAY REPAIR SHOPS

QUEBEC. New Repair Shop at Quebec. Elec. Ry. Jl., vol. 71, no. 10, Mar. 10, 1928, pp. 389-391, 9 figs. Main shop building and carhouse were constructed; additions provide boiler room, general storeroom and lumber storage; interior transfer tables not affected by extreme winter conditions; Quebec Railway, Light, Heat and Power Co., at Limoilou, supplies all electric power and gas used in vicinity of Quebec and operates city tramway system as well as 25-mile suburban line; list of various machine tools is given on accompanying plan.

REFRIGERATING MACHINES

CARBON DIOXIDE. Carbon Dioxide Refrigerating Machines, J. C. Goosmann. Power, vol. 67, no. 12, Mar. 20, 1928, pp. 518-519. Early experiments with carbon dioxide; modern compressor designs; increasing machine output. Abstract of paper read before Milwaukee Eng. Soc.

COMPRESSOR CHARTS. Practical Tonnage Chart, G. V. Rupp and H. W. Whiting. Ice and Refrigeration, vol. 74, no. 3, Mar. 1928, p. 274, 1 fig. Presents chart with variable-compressor size, back pressures and speeds, and with volumetric efficiencies taken approximately as average of various makes of vertical single-acting compressors; calculations are based on U.S. Bureau of Standards tables.

REFRIGERATION

SILICA GEL SYSTEM. Silica Gel Refrigerating System. Ice and Refrigeration, vol. 74, no. 3, Mar. 1928, pp. 217-221, 10 figs. New dry-absorption system; composition and properties of silica gel; arrangement and operation of refrigerating system; thermostatic control; household and commercial units; apparatus in operation exhibited; application to refrigeration cars being tested in actual service.

RESERVOIRS

GUNITE LINING. Relining Payson Park Reservoir; Cambridge Water Works, L. M. Hastings. N.E. Water Works Assn.—Jl., vol. 42, no. 1, Mar. 1928, pp. 45-51 and (discussion) 51-52, 2 figs. Describes some of principal features of work as carried out; lining was of gunite not less than two inches thick at any point and reinforced in centre with wire mesh; gunite was specified to consist of one part Portland cement and 2½ parts of sand.

OUTLET GATES, HIGH-PRESSURE. Standard High-Pressure Gates, P. A. Kinzie. New Reclamation Era, vol. 19, no. 3, Mar. 1928, pp. 44-46, 1 fig. At Tieton dam on Yakima project, Washington, two high-pressure gates 5 feet wide by 6 feet high are installed beneath dam, where they work under maximum head of 200 feet of water; usual plan of gates; wide range of use; operation of emergency gates.

RETAINING WALLS

EARTH-PRESSURE ON. Earth-Pressure on Flexible Walls, R. N. Stroyer. Instn. Civ. Proc. (Lond.), no. 4619, 1928, 16 pp., 9 figs. From sheet piles in cofferdam to heavy reinforced-concrete piles in permanent retaining walls there is wide range of application of sheet wall for retaining purposes; presents special problems in connection with calculation of earth-pressure on such walls; application to new form of wharf construction; this design provides cheapest possible form of wharf construction. See also Engineering, vol. 125, no. 3243, Mar. 9, 1928, p. 303.

RIVERS

GAUGING STATIONS. The Recording of River Discharge, N. C. Grover. Military Eng., vol. 20, no. 110, Mar.-Apr. 1928, pp. 120-124, 5 figs. General stream gauging is proper function of government, either state or federal; Geological Survey is authorized federal agency for such work; use of recording gauges is becoming necessary for collection of reliable records of discharge of increasing number of rivers; shows Au recording gauge; typical river-measuring station; records of discharge obtained mechanically by applying graphic record of stage to station-rating curve by means of discharge integrator.

SEDIMENTATION. Sedimentation Studies of Turbid American River Waters, A. W. Bull and G. M. Darby. Am. Water Works Assn.—Jl., vol. 19, no. 3, Mar. 1928, pp. 284-305, 14 figs. Sedimentation studies of waters of some turbid rivers of Middle West; presents summarized results of these studies with comparison of settling behaviour of different river waters; comparative clarification rates in short cylinders; comparison of clarification tests in cylinders with tests in continuous clarifier; studies of sludge thickening and discharge.

ROAD MACHINERY

SURFACING. Mechanical Spreading, Raking, Finishing of Asphaltic Concrete Pavement, C. S. Pope. Calif. Highways, vol. 5, nos. 2-3, Feb.-Mar. 1928, pp. 16-17, 2 figs. Machine described was placed on contract for asphaltic surfacing, eight miles in length, in Kern County, Calif., near town of Delano; paving operation; advantages obtained by use of machine are, economy of material; decrease in hand labour; increase in smoothness of paving.

ROAD MATERIALS

CONCRETE. Discussion of Bureau of Public Roads' Report on Comparative Tests of Crushed Stone and Gravel Concrete in New Jersey, S. Walker. Nat. Sand and Gravel Bul., vol. 9, no. 3, Mar. 15, 1928, pp. 27-31, 1 fig. Complete study of economic advantages of different aggregates, such factors as surface wear, surface conditions, durability and general ability to withstand destructive influences of traffic and weather as measured by field surveys should be given major consideration.

CONCRETE, QUICK-HARDENING. Quick-Hardening Concrete, F. V. Regal. Pit and Quarry, vol. 15, no. 12, Mar. 14, 1928, pp. 63-66. Problem solved by special cements, and special mixes using normal cements, with or without accelerating compounds; high alumina cement feature chemical composition; super-cement results due to finer grinding; manufacture and use of quick-hardening cements not well standardized for concerted action on specifications.

SAND. Miscellaneous Uses of Sand in Highway Construction, S. Walker and C. E. Proudley. Nat. Sand and Gravel Bul., vol. 9, no. 3, Mar. 15, 1928, pp. 9-12. Specifications for sand for cushion, recommended by National Paving Brick Manufacturers' Assn., place maximum grain size as one-quarter in.; sand for cement grout filler; recommended specification for top soil or sand-clay for road surfacing; material for subgrade treatment.

TESTING. Inspection and Tests of Road Building Material, W. J. Emmons. Cement, Mill and Quarry, vol. 32, no. 5, Mar. 5, 1928, pp. 48-50 and 52. Upon laboratory organization devolves responsibility for quality of materials entering into state highways of Michigan; specifications constitute basis upon which suitability of materials is judged; tests for soft stone; training of inspectors.

ROADS

BRITISH COLUMBIA. Development of Highways in British Columbia, E. L. Harris. Commerce Reports, no. 11, Mar. 12, 1928, pp. 705-706. Advance in road building; paved roads; highway improvement affects tourist traffic; Pacific Highway; trans-provincial highway; Okanagan country; Columbia Highway.

CONCRETE, CONSTRUCTION. Some Typical Concrete Road Building in Illinois. Highway Engr. and Contractor, vol. 18, no. 3, Mar. 1928, pp. 40-42, 7 figs. Camp facilities big factor in success; two jobs carried on simultaneously; equipment and personnel.

CONSTRUCTION. Contractor in Highway Work, E. L. Miles. Can. Engr. (Toronto), vol. 54, no. 12, Mar. 20, 1928, p. 383. Construction methods in Victoria County; day labour and contract systems; question of method debatable, as both systems have their place and value. Paper presented before Ontario Good Roads Assn.

CONSTRUCTION, CALIFORNIA. The Valona Slide and Highway Reconstruction Near Carquinez Strait Highway Bridge, California, A. W. McCurdy. West. Constr. News, vol. 3, no. 5, Mar. 10, 1928, pp. 150-154, 10 figs. Methods adopted for relocating highway passing over Valona Slide and plan followed by Highway Commission of California to prevent earth from sliding over highway; details of work are given and results commented on; general change and rerouting of highway traffic made when new Carquinez highway bridge was opened to traffic.

CONSTRUCTION, SWAMPS. Blasting Muskeg for Road Construction, T. H. Michell. Roads and Streets, vol. 68, no. 3, Mar. 1928, p. 132. Methods employed to prevent settling of fill over muskeg swamp and produce solid foundation for road; blasting process produced results immediately with elimination of continued settling.

ELEVATED. Super-Tracks, S. Norris. Roads and Road Constr. (Lond.), vol. 6, no. 62, Feb. 1, 1928, pp. 46-47, 3 figs. Suggested solution of city-suburban traffic problem; unexploited sites, which would provide direct routes of easy gradient and effective width, converging upon metropolis and all large towns; writer's suggestion is that all these open near-city railway tracks being, potentially, first-class speedways, their present half-utilized capacity might be fully exploited by erection of reinforced-concrete roads directly above them.

GRAVEL. Tar-Treated Gravel Roads, G. E. Martin. Highway Engr. and Contractor, vol. 18, no. 3, Mar. 1928, pp. 34-37, 8 figs. Light tar binder saves road metal and eliminates dust; several methods of treatment; modern practice; mulch method; application of seal coat; spring treatment.

GRAVEL, SURFACE TREATMENT. Tar Treatment of Gravel Surfaces, H. Irwin. Can. Engr. (Toronto), vol. 54, no. 13, Mar. 27, 1928, pp. 398-400. Motor vehicle increase creates problems in gravel-road maintenance; two established methods of sealing road surface against weather and traffic wear; means of increasing traffic capacity and extending economic life; excessive annual wastage of gravel; over-taxed traffic capacities; sealing surface to save road; mixed "Mulch" method; surface or "Skin" treatment; choice of method quite important; cost comparisons.

MAINTENANCE AND REPAIR. Urban County Highway Maintenance, W. W. Chadsey. Roads and Streets, vol. 68, no. 3, Mar. 1928, pp. 153-154. Finds that laws of states, rules of boards of supervisors or highway committees of these boards and officers in charge of maintenance work vary greatly, and in some countries are hindrance to good practice; recommends good practical method of maintaining urban highways; uniform practice needed; county unit favoured; objection to town unit; patrol system; oiling dirt roads. Committee report presented to Am. Road Builders' Assn.

MAINTENANCE EQUIPMENT. Selection of Road Maintenance Equipment, G. A. Nikirk. Highway Engr. and Contractor, vol. 18, no. 3, Mar. 1928, pp. 43-46, 3 figs. Power equipment replaces manual labour; determining type of equipment; productive costs; non-productive costs; delays; choosing make of equipment.

MAINTENANCE ORGANIZATION. A Proper Township Road Organization, J. McVicar. Contract Rec. (Toronto), vol. 42, no. 12, Mar. 21, 1928, pp. 313-315 and 323. How construction and maintenance of township highways should be controlled; functions of council and superintendent; cost of upkeep; aim or object; construction and measure of value; wasted maintenance; how much should maintenance cost; three methods present themselves for consideration in seeking method of financing roads; highway engineer.

ROCK-ASPHALT, RESURFACING. Resurfacing Old Roads with Rock-Asphalt on Bituminous Top, A. H. Hinkle. Roads and Streets, vol. 68, no. 3, Mar. 1928, pp. 155-157, 9 figs. Account of four projects carried out in 1927 in Indiana; before resurfacing, places that were too defective in old concrete slab were patched with concrete; constructing bituminous macadam for rock-asphalt top; ¾-in. rock-asphalt top; cold pulverized-rock asphalt; steamed-rock asphalt; spreading rock asphalt on black base; rolling and planing; curing before planing.

SURFACE TREATMENT. Mixed Treatment for Rural Districts, K. D. MacDonald. Can. Engr. (Toronto), vol. 54, no. 13, Mar. 27, 1928, pp. 405-407. Suggested method of surface treatment for rapidly extending good highways to rural districts at reasonable first cost and low maintenance cost; study of new means of increasing serviceability of cheaper type of roads; analysis of present conditions; improving low-cost roads; increasing serviceability of gravel; mixed method of treatment; accompanying table from California report gives accurate idea of costs under conditions obtaining in that state.

ROLLING MILLS

BLOOMING MILLS, ELECTRIC EQUIPMENT. 40-Inch Reversing Blooming Mill, Wisconsin Steel Co., F. A. Wiley. Iron and Steel Engr., vol. 5, no. 3, Mar. 1928, pp. 120-126, 10 figs.

BLOOMING MILLS, GERMANY. Details of Reversing Blooming Mills (Eizelheiten von Umkehrblockwalzwerken), F. Funke. V.D.I. Zeit. (Berlin), vol. 72, no. 9, Mar. 3, 1928, pp. 311-316, 16 figs. Supplementary information to paper by same author in previous issue (Feb. 18, p. 197) describing reversing blooming mills of A. Thyssen metallurgical works at Hamborn and Phoenix works at Ruhrort; details of motors, pinions, pinion housings, roll housings, spindles, top-roll accessories, methods of balancing, etc.

POWER REQUIREMENTS. Calculation of Power in Rolling Mills (Calcul des efforts dans les laminoirs), L. Genfron. Pratique des Industries Mécaniques (Paris), vol. 10, no. 12, Mar. 1928, pp. 519-521, 2 figs. Shows how to calculate power necessary to drive rolls of rolling mills when rolling thin plates if pressure on upper rolls and reduction in plate thickness are known.

SHEET MILLS, CONTINUOUS. Continuous Mill Will Supply Bars for Tin Plate Division, F. B. Pletcher. Iron Trade Rev., vol. 82, no. 12, Mar. 22, 1928, pp. 749-751, 2 figs. Modern 21-in., 2-high continuous sheet bar and skelp mill of Youngstown Sheet & Tube Co.; light weight tin bars delivered by finishing rolls at high speed are made to overlap before reaching bar piler; three hot beds are provided; 21-in. mill laid out parallel to 28-in. billet mill; slab transfer with approach tables, and 1,000-ton motor-driven up-cut shear installed. See also description by R. A. Fiske in Iron Age, vol. 121, no. 12, Mar. 22, 1928, pp. 799-802, 6 figs.

ROOF TRUSSES

WELDED. A Roof Truss Designed to Be Welded. Am. Mach., vol. 68, no. 13, Mar. 29, 1928, p. 526, 5 figs. Five half-tones illustrating roof trusses designed to be welded; each cut accompanied by brief description; 2 roof trusses under construction in shop of American Bridge Co.; close-up of panel-point showing tack welds used; close-up of panel-point welds showing lugs for connection of sway-bracing rods; finished truss.

SCHOOL BUILDINGS

HEATING AND VENTILATION. Heating and Ventilating a Large Church School. Heating and Vent. Mag., vol. 25, no. 3. Mar. 1928, pp. 74-78, 7 figs. Heating and ventilating installation at St. George High School, Evanston, Ill., discussed with some detail to supply information on present trends in school ventilation; individual desk exhausts in laboratory; arrangement of direct radiation.

S

SCHOOL LIGHTING

CORRECT PRINCIPLES. Illumination, I. E. Houk. Bldg. Age, vol. 50, no. 3, Mar. 1928, pp. 110-111, 4 figs. Correct principles of lighting applied to Denver High School; auditorium is illuminated by direct diffusing units of varying size; diffused, direct lighting is system generally adopted throughout building; library illuminated by 14 units in specially designed fixtures; flood lights illuminate central portion of exterior at night.

SEA

COLD WATER AT GREAT DEPTHS, UTILIZATION OF. Utilization of Cold Water from the Depth of Oceans (Utilisation rationnelle de l'eau glacée du fond des océans), P. Boucherot. Revue Universelle des Mines (Liége), vol. 17, no. 5, Mar. 1, 1928, pp. 205-214. Points out that low temperature of ocean water at great depths is natural product, in unlimited quantities, which can be visualized as future source of low temperature, with possibilities of utilization for cooling purposes, production of energy and softening of water; in process described refrigeration may be regarded as by-product of power generation, or vice versa; water softening is effected by distillation in vacuum of surface water.

SCREWS

CAP, MANUFACTURE OF. Cap Screws Made by New Method, F. L. Prentiss. Iron Age, vol. 121, no. 14, Apr. 5, 1928, pp. 936-938, 3 figs. Recent improvements in processes of making cold-headed cap screws employed by Cleveland Cap Screw Co.; blank for threading produced by extrusion process; increase of 30 per cent in tensile strength claimed; wire reduced to proper pitch diameter simultaneously with heading; trimmed screws pass through tumbling and lubricating machine; heat-treated in electric furnace; passed through quenching machine into rustproofing solution.

SEWAGE CHLORINATION

DESCRIPTION OF. Chlorination in Sewage Treatment, L. H. Enslow. Water Works, vol. 66, no. 12, Dec. 1927, pp. 505-506. How liquid chlorine is used in correcting odor nuisances at sewage plants; main cause of odors; prevention chief objective; conditions where odor production exists; effect of course of sewage flow; pump-station collecting wells and their relationship to odor control; methods employed in prechlorination for odor correction at two Kansas plants. Paper presented at North Carolina Conference on Water Purification and Sewage Treatment.

SEWAGE DISPOSAL

ACTIVATED SLUDGE METHOD. Bulking of Activated Sludge: An Investigation as to Its Cause, W. Scott. Surveyor (Lond.), vol. 73, no. 1887, Mar. 23, 1928, pp. 345-347. Bulking is often looked upon as distinct drawback to process; suggested remedies for curing so-called bulking evil; results of experiments; analyses of sludges; Bury's sewage contains variety of trade wastes, chiefly tannery; fellmongers, dye, bleachers, brewery wastes and gas liquor; experiments with brewery waste; account of experiments which have been carried out.

SLUDGE UTILIZATION. Utilization of Sewage Sludge, S. Duxbury. Can. Engr. (Toronto), vol. 54, no. 13, Mar. 27, 1928, pp. 403-404. Advantages of sludge as fertilizer; need for intelligence; fermentation; wet sewage sludge; method of handling sludge; rate of application. Paper presented before Assn. of Mgrs. of Swage Disposal Works.

SEWAGE TREATMENT

CHEMICALS. Use of Chemicals in Sewage Treatment, J. F. Jackson. Water Works, vol. 66, no. 12, Dec. 1927, pp. 493-494. Results obtained at experimental plant in New Britain, Conn., in 1920 and 1921; some attention given to effect of iron; conversion of organic matter; oxidation of raw sewage in presence of iron without addition of any activated sludge; returned sludge richer in iron; catalytic action of iron; iron in sewage came mostly from pickling liquors and was probably discharge into sewers in sulphate form.

SEWERS

CLAY LINING. Practices in Placing Vitrified Clay Liner Plates in Sewers. Eng. News-Rec., vol. 100, no. 11, Mar. 15, 1928, pp. 428-430, 7 figs. Philadelphia building large lined concrete collector; other cities' methods in building lined precast and monolithic sewers; reviews some of construction practices involved in placing liner plates in sewers; important reasons for adopting liner plates.

CONSTRUCTION. North Toronto Sewer Construction. Contract Rec. (Toronto), vol. 42, no. 12, Mar. 21, 1928, pp. 318-320, 8 figs. Following 2 previous articles on concrete-lined and brick-lined tunnels respectively (Feb. 15 and Mar. 7), present issue deals with practical features of section of open-cut work; plant; excavations; forms and concreting; protection from frost.

CONSTRUCTION, TORONTO. North Toronto's Big Sewer System. Contract Rec. (Toronto), vol. 42, no. 13, Mar. 28, 1928, pp. 340-341, 4 figs. Practice of not using concrete in sewers in sizes smaller than some set standard (usually about 30 in.), all pipe specified for laterals is vitrified, salt-glazed shale or clay sewer pipe, varying from 6 to 30 in. in diameter; manhole shafts are being constructed either of brick or of concrete. (Concluded.)

LAYING. Laying Sewer Pipe in Water. Pub. Works, vol. 59, no. 3, Mar. 1928, pp. 102-103, 2 figs. One excavating machine, travelling on parallel dock, used for trucking, laying 48-in. pipe and backfilling; permanent conduit from hot-water outlet to intake to lie about 18 ft. from dock, mostly under water.

SNOW REMOVAL

ROADS. Review of Research, Experiment and Practice, H. C. Badder. Roads and Road Constr. (Lond.), vol. 6, no. 62, Feb. 1, 1928, pp. 39-41, 5 figs. County authorities have equipped all motor trucks and motor buses running country routes with special detachable steel plow, which is stored in their garages ready for attachment at first fall of snow; municipal snow problem; blade and rotary plows; latest type of rotary snow remover to handle snow under any conditions.

STEAM ENGINEERING

RESEARCH. Heat-Power Research (Versuche aus dem Gebiete der Waermekraftforschung), M. Jakob. V.D.I. Zeit. (Berlin), vol. 72, no. 11, Mar. 17, 1928, pp. 379-380, 1 fig. Report on papers and discussions at fourth conference of German commission for research in heat engineering; review of papers on steam-discharge measurements, specific heat of superheated high-pressure steam, combustion phenomena in engines, combustion of pulverized coal under compression, etc.

STEAM ENGINES

BINARY-VAPOUR. Working Fluids Which May Be Used in Power Generation (Die moeglichen Arbeitsmittel der Dampfkraftanlagen), A. Loschge. Archiv fuer Waermewirtschaft (Berlin), vol. 9, no. 3, Mar. 1928, pp. 75-79, 13 figs. Thermodynamics of engines using mercury vapour, ammonia, diphenyl-oxide or other vapours jointly with steam, steam being generated by condensing of fluid of higher boiling point; principal American and European systems, results of experiments.

UNIFLOW. 800-H.P. Heat-Extraction Uniflow Compound Engine. Engineering (Lond.), vol. 125, no. 3244, Mar. 16, 1928, pp. 318-319, 6 figs, partly on p. 317 and supp. plate. Cross-compound heat-extraction engine, built by Galloways, Ltd., Manchester, to replace existing set of engines in Burnley textile mill.

STEAM PIPE LINES

FLEXIBILITY. The Flexibility of Plain Pipe Lines, J. R. Finniecome. Metropolitan-Vickers Gaz. (Manchester), vol. 10, no. 179, Feb. 1928, pp. 327-333, 7 figs. Graphic method of determining flexibility of any pipe bend; method when whole pipe bend is in one plane, and when pipe does not lie in one plane; wire model method; graphical method; actual deflection-stress factor for U-bends; ratio of actual deflection-stress factor to theoretical deflection-stress factor; ratio of test and theoretical deflection-thrust factor.

STEAM TURBINES

LUBRICATION. The Circulation System in the Oiling of Steam Turbines. Power House (Toronto), vol. 22, no. 3, Feb. 5, 1928, pp. 31 and 42. Systems of lubrication decided on; individual ring-oiled bearings for small auxiliary type of turbine and improved circulation system for main units; constant circulation; needs light-bodied oil; mineral and petroleum acids; after oil is put into service in turbine circulating system, petroleum acids may be formed.

STEEL

ALLOY. *See Alloy Steels.*

AUTOMOBILE, MACHINABILITY OF. The Machinability of Steels in Automobile Construction (Die Bearbeitbarkeit der Konstruktionsstaehle im Automobilbau), G. Schlisinger. Stahl u. Eisen (Dusseldorf), vol. 48, nos. 10 and 11, Mar. 8 and 17, 1928, pp. 307-312 and 338-345, 22 figs. Determination of best cutting speeds and feeds for machining of case-hardened and high-grade standard steels; comparative investigation with ordinary mild open-hearth steels; influence of water cooling; importance of standardizing alloyed and unalloyed structural steels.

COLD WORKING. The Influence of Cold-Drawing on Mild Steel, R. M. Brown. Iron and Coal Trades Rev. (Lond., vol. 116, no. 3132, Mar. 9. 1928, p. 341.

HEAT TREATMENT, QUENCHING. On a New Method of Quenching Steels in a High-Temperature Bath, K. Honda and K. Tamaru. Tohoku Imperial Univ.—Science Reports (Sendai, Japan), vol. 17, no. 1, Jan. 1928, pp. 69-83, 7 figs. Method of obtaining tempered structures by single process without risk of internal failure in steels which might result during quenching; steels quenched in salt bath heated to high temperatures up to 570 deg., and their hardness and microstructure examined; maximum hardness at quenching temperature of 110 deg. (In English.)

MANUFACTURE, DIRECT PROCESS OF. Direct Steelmaking Process for the Manufacture of Rustless Steel. Swedish Export (Stockholm), vol. 12, no. 3, Mar. 1928, p. 32. Plan for making steel direct from iron ore instead of first reducing ore to pig iron; Flodin-Gustafson process; melting briquettes of iron concentrate and charcoal in electric furnace; intimate mixing of finely distributed iron ore with charcoal, shortens reduction process and gives product that can be rolled.

STRENGTH AT HIGH TEMPERATURES. Determining Endurance of Steel at High Temperatures (Ermittlung der Dauerstandtestigkeit von Stahl bei erhoehten Temperaturen), F. Koerber. Zeit. fuer Metallkunde (Berlin), vol. 20, no. 2, Feb. 1928, pp. 45-49 and (discussion) 49-50, 13 figs. Points to necessity of testing materials at high temperatures; inadequacy of usual hot tensile tests; influence of time; endurance strength as limit load for continuous deformation; results of new tests; study of expansion; importance of strain hardening and recrystallization; simplified method for determination of endurance.

STEEL CASTINGS

MANUFACTURE. Steel Foundry Triples Staff in Past Two Years, W. H. Martin. Can. Machy. (Toronto), vol. 39, no. 5, Mar. 8, 1928, pp. 32-33 and 63, 5 figs. Describes foundry of Joliette Steel, Ltd.; production of steel castings, largely manganese and to lesser extent carbon-steel products; all steel is made by electric-furnace process, scrap steel being used throughout; reversible dipper teeth with replaceable wearing edges; five core ovens maintained in constant use for drying moulds and cores; sand ramming accomplished by pneumatic rammers.

STONE QUARRIES AND QUARRYING

VIBRATING SCREENS. Relative Values of Various Vibrating Screens, D. W. Yambert. Cement, Mill and Quarry, vol. 32, no. 5, Mar. 5, 1928, pp. 25-28. Vibrator screens can be divided into four classes, according to means of imparting vibration to screen cloth; reference for quickly determining and comparing features of several makes of screens.

STORAGE BATTERIES

TEMPERATURE EFFECT. Effect of Temperature and Other Factors on the Performance of Storage Batteries, G. W. Vinal and C. L. Snyder. Am. Electrochem. Soc.—Advance Paper, no. 13, for mtg., Apr. 26-28, 1928, pp. 119-130, 10 figs. Experiments are described in which effect of extreme conditions, such as low temperatures and high discharge rates are determined separately for positive and negative plates of lead storage battery; it was found that temperature effects are less for higher concentrations of electrolyte in case of positives, whereas reverse is true for negatives.

STREETS

LOW COST. Low Cost Pavements for City Streets, C. N. Conner. Pub. Works, vol. 59, no. 3, Mar. 1928, pp. 92-95, 3 figs. Types are considered whose average initial cost is $2.00 or less per square yard; untreated surfaces of gravel, chert, shale and sand-clay; broken stone and lime rock base; bituminous surface treatments; mixed-in-place method; premium bituminous types; Portland cement concrete; calls attention to few of salient facts on low-cost paving for city streets.

WIDENING Effect of Street Widening on Value of Abutting and Adjoining Property. Roads and Streets, vol. 68, no. 3, Mar. 1928, pp. 133-135, 4 figs. Results of questionnaire to municipal and private engineers; well authenticated information on this question grows more important as increasing numbers of cities resort to street widening; to get such information, survey among both municipal and private engineers was conducted; brought to light numerous examples of more specific information.

STRUCTURAL STEEL

WELDING. Welding Trusses for Industrial Buildings, A. Vogel. Contractors' and Engrs'. Monthly, vol. 16, no. 3, Mar. 1928, pp. 166-167, 1 fig. It has been definitely shown that cost of welding trusses is no more than cost of riveting trusses; necessary to make various truss designs and compare them with riveted trusses in order to see what results would be obtained; simpler members can be used in welded trusses, resulting in saving of rolling cost, handling cost, paint and inspection.

SWIMMING POOLS

WATER TREATMENT. Purifying Water in Swimming Pools. Can. Engr. (Toronto), vol. 54, no. 12, Mar. 20, 1928, pp. 373-374, 3 figs. Popular size of swimming pools; rate of refiltration and turning periods; sterilizing by ultra-violet rays; removal of hair and lint by means of suction cleaner; filters and cleaning of St. Jacques Bath, Montreal; water is turned in this pool approximately every 10 hours; it passes through two 60-in. filters and then through ultra-violet ray two-lamp sterilizer; equipped with suction cleaner.

T

TIN ORE TREATMENT

LEACHING. Reduction Roast, Leaching and Electrolytic Treatment of Bolivian Tin Concentrates, C. G. Fink and C. L. Mantell. Eng. and Min. Jl., vol. 125, no. 11, Mar. 17, 1928, pp. 452-455, 4 figs. Method proposed for Bolivian concentrates consists of reduction by gas, leaching with stannous solution, electrolytic precipitation of metal and re-use of partly stripped electrolyte as solution for leaching fresh reduced concentrate; experiments indicate possible recovery higher than 96 per cent; authors close with résumé of this and five previous articles.

TOPOGRAPHIC MAPPING

UNITED STATES. Topographic Mapping of the United States, C. H. Birdseye. West. Soc. Engrs.—Jl., vol. 33, no. 1, Jan. 1928 (Tech. Sec.), pp. 5-6. Temple Act, passed by Congress in 1925, authorized completion of topographic mapping of United States in 20 years; federal appropriation for fiscal year 1927 was $453,059, for 1928, $510,200, and for 1929 budget is $505,000; Topographic Branch of Geological Survey is map-making organization; outstanding development in modern surveying is increasing use of aerial photography.

TORSION BALANCES

OERTLING. Torsion Balances and Its Applications (La balance de torsion et ses applications). Revue de l'Industrie Minérale (Paris), no. 173, Mar. 1, 1928, pp. 72-73, 3 figs. How torsion balance is used in locating underground geologic formations; Oertling balance is described.

TROLLEY LINES, OVERHEAD

MAINTENANCE AND REPAIR. Neglected Overhead, L. W. Birch. Elec. Ry. Jl., vol. 71, no. 11, Mar. 17, 1928, pp. 435-438, 9 figs. Many railways have increased car speeds and weights and added power load without improvements in overhead; small factors of safety are insufficient when deterioration occurs; a slack trolley wire is linesman's enemy; rustproofing pays; in this article, no attempt is made to discuss relative merits of direct suspension system and catenary system other than is necessary to emphasize fully thought of correcting common errors in overhead line maintenance; span wires and span insulation; association committee assists in improvement of practices.

TURBO-GENERATORS

FOUNDATIONS, VIBRATION OF. Computed and Measured Vibrations of a Turbine Foundation (Rechnerisch ermittelte und gemessene Schwingungszahlen en einen Turbinenfundament), G. Mensch. Bauingenieur (Berlin), vol. 9, no. 9, Mar. 2, 1928, pp. 152-163, 5 figs. Plan and section of 12,500-kw. turbo-generator installation at Wilmersdorf power plant of Elektricitaetswerk Sudwest A.G.; comparison of vertical and horizontal vibrations of foundation, as determined mathematically and as actually measured by means of Schenk instrument, shows that computed values are in excess of measured values.

Vibration of Turbine-Generator Foundations, T. C. Rathbone. Power, vol. 67, no. 14, Apr. 3, 1928, pp. 588-592, 6 figs. Points out that customary efforts to avoid resonance by design are quite insufficient, most structures are too complex to predetermine many modes of vibration, and many harmful or beneficial features affecting smooth running are too often overlooked; how mass and elasticity affect natural frequencies; presents chart for finding critical-speed coefficients.

V

VACUUM TUBES

HIGH-FREQUENCY. High-Frequency Current. Power, vol. 67, no. 13, Mar. 27, 1928, p. 547, 4 figs. Describes new high-frequency vacuum tube about six inches in diameter and two feet long, developed by engineers of General Electric Co. laboratories; has capacity of 15 kw. at 50,000,000 cycles and 6-meter wave length.

WATER COOLING. Water Cooling for Radio, J. O. Gargan. Bell Laboratories Rec., vol. 6, no. 1, Mar. 1928, pp. 221-225, 4 figs. Disposes of heat generated in vacuum tubes of high-power broadcasting station; development and introduction of water-cooled tubes; new type of water jacket in which thin cylindrical sheet of water passes over anode surface at very high velocity; distilled water is used for cooling.

VEHICULAR TUNNELS

CONSTRUCTION. Large-Section Tunnel Construction at Asheville, E. L. Hageman. Eng. News-Rec., vol. 100, no. 11, Mar. 15, 1928, pp. 441-443, 6 figs. Section 48 by 27 ft. opened by widening centre heading and taking out bench in two lifts, using power shovels and cars; rock tunnel of unusually large section, 920 feet long; construction methods and plant; estimated that average of 7,000 vehicles daily will pass through this tunnel.

VOLTMETERS

HARMONIC ANALYZER. Harmonic Analyzer for Power Circuits, W. V. Lovell. Elec. News (Toronto), vol. 36, no. 5, Mar. 1, 1928, pp. 41-43, 2 figs. Harmonic analyzer described is essentially voltmeter capable of measuring magnitude of any single-frequency voltage in range of 60 to 3,000 cycles in presence of voltages of other frequencies; sensitivity; selectivity; susceptibility to stray fields; calibration; method of operation.

W

WALLS, BRICK

TESTING. Brick Masonry—Its Strength and Physical Properties. Brick and Clay Rec., vol. 72, no. 6, Mar. 13, 1928, pp. 414-420, 1 fig. Contains valuable data on brick wall strength, compressive strength, both for solid and hollow walls, fire resistance, sound and moisture penetration and other properties which mean so much to builder and building official.

WATER DISTRIBUTION

SURVEY. Water Distribution Surveys Reduce Extension Costs, P. J. Hurtgen. Water Works Eng., vol. 81, no. 7, Mar. 28, 1928, pp. 408 and 442. Thousands of dollars saved where leak survey was made; results often indicated that larger mains were not necessary; probable increase in population during next 25 years; present water consumption; plans and recommendations for economical programme of construction; pitometer used on main to measure flow; pressures obtained by test gauges attached to hydrants; design of mains for present and future. Abstract of paper presented at Wis. Section, Am. Water Works Assn.

WATER FILTRATION PLANTS

OPERATION OF. One Year's Operation of the St. Catharines Filter Plant, A. Milne. Contract Rec. (Toronto), vol. 42, no. 11, Mar. 14, 1928, pp. 295-297, 5 figs. Operating staff; plant operation is performed by four men; unusual turbidity conditions; total amount of water filtered during year was 1,722,890,-000 imperial gallons; tests and records; operating costs; cost of production per million gallons works out at $16.57 at rate filtered.

St. Catharines Filter Plant Operation, A. Milne. Can. Engr. (Toronto), vol. 54, no. 11, Mar. 13, 1928, pp. 113-114, 4 figs. Records of past year show that plant could filter and chlorinate water at $9 per million imperial gallons; preliminary cleaning and sterilizing; turbidity counts frequently high; amount of chlorine used; daily bacterial tests; operating costs. Paper read before Can. Sec., Am. Water Works Assn.

CHEMICAL WATER TREATMENT. Modern Filtration Plants Depend Primarily on Chemical Water Treatment, C. A. Brown. Hydraulic Engr., vol. 4, no. 3, Mar. 1928, pp. 158, 160, 169, 171 and 175. Constantly improving methods of water purification demand more complex chemical treatment; dry and wet feed systems; filter controllers; proportional rate control; loss of head gauges; plant operation; function of operation.

WATER PIPE LINES

CONSUMPTION MEASUREMENTS. Pitometer Analysis of Distribution System Flow, P. J. Hurtgen. Am. Water Works Assn.—Jl., vol. 19, no. 3, Mar. 1928, pp. 274-279. City of Kenosha deemed it advisable to have survey made of water works distribution system in order to determine adequacy of present system and requirements 25 years hence; Pitometer Co. made chart showing average daily pumpage together with their predictions for future consumption; pitometers were placed on each of two mains to measure total consumption for 24 hours, night rate and maximum for one hour; determination of loss of head and investigation of weak points in distribution system; design of mains for present and future.

Electrolysis. Electrolysis of Water Pipes and Means of Combatting It, W. B. Buchanan. Contract Rec. (Toronto), vol. 42, no. 13, Mar. 28, 1928, pp. 335-337, 4 figs. Corrosion may occur at junction of 2 pipes of dissimilar metals due to local action or it may also occur on single piece of metal pipe which contains impurities; effects of stray currents; analyzing electrolysis conditions; survey procedure; conductivity in joints; meters and measurements.

Supporting, Bridge. Constructing Water Mains on Bridges, G. G. Routledge. Can. Engr. (Toronto), vol. 54, no. 11, Mar. 13, 1928, pp. 119-120. Experience of Toronto officials with various types of joints, supports, air valves and insulation; details which require consideration in connection with construction of water main on bridge; pipe joints; using "Victaulic" joints; location of air valves; protection from frost; mains over steam railways. Paper read before Can. Sec., Am. Water Works Assn.

WATER POWER

New Brunswick. Hydro Power in New Brunswick. Can. Engr. (Toronto), vol. 54, no. 12, Mar. 20, 1928, pp. 385-386, 3 figs. Developed and undeveloped water powers in province; largest development at Grand Falls; powers well distributed; completed developments; undeveloped sites that have been more or less investigated and subjects of reports; eight isolated central stations in province all under separate management and ownership.

WATER PURIFICATION

Sludge. Returned Sludge in Water Purification, A. W. Bull. Water Works, vol. 67, no. 3, Mar. 1928, p. 112. Reducing supersaturation or lack of chemical reaction; sludge which may be obtained from coagulation basins is suitable material for this purpose; brief summary of data obtained on this point at Columbus, Ohio, and at Pittsburgh, Pa.

WATER SOFTENING

Methods. Water Hardness: Its Effects and Removal, R. E. Thompson. Contract Rec. (Toronto), vol. 42, no. 12, Mar. 21, 1928, pp. 309-311. Temporary and permanent hardness; effects of hardness; effect in boiler operation; railroads have found water treatment to be important means of reducing operating costs; softening methods; lime-soda process; softening by base exchange; lime-zeolite method. Paper read at Can. Section, Am. Water Works Assn.

WATER WORKS

Laboratory Tests. Value of Water Works Laboratory Tests, A. E. Berry. Can. Engr. (Toronto), vol. 54, no. 11, Mar. 13, 1928, pp. 111-112 and 120. Safety of Supply depends upon adequate control; operator should keep definite records; plants laboratory frequently saves more than it costs; laboratory facilities; laboratory service required; research in plant operation; routine tests; laboratory personnel and training; keeping plant records. Paper read before Can. Sec., Am. Water Works Assn.

London, Ontario. The London Municipal Water Works System, E. V. Buchanan. Contract Rec. (Toronto), vol. 42, no. 11, Mar. 14, 1928, pp. 287-290, 7 figs. Beck Wells pumping station proper has three 2,000,000-gal., 2-stage turbine pumps running at 750 r.p.m. against pressure of 115 lbs.; all driven by 550-volt synchronous motors; Springbank pumping station; two 3,000,000-gal. turbine pumps driven by 2,300-volt synchronous motors; nature of wells; water is of excellent quality from bacteriological point of view; water works has always been self-sustaining.

Municipal Management. Management of a Municipally-Owned Water Works, F. W. Albert. Am. Water Works Assn.—Jl., vol. 19, no. 3, Mar. 1928, pp. 253-273, 1 fig. Assumes that selection of water supply has been properly handled, plant built and equipped and mains and services laid, and limits discussion to sufficiently large problem of management of municipally-owned water works as going concern; what management implies; line organization; engineering and construction unit; pumping and filtration divisions; budget; external contacts; good will of public.

WIRE, COPPER

Tensile Strength. Distribution of Tensile Strength in Hard Drawn Copper Wire, F. W. Harris. Am. Inst. and Met. Engrs.—Tech. Pub., no. 93. Mar. 1928, 18 pp., 17 figs. Strength is largely matter of physical structure, and all factors known to affect this structure, such as rolling temperature, die contours, lubricants, drawing speeds, etc., are matter of prime importance; results of experiments carried out during past year at Baltimore plant of Am. Smelting and Refining Co.; region of highest strength appears to be in zone near core; annealed rod is almost uniform throughout.

WIRE DRAWING

Power Required in. Power Consumption and Flow of Metal in Wire Drawing, J. D. Brunton. Wire, vol. 3, no. 3, Mar. 1928, pp. 79-80, 1 fig. Number of readings have been taken with idea of trying to arrive at actual horse power necessary for drawing different sizes of wire; wide range of sizes and qualities of material were taken, and formula worked out.

WIRE, STEEL

Cold Rolling. The Cold Rolling of Steel Wire (Das Kaltwalzen von Eisendraehten), M. v. Schwarz and H. Goldschmidt. Stahl u. Eisen, vol. 48, no. 9, Mar. 1, 1928, pp. 265-268, 13 figs. Account of tests whereby wire drawing was replaced by cold rolling; results demonstrate advantages of cold rolling; relative strength values of drawn and rolled wire.

ZINC METALLURGY

Cowley Process. The Cowley Process of Zinc Extraction, H. E. Colly. Metal Industry (Lond.), vol. 32, no. 9, Mar. 2, 1928, pp. 225-227. "Nascent" condition of carbon; reduction by hydrocarbons; variety of metal oxides; apparatus employed; cylinder expansion and zinc-fume difficulties.

ZINC ORE ROASTING

Australia. Drying and Roasting of Zinc Concentrate, E. H. Fraser. Am. Zinc Inst.—Bul., vol. 11, nos. 3-4, Mar.-Apr. 1928, pp. 21-23 and 60. Zinc concentrate, produced at Zeehan by flotation from Read-Rosebery ore, dried and roasted for production of calcine suitable for electrolytic zinc process at Risdon, Tasmania; roasting equipment, four 7-hearth, 10-ft. internal-diameter Herreshoff furnaces; careful control of temperatures necessary to avoid volatilization of lead and formation of zinc ferrate; undesirable in that it adversely affects extraction of zinc in electrolytic process.

Engineering Index

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A

AERIAL SURVEYING

Topographic, Canada. Topographical Surveying in Canada, T. H. Bartley. Can. Engr. (Toronto), vol. 54, no. 15, Apr. 10, 1928, pp. 437-439, 3 figs. Aerial surveys under Dominion auspices; graphical methods of plotting are exclusively employed; stereoscope used with vertical aerial photographs is developing promising possibilities; operations by Ontario Surveys Branch; international boundary; precise leveling. Report of committee on topographical and exploration survey presented at Ontario Land Surveyor's Assn.

AIRPLANE ENGINES

Exhaust-Pipe Tests. Exhaust Equipment Temperature Determinations, F. W. Heckert. Air Corps Information Cir., vol. 6, no. 594, Sept. 15, 1927, 7 pp., 5 figs. Investigation of actual exhaust-pipe temperatures prevailing in flight and on ground; by means of potentiometer temperature recorded in pilot's cockpit; data obtained from aluminum stacks and standard steel exhaust equipment; built-up short aluminum finned stacks used; showed better insurance against fire hazard; highest temperatures recorded from steel whirl-chamber type exhaust manifold.

Oil Engines. The Performance of Several Combustion Chambers Designed for Aircraft Oil Engines, W. F. Joachim and C. Kemper. Nat. Advisory Committee for Aeronautics—Report, no. 282, 1928, 12 pp., 13 figs. Investigations of single-cylinder test engines to determine performance characteristics of four types of combustion chamber; increase in specific power output of high-speed aircraft oil engine depends upon ability to obtain higher mean effective pressures and improvements in mechanical efficiency of engine; best performance with bulb-type combustion chamber designed to give high degree of turbulence.

AIRPLANE PROPELLERS

Design. Propeller Data for Performance Estimates, E. M. Bertran. Aero Digest, vol. 12, nos. 3 and 4, Mar. and Apr. 1928, pp. 346-348 and 465 and 514-516 and 704, 13 figs. Mar.: Estimating combination of different propellers and engines with view to fairly accurate estimate of power available of airplane in different conditions of flight; computing horse power available for full throttle flight at sea level. Apr.: Flight at sea level with motor throttled; horse power delivered by motor at given r.p.m. decreases with altitude.

AIRPLANES

Metal, Construction of. Duralumin All-Metal Airplane Construction, W. B. Stout. Soc. Automotive Engrs.—Jl., vol 22, no. 4, Apr. 1928, pp. 430-432 and (discussion) 432-436. Structural members fashioned from sheet duralumin rather than from tubes; for compression loads, duralumin has great deal more strength for giving weight than steel, cannot be used for compression members in combination with steel in tension members; damaged parts repaired readily; built-up sections of metal riveted together give warning of coming failure; exterior protection against corrosion.

Methods of Building Metal Airplane Structures, C. W. Hall. Soc. Automotive Engrs.—Jl., vol. 22, no. 4, Apr. 1928, pp. 426-430, 5 figs. Parts of blanked and pressed metal made directly by machine in complete units ready for final assembly; methods followed by Hall-Aluminum Aircraft Corp. in forming members, building frames and assembling; making flanged-tube sections for truss chords; members secured together by riveting; high ratio of strength to weight obtained; cost of production lower; use by Navy; lightness of wing and aileron structures.

Stress Analysis. Stress Analysis of Commercial Aircraft, A. Klemin and G. F. Titterton. Aviation, vol. 24, nos. 15. 16, 17, 18 and 19, Apr. 9, 16, 23, 30 and May 7, 1928, pp. 890-891 and 896-899, 5 figs., 974 and 1034-42, 3 figs., 1148-64, 5 figs., 1244-50, 6 figs., and 1314-20, 6 figs.

Wings, Slotted. The "Slotted Moth." Flight (Lond.), vol. 20, no. 12, Mar. 22, 1928, pp. 195-197, 4 figs. Four separate flights, each made with object of showing some particular function of slotted-wing machine; demonstration of stalling machine from about 200 ft. without any power to flatten out; vertical rate of descent, 9 ft. per second; Moth appeared to descend in series of steps; under-carriage itself was entirely undamaged, but fuselage gave way; automatic slots greatly reduced seriousness of mistakes in piloting. See also Aeroplane, vol. 34, no. 12, pp. 388, 390.

ALLOY STEELS

Automotive Industry. Alloy Steels and Their Uses, B. Egeberg. Soc. Automotive Engrs.—Jl., vol. 22, no. 4, Apr. 1928, p. 484. Suitability for automotive purposes considered; automotive industry is especially interested in alloys containing up to 5 per cent of nickel and up to approximately 1.5 per cent of chromium, with carbon content ranging from 0.10 to 0.50 per cent; results of increasing nickel content; corrosive agents with which alloy steel will come into contact.

ALUMINUM

Welding. Welding of Aluminum (Bemerkenswertes ueber die Aluminiumschweissverfahren und ihre technische Bedeutung), H. Holler. Autogene Metallbearbeitung (Halle, Germany), vol. 21, nos. 4 and 5, Feb. 15 and Mar. 1, 1928, pp. 46-54 and 66-70, 30 figs. Description of methods used in welding aluminum plates, pipes, vessels, etc.; microstructure of aluminum welds; study of hammer welded joints of aluminum.

ALUMINUM CASTINGS

Properties. Influence on Mechanical Properties of Aluminum, W. Claus and F. Goederitz. Can. Foundryman (Toronto), vol. 19, no. 4, Apr. 1928, pp. 13-14 and 21, 7 figs. Investigation made by authors of influence of moulding methods, (chill, cast, green sand, dry sand), on some mechanical properties such as grain size, hardness, tensile strength and elongation; besides pure aluminum, American alloy with 8.0 per cent of copper and German alloy with 10.0 per cent of zinc and 2.0 per cent of copper wire were used. Abstract translated from Giesserei-Zeitung, Sept. 15, 1927, p. 516. See reference in Eng. Index, 1927, p. 34.

AQUEDUCTS

Hetch Hetchy, San Francisco. Construction Progress on Hetch Hetchy Aqueduct, M. M. O'Shaughnessy. Eng. News-Rec., vol. 100, no. 16, Apr. 19, 1928, pp. 614-616, 4 figs. Work approaching completion on 17 mi. of foot-hill tunnels; shafts completed for 30-mi. coast-range tunnels; aqueduct for water supply of San Francisco, Calif., is 156 mi. long; cross-sections of two sizes were used 10¼ and 14¼ ft. high, both of horseshoe shape; cost estimates on work yet to be done in San Joaquin and coast range divisions.

ARCHES, CIRCULAR

Stresses. A Graphic Method for Determining the Stresses in Circular Arches Under Normal Loads by the Cain Formulas, F. A. Noetzli. Am. Soc. Civil Engrs.—Proc., vol. 54, no. 5, part 1, May 1928, pp. 1531-1533. Stresses in one of arch slices of Stevenson creek test dam were calculated with these curves and compared with stresses as determined from tests. Discussion of paper by F. H. Fowler, continued from Mar. 1928 issue of Proceedings.

ASH HANDLING

Hydraulic System. Removing Molten Ash by Hydro-Jet System, D. H. Scranton. Power, vol. 67, no. 18, May 1, 1928, pp. 754-757, 7 figs. Among innovations in connection with installation of pulverized-fuel-burning boilers at C. R. Huntley Station of Buffalo General Elec. Co. is hydro-jet system of ash removal applied to disposal of molten ash, where comparatively low-fusion-ash coals are being burned.

AUTOMOBILE PLANTS

Machine Tools. Single-Purpose Manufacturing, F. L. Faurote. Factory, vol. 75, no. 4, Apr. 1928, pp. 769-773, 7 figs. Machine-tool equipment in Ford plant based upon idea of one-purpose machines; standard and adapted machines and transportation and handling devices; 53,000 machine tools in Ford shops; tool-design department; new welding machines necessary; Johannson blocks made in Ford laboratory; machine-tool efficiency starts with foresight and planning, followed by accurate scheduling and routing.

AUTOMOBILES

Frames, Manufacture of. The Automatic Fabrication of Automobile Frames, J. P. Kelley. Soc. Automotive Engrs.—Jl., vol. 22, no. 5, May 1928, pp. 565-569, 5 figs. Methods of A. A. Smith Corp.; daily capacity of 7,000 frames; nearly all steel comes to plant in form of strips, which are rolled to remove curvature and inspected automatically for dimensions; operations and handling are automatic except pickling, cleaning and oiling stock and inspecting assembled frame; economical use of strip steel dependent upon offsetting operation making strip conform to vertical curves of finished frame.

B

BALANCING

Rotors. The Static Balancing of Rotors, B. P. Haigh. Engineer (Lond.), vol. 145, no. 3768, Mar. 30, 1928, pp. 338-340, 9 figs. partly on p. 350. As current method of balancing by rolling rotor on rails does not appear sufficiently sensitive or reliable for many practical purposes, author considers in detail principle and mode of operation of Martin static balancing machine. variety of work that can be balanced in such machines, with beneficial results in service appears to be almost unlimited.

BEAMS, REINFORCED CONCRETE

Stresses. An Investigation of Web Stresses in Reinforced Concrete Beams—Restrained Beams, F. E. Richart and L. J. Larson. Univ. of Ill.—Bul., vol. 25, no. 34, Apr. 24, 1928, 76 pp., 27 figs. Tests form part of extended investigation of web stresses; study of action of web reinforcement in overhanging or restrained beams in which there are both positive and negative bending moments; tests made on 59 large rectangular beams, 18 ft. long, 8 in. wide and 15 in. in effective depth.

BEARINGS

Efficiency. Factors Governing Efficiency of Various Types of Bearings. Can. Machy. (Toronto), vol. 39, no. 8, Apr. 19, 1928, pp. 46 and 48 and 50 and 77. Notable progress made; lubricating methods; provision for adjustment; post hanger; Hyatt bearing for use with high-speed shafting; greatly increased shaft life; split pillow block; alignment and expansion; adjustable bearing; safety considered when placing bearings.

Lubrication. Lubrication and Bearing-Metal Problems in Metallurgical Works (Schmiermittelund Lagermetallfragen im Huettenbetriebe), K. Hopfer. Stahl u. Eisen (Dusseldorf), vol. 48, no. 13, Mar. 29, 1928, pp. 408-410, 2 figs. Refers to early and more recent works on development of hydrodynamic bearing-friction theory, and discusses properties and suitability of different bearing alloys; claims that problem of bearing metal and lubricant cannot be treated separately.

Non-Metallic. Non-Metallic Bearings (Nichtmetallische Lagerschalen), Maschinenbau (Berlin), vol. 6, no. 24, Dec. 15. 1927, p. 1210. In review of new bearing materials German Committee for Economical Production (AWF) mentions, besides rubber and wooden bearings, new type of bearing in which carrying material is of horny character; this material is pressed on to steel backings; it is said to be resistant to acids, pressure and heat. not to break or spall and to be elastic. See brief translated abstract in Automotive Abstracts, vol. 6, no. 4, Apr. 20, 1928, p. 117.

BOILER FURNACES

IMPROVEMENTS. Progress in Burning Coal, A. G. Christie. Power, vol. 67, no. 15, Apr. 10. 1928, pp. 658-660, 1 fig. Recent progress may be credited to following influences: increased furnace size and better combustion; increased furnace temperatures; better appreciation of radiant heat transfer and of equipment and furnace requirements for various coals; improvements in stoker design and in powdered-coal systems; better instruments and improved furnace control. Abstract of address before Philadelphia Sec., A.S.M.E.

PULVERIZED COAL. A New Method of Firing Boilers With Pulverized Coal Without Furnace (Neue Kohlenstaubfeuerung fuer Flammrohrkessel ohne Brennkammer), K. Jaroschek. Braunkohle (Halle a-S. Ger.), vol. 27, no. 12, Mar. 24, 1928, pp. 221-224, 1 fig. Theory and practical method of new system of firing Lancashire boilers with pulverized lignite; tests showing efficiency of 76.7 per cent; adapting this system to firing with other pulverized coals.

BOILERS

HIGH-PRESSURE. Developments in High-Pressure Boilers, D. S. Jacobus. Engrs'. Soc. West. Penn.—Proc., vol. 43. no. 9, Dec. 1927, pp. 398-408 and discussion 409-416, 13 figs. One of boilers at Crawford Avenue station of Commonwealth Edison Co., Chicago; 650 lb. gauge; Babcock and Wilcox boiler for 1,200-lb. working pressure installed at Edgar station of Edison Electric Illum. Co. of Boston; Stirling boiler constructed for 1,390-lb. working pressure at lake-side plant of Milwaukee Electric Ry. and Light Co.; drumless boiler and its furnace.

KLINGENBERG PLANT, BERLIN. The Boiler Plant, F. Muenziger. Eng. Progress (Berlin), vol. 9, no. 3, Mar. 1928, pp. 72-79, 13 figs. Details of boilers and boiler-house equipment at Klingenberg station, Berlin, Germany; design of boilers worked out by A.E.G., on which tenders were based; system where boilers, economizers and air preheaters are arranged one above other was especially recommended; boiler heating surface, inclusive of cooling surface of combustion chamber was fixed at 18,850 sq. ft.; preparation and pulverizing of coal.

LOCOMOTIVE. *See Locomotive Boilers.*

WASTE-HEAT. Steam Generation—Waste Heat Boilers—Reduction of Steelworks Costs, J. Adamson and F. Jones. World Power (Lond.), vol. 9, no. 11, Mar. 1928, pp. 167-176, 7 figs. Effect of high-gas-velocity theories on design of modern boilers; modern waste-heat boilers; flame-tube boiler; installation of waste-heat plant; economies possible with various furnaces; construction of fire-tube waste-heat boilers and maintenance; economic aspect; value of equivalent coal saved; typical balance sheets for waste-heat boiler installations in steel works. Abstract of paper read before Instn. Mech. Engrs.

The Utilization of Waste-Heat from Large Gas Engines, Industrial Furnaces and Producers. Demag News (Duisburg), vol. 2, no. 2, Apr. 1928, pp. 31-37, 15 figs. Smoke-tube waste-heat boilers used in combination with industrial furnaces; producers with steam jackets; interpolating waste-heat boiler between cooler scourer and producer; making use of heat of water-gas producers, for generation of steam as well; diagram of water-gas producer plant with waste-heat utilization.

See also Pressure Vessels.

BORING

TEMPERATURE EFFECT VS. ACCURACY. Effect of Temperature on Bored Holes. Machy. (Lond.), vol. 32, no. 808, Apr. 5, 1928, p. 22. Effect of variations in temperature on accuracy of work; as machining progresses, casting becomes heated by work of cutting tool; if, in machining, proper attention is paid to elements of clamping, temperature and order of machine work it will be unnecessary to season castings or forgings that have been properly annealed or allowed to cool slowly.

BRICK

PAVING, TESTING. A New Method of Testing Paving Bricks, J. A. van der Kloes. Roads and Road Construction (Lond.), vol. 6, no. 63, Mar. 1, 1928, pp. 80-81, 4 figs. Most suitable test for paving bricks is ball test; has been in use in Holland for some years and is becoming increasingly popular.

BRIDGES

CONCRETE, ARCH. Long-Span Reinforced-Concrete Bridge Over the Luzhnits at Bekhynye (Eine 90 m. weit gaspannte Eisenbetonbogenbruecke ueber den Luzincfluss in Bechyne), E. Viktora. Beton u. Eisen (Berlin), vol. 27, no. 6, Mar. 20, 1928, pp. 103-109, 9 figs. Design of highway bridge also carrying one track of electric railroad, near Tabor in Czechoslovakia; bridge comprises reinforced-concrete arch of 90 m. span, 38 m. rise, approaches total over 150 m.; width of roadway, including sidewalks, 8.9 m.; estimated cost, 5.5 million crowns.

CONCRETE, GERMANY. The Hindenburg Bridge Over the Saale at Hof (Die Hindenburgbruecke ueber die Saale in Hof). Bauingenieur (Berlin), vol. 9, nos. 12, 13, Mar. 27, 1928, pp. 199-201, 9 figs. Design and construction of reinforced-concrete bridge consisting of 4 single and 2 double longitudinal bents of 34 m. span, each bent being a rigid, practically rectangular frame; design combines features of leg bridges and T-beam bridges; details of form-work and reinforcement; description, with sketches, of rigorous loading tests.

DESIGN. Bridges, E. O. Williams. Roy. Inst. Brit. Architects—Jl. (Lond.), vol. 35, no. 9, Mar. 10, 1928, pp. 296-304, 20 figs. Classified into three main types, arch, beam and suspension, with other subsidiary variations of these; various bridges of world drawn to same scale; in designing bridge, type should to some extent reflect nature of soil below; use of various materials for construction is indicated by diagram.

HIGHWAY, NEW BRUNSWICK, N.J. Contract To Be Placed for Raritan River Bridge. Port of New York, vol. 7, no. 3, Mar. 1928, p. 9. New bridge at New Brunswick, N.J., to cost $1,500,000; total length of structure will be 1,740 ft., consisting of reinforced-concrete arch rib spans and two approach solid-barrel arches having span of 70 ft. each in clear; roadway width of 50 ft. with two 6-ft. sidewalks.

PIERS, STABILITY. Movements of Débris and Shifting of Stream Beds at Midstream Piers (Grundstroemung und Geschiebebewegung an umflossenen Strompfeilern), A. Hinderks. Bautechnik (Berlin), vol. 6, no. 11, Mar. 16, 1928, pp. 133-135, 10 figs. Report on experiments with models of piers, made at hydraulic laboratory of Hanover Institute of Technology; study of stream lines and undermining tendencies at bases of plates and piers of rectangular and other cross-sections.

RAILING, MALLEABLE IRON. Malleable Iron Bridge Railing Withstands Severe Tests, F. W. Groh. Eng. News-Rec., vol. 100, no. 16, Apr. 1928, pp. 618-619, 4 figs. New railing material meets all requirements for strength and appearance in new Liberty highway bridge spanning Monongahela river in Pittsburgh; specification requirements for malleable iron castings.

SKEW ARCH, DESIGN. Crown Stresses in a Skew Arch, B. F. Jakobsen and E. Godfrey. Am. Soc. Civ. Engrs.—Proc., vol. 54, no. 5, part 1, May 1928, pp. 1639-1643. Deals with arches as applied to dams; it is claimed that if skew arch must be used it should be done by constructing separate parallel ribs not bonded in such manner as to transmit shear from one to another. Discussion of paper by J. C. Rathbun, published in Feb. 1928 issue of Proceedings.

STEEL, ARCHITECTURE. Architectural Forms of Steel Bridges (Die Gestaltung der eisernen Bruecke), K. Schaechterle. Bauingenieur (Berlin), vol. 9, nos. 14 and 15, Apr. 6 and 13, 1928, pp. 239-244 and 261-267, 28 figs. Discusses use of girder truss and arch forms in bridge building from engineering and architectural points of view; architectural features of short-span and long-span German steel bridges of following types: arch, girder, cantilever, suspension, stiffened suspension, etc.

STEEL, ARCH—NEW YORK CITY. Old Masonry Arches Give Way to New Steel Span at High Bridge. Constr. Methods, vol. 10, no. 5, May 1928, pp. 16-19, 15 figs. 426-ft. steel arch span now carries Croton aqueduct over Harlem river, New York City, in place of five of masonry arches and four of river piers of High bridge.

STEEL, ARCH—SYDNEY, AUSTRALIA. The Sydney Harbour Bridge. Engineering (Lond.), vol. 125, no. 3249, Apr. 20, 1928, pp. 467-471, 20 figs. (partly on p. 480 and supp. plate). Main bridge consists of two-hinged arch with five steel approach spans at either end; main span consists of two silicon-steel arch trusses, spaced 98 ft. 6 in. apart with span of 1,650 ft.; all material in approach spans is structural carbon steel; abutment towers are hollow rectangular concrete chambers.

STEEL, CONSTRUCTION. The Erection of the Yuma, Arizona, Bridge Over the Colorado River, J. W. Towle. Cornell Civil Engr., vol. 36, no. 7, Apr. 1928, pp. 177-180, 196 and 198, 6 figs. Tells how single-span bridge was erected on one side of river, run out over pier until one end rested on barge which was floated across river and bridge end landed in place on abutment.

SUSPENSION, DESIGN. The Stiffness of Suspension Bridges, S. Timoshenko. Am. Soc. Civil Engrs.—Proc., vol. 54, no. 5, part 1, May 1928, pp. 1464-1478, 5 figs. Method is developed by which additional cable stress and deflection curve produced in suspension bridge either by live load or by temperature variation may be directly calculated; due to quick convergence of series used, deflections and bending moments in span truss can be calculated in much shorter time than by usual method.

SUSPENSION—HUDSON RIVER, NEW YORK CITY. The Hudson River Bridge, O. H. Ammann. Engineer (Lond.), vol. 145, no. 3771, Apr. 20, 1928, pp. 426-428, 6 figs. Abstract of first progress report on condition at beginning of year of Hudson river bridge, which is being built at New York, between Fort Washington and Fort Lee; deals specially with design of bridge, which will have span twice length of any suspension bridge constructed up to present time.

WOODEN, CREOSOTED. New Mexico's Experience with Treated Timber Highway Bridges, E. B. Van de Greyn. Wood Preserving News, vol. 6, no. 4, Apr. 1928, pp. 38-41 and 52, 2 figs. First creosoted timber bridge; reasons for adoption of creosoted timber and piles; comparison of cost of creosoted and untreated timber bridge; design basis; construction features.

BUILDING MATERIALS

HEAT INSULATION PROPERTIES. Heat Insulation Properties of Building Materials (Varmegennemgang i bygningskonstruktioner), J. T. Lundbye. Tekniske Forenings Tiddsskrift (Copenhagen), vol. 52, no. 3, Feb. 1928, pp. 85-94, 8 figs. Tells of tests made together with illustration and tables; report based on results of 250 to 300 measurements daily, totalling 500,000 items. Paper presented at meeting of Scandinavian Refrig. Engrs.

PRODUCTION STATISTICS, CANADA. Building Materials Production in Canada Sets New High Record. Contract Rec. (Toronto), vol. 42, no. 15, Apr. 11, 1928, pp. 379-382. Highest total for structural materials; clay products and other structural materials; sand-lime brick; sand and gravel; stone.

BUILDINGS

REINFORCED CONCRETE, CODES. Modern Building Regulations for Reinforced Concrete, F. R. McMillan. Eng. Jl. (Montreal, Canada), vol. 11, no. 4, Apr. 1928, pp. 291-292. Proposed standard regulations of American Concrete Institute and Concrete Reinforcing Steel Institute; points out some of more important features in which this set of regulations differs from what has generally been practice; load tests; concrete aggregates; quality of concrete; unit stresses; mixing, placing and details of construction; columns and walls.

STEEL, DESIGN. The Design of Tall Building Frames to Resist Wind, A. W. Ross and C. T. Morris. Am. Soc. Civil Engrs.—Proc., vol. 54, no. 5, part 1, May 1928, pp. 1395-1433, 7 figs. Presents 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 Am. Insurance Union Bldg., in Columbus, Ohio, by slope-deflection method; results tabulated and compared with other methods.

WELDED STEEL. Electric-Arc Welding. Constr. Methods, vol. 10, no. 5, May 1928, pp. 6-9, 12 figs. Fifty-ft. high building consisting of 78- by 171-ft. head-house or transept and two main aisles 474 ft. long and 59 and 79 ft. wide respectively; saving of from 12 to 15 per cent in tonnage of steel required; design; roof trusses; welding process; shop fabrication.

C

CANALS

WELLAND, CANADA. Moving 63,000,000 Cubic Yards for Welland Ship Canal. Excavating Engr., vol. 22, no. 4, Apr. 1928, pp. 133-143, 36 figs. New Welland Ship Canal now eighty per cent completed; to be finished in 1930; total cost estimated as $115,000,000; four relocations in one hundred years; canal to take vessels of 25-ft. draught; siphon culvert carries Chippewa creek under canal; unique fastening of discharge pipes; dewatering a problem.

DIVERSION, SPILLWAYS. Side Spillways for Regulating Diversion Canals, A. P. Flockart and G. M. Bacon. Am. Soc. Civil Engrs.—Proc., vol. 54, no. 5, part 1, May 1928, pp. 1527-1529. Discussion of paper by W. H. R. Nimmo, continued from Feb. 1928 issue of Proceedings.

CARS

STREET RAILROAD. Street Car Regenerative Control. Elec. Traction, vol. 24, no. 4, Apr. 1928, pp. 189-190, 2 figs. Europe equipping electric railways with automatic regenerative control and braking at saving of 30 per cent in energy; new system can be used in conjunction with magnetic rail-shoe brakes or electric brakes of any kind; such brakes only required for emergency braking; essential conditions required for traction regeneration; operation of system; advantages claimed for new system.

CASE HARDENING

PRINCIPLES. Facts and Principles Concerning Steel and Heat Treatment. Am. Soc. Steel Treating—Trans., vol. 13, no. 5, May 1928, pp. 848-880, 16 figs. Second series of articles on case hardening; explains mechanism of carburizing and effect of different heat treatments following it; carburizing is due to solution of carbon into steel from some carburizing gas; decarburizing may take place during carburizing; effect of five different heat treatments after carburizing.

CASTING

CENTRIFUGAL. Intricate Spun-Sorbitic Castings, J. E. Hurst. Iron Age, vol. 121, no. 15, Apr. 12, 1928, pp. 1007-1008, 2 figs. Produced in Great Britain by new process; have high strength, machinability and wear resistance; useful for engine cylinders and pistons of all kinds; desirable structure to resist wear; larger and more intricate castings may be made.

PERMANENT-MOULD. Vacuum Principle Is Applied to Permanent Mould Casting, E. Bremer. Foundry, vol. 56, no. 7, Apr. 1, 1928, pp. 256-259, 6 figs. Process developed from practices in moulding and forming glass; operations consist essentially of opening vacuum line, dipping ingress of mould into molten metal, allowing proper time for solidification, opening mould and ejecting finished casting, cooling mild, smoking joints to make proper seal for vacuum, brushing out soot and closing and clamping; control movement.

CEMENT

PORTLAND, SETTING. Setting and Hardening Processes in Cement, R. Nacken. Pit and Quarry, vol. 15, no. 13, Mar. 28, 1928, pp. 79-83, 7 figs. Author discusses use of X-ray in carrying out investigations on cements; nature of testing apparatus and details regarding its use; tells of certain studies made along these lines on composition and constitution of cement and of new experiments recently instituted, dealing with application of these methods to setting and hardening of cement.

CHROMIUM STEEL

WELDING. Welding Chromium Irons and Steels. Iron Age, vol. 121, no. 18, May 3, 1928, pp. 1242-1244, 3 figs. It is necessary to prepare clean joint, use proper flux and strictly neutral flame of minimum dimensions, ending with properly adjusted heat treatment; heat treatment of welded joints; cutlery steels infrequently welded; rustless chrome-nickel irons give ductile welds; extra high chromium induces brittleness; castings should be welded hot.

CITIES AND TOWNS

GEODETIC SURVEYS. Why Cities Need Geodetic and Topographic Surveys, R. H. Randall. Am. City, vol. 38, no. 5, May 1928, pp. 133-134, 1 fig. Inventory of physical facts concerning land and its occupation is of fundamental and prime importance; purpose of city survey to provide this sort of inventory; geodetic and topographic survey is used by city departments and by private individuals and corporations as basis for planning and constructing all general and specific improvement projects.

PLANNING. Some Legal Aspects of City Planning, C. Williams. Wis. Engr., vol. 32, no. 7, Apr. 1928, pp. 216-218, 3 figs. Important problem before city planner is question of costs, which swings to-day on very unstable pivot due to unsettled condition of law; building height regulation; property rights; setback lines in street widening cases; city planner and city attorney owe it to community and to law to hurry along some of these unsettled problems. Abstract of speech presented before Eng. Soc. of Wis.

PLANNING, QUEBEC. Town Planning Project at Chicoutimi, N. Cauchon. Can. Engr. (Toronto), vol. 54, no. 14, Apr. 3, 1928, pp. 421-422, 2 figs. Important developments contemplated at Chicoutimi, Que., to provide facilities for handling traffic from large and populous district; plan to suit peculiar topography of town; work started on extensive harbour improvements on Saguenay river; population is now about 15,000; power and industrial development; planning Chicoutimi.

PLANNING, ONTARIO. Town Plan for North Bay. Town Planning (Ottawa), vol. 7, no. 2, Apr. 1928, pp. 35-38. Appointed Town Planning Commission for town in Ontario of about 15,000 people.

COAL

CARBONIZATION. The Economics of Carbonization at Electric Central Stations, R. P. Soule. Combustion, vol. 18, no. 4, Apr. 1928, pp. 237-243 and 260. Important carbonization products are coke, gas and tar; B.t.u. in form of gas is worth more to central station than B.t.u. in form of solid fuel, because of reduction in size of furnace and boiler, more complete combustion and more automatic control; in discussing cost of carbonizing coal, distinguish between fixed charges and operating expense; conclusions reached in analysis of economics of carbonization at electric central stations is summarized.

See also Pulverized Coal.

COAL BUNKERS

REINFORCED CONCRETE, DESIGN. Coal Bunkers at the Tiefstack Plant of the Hamburg Gas Works (Kohlenbunker auf Gaswerk Tiefstack der Hamburger Gaswerke G.m.b.H. zu Hamburg), H. Kuball. Beton u. Eisen (Berlin), vol. 27, no. 6, Mar. 20, 1928, pp. 115-118, 11 figs. Detailed design of three reinforced-concrete bunkers of 600 cu. m. capacity each; reinforced-concrete water and ammonia water tanks built on top of these bunkers, etc.

COAL

CONSUMPTION, CANADA. Coal Consumption in Canada, F. W. Gray. Iron and Steel of Can. (Gardenvale, Que.), vol. 11, no. 4, Apr. 1928, pp. 100-101. Discussion of preliminary report of Dominion Bureau of Statistics on coal statistics for 1927; comparison with 1920; figure of 3.86 tons per capita use of coal in 1927; avoiding use of coal by increased output of hydro-electric installations and displacement of coal by petroleum products considered; forecast of statistics of Canadian coal usage and production for ten-year period ending 1931.

COAL MINES AND MINING

CANADA. Notes on Coal Mining in Canada, D. H. C. Briggs. Imperial Inst.—Bul. (Lond.), vol. 26, no. 1, Apr. 1928, pp. 60-65, 2 figs. on supp. plate. Estimated coal reserves of Canada; very large amount of coal seams seen, being of sub-bituminous character, contained high ash and moisture contents, but lacked good coking qualities.

COAL TIPPLES

CONCRETE CONSTRUCTION. Concrete in Tipple Construction. Coal Age, vol. 33, no. 4, Apr. 1928, pp. 230-231, 6 figs. As rule, use is confined to foundations only, structure above this point being of wood or steel and glass; main or coal tipple at Kathleen mine, Dowell, Ill., employs concrete for column footings and as support and stiffener of headframe, three sides of shaft lining being carried up from ground landing to dumping point; O'Gara No. 12 tipple, at Harrisburg, Ill., is solid-block reinforced monolithic concrete; examples of concrete tipple construction illustrated.

COLD STORAGE WAREHOUSES

HEATING AND COOLING. Continent's Most Modern Warehouse Now Serves the Port of Montreal, W. H. Martin. Power House (Toronto), vol. 22, no. 8, Apr. 20, 1928, pp. 34-38, 10 figs. Details of heating and cooling systems of Place Viger warehouse of Montreal; thoroughly insulated; two-motor-generator sets; 2-stage system of ammonia compression: advantages of intercooler; efficient lubricating system; boiler-room details; sprinkler system; electrical load.

COLUMNS

CONCRETE. The Essentials of Reinforced Concrete Design, E. S. Andrews. Structural Engr. (Lond.), vol. 6, nos. 1 and 4, Jan. and Apr. 1928, pp. 6-10 and 117-121, 6 figs. Calculation of stresses due to eccentric loading; resultant stress in tension across whole and method; tension in steel over portion of section; limits of formula; case in which reinforcement is not same on both sides; tension in steel. (Continuation of serial.)

CONCRETE, STEEL CORES. Structural Steel Column Cores, H. H. Alger. Eng. and Contracting, vol. 67, no. 3, Mar. 1928, pp. 167-168, 1 fig. Their use in concrete buildings; advantages of structural-steel column cores; long column sections now used; H-section preferred to riveted or built-up members; what column schedule should show; steel column cores can be used to advantage to carry concrete beam and girder floors. Reprinted from Turner Constructor.

DESIGN. A Proposed Formula for Columns, T. E. Hickerson. Am. Soc. Civil Engrs.—Proc., vol. 54, no. 5, part 1, May 1928, pp. 1435-1448, 6 figs. Stresses resulting from possibility of incipient bending may reach yield point of material and produce sudden collapse of column; effect of all imperfections may be accounted for by assumed initial curvature of column axis and eccentricity of loading if applied to ideal column, will cause it to fail at same load as imperfect column of practice.

COPPER

CANADA. Canada's Future in Copper, S. J. Cook. Can. Min. and Met. Bul. (Montreal), no. 192, Apr. 1928, pp. 488-509, 6 figs. New fields of copper-bearing ore discovered in recent years; domination in world's markets exercised by United States and Chile; world-output curve provides one means of forecasting possible future; war-time outputs beyond normal industrial demand; estimated output of copper for Canada in 1937, 230,000 metric tons.

COPPER MINES AND MINING

MANITOBA. The Flin Flon District, Manitoba, F. J. Alcock. Can. Min. Jl. (Gardenvale, Que.), vol. 49, nos. 14 and 15, Apr. 6 and 13, 1928, pp. 292-294 and 307-310, 7 figs. Apr. 6: Rock exposures are plentiful throughout plateau; relation of surface features of bedrock; drainage; climate; geological history; Apr. 13: Copper-zinc-iron sulphide bodies; gold-bearing quartz veins; iron-sulphide bodies; only first type proved of economic importance; Mandy mine on west side of northwest arm of Schist lake; Flinflon ore body on north shore of southeastern bay of Flinflon lake.

CONCRETE AGGREGATES

GRAVEL. Gravel As An Aggregate for Concrete, R. W. Crum and F. H. Jackson. Pit and Quarry, vol. 15, no. 13, Mar. 28, 1928, pp. 61-62. Tests conducted by prominent engineers and investigators covered studies of effect of size and grading of sample, amount of abrasive charge, revolutions of cylinder, effect of removing dust through slots in cylinder, tests of types of abrasion machines other than Deval and other variables. Abstracted from report presented to Am. Concrete Inst.

MEASUREMENT. Measurement of Materials for Concrete, R. T. Giles. Highway Engr. and Contractor, vol. 18, no. 4, Apr. 1928, pp. 31-34, 3 figs. Specifications are outlined, and it is claimed that the nearer these specifications are approached the more ideal will be results; measuring fine aggregates by weight; inundation method; voids effect strength of mixture.

CONCRETE CONSTRUCTION

REINFORCED. Bonding and Anchorage of Reinforcing Steel, H. C. Adams. Concrete and Constr. Eng. (Lond.), vol. 23, no. 4, Apr. 1928, pp. 317-323, 8 figs. Consideration of common types of members, beams, slabs, retaining walls, column footings and columns; securing good bond; anchorage.

CONCRETE MIXING PLANTS

DESCRIPTION. Build a Special Concrete Plant to Line Tunnel. Ry. Age, vol. 84, no. 15, Apr. 14, 1928, pp. 850-854, 7 figs. How concrete materials are received; proportioning materials; cycle of operation at mixing plant; mixing plants are able to deposit about 16 cu. yd. of concrete an hour; water under pressure was encountered.

CONCRETE MIXTURES

ESTIMATING. Field Determination of Material Per Cu. Yd. of Concrete, D. V. Terrell. Cement, Mill and Quarry, vol. 2, no. 6, Mar. 20, 1928, pp. 22-23. Proposed method; list of necessary equipment; describes use of method; example of problem and solution; table of expected strength and example of designing mix to give desired strength at 28 days.

CONCRETE

POROUS. Ice Concrete and Porous Concrete. Ice and Refrig., vol. 74, no. 4, Apr. 1928, pp. 375-376. New method of making porous concrete in England; finds favour in production of certain types of building materials where low cost is prime factor and where there is no demand for high breaking strength; lukewarm water hastens setting; insulated layer prevents shrinking.

TESTING. Wear Tests of Concrete, C. H. Scholer and H. Allen. Kansas State Agric. College—Bul., no. 20, vol. 12, no. 3, Feb. 15, 1928, 36 pp., 19 figs. First object of test was to develop method of testing resistance of concrete to wear which could be used in any laboratory having standard equipment; second object to study effect of various factors on resistance of pavement concrete to wear; materials; making specimens; discussion of tests and results.

CONCRETE SLABS

STRESSES. The Strength of Flat Plates, T. A. Bryson and T. Cheeger. Rensselaer Polytechnic Inst.—Eng. and Science Series, Apr. 1928, pp. 3-19, 11 figs. Design of reinforced concrete floor slabs, especially when wire mesh reinforcement is used; suspension stresses begin at low pressures and gradually supplant bending; suspension proportional in intensity to deflection of plate and to elasticity of material; for steel, effect of suspension is not sufficient to change form of bending formula other than to reduce its coefficient.

CULVERTS

LOCATION. Culvert Design and Location, A. Sedgwick. Can. Engr. (Toronto), vol. 54, no. 14, Apr. 3, 1928, pp. 425-426. Aggregate for concrete; culverts under embankments; important to see that they are built in proper place on road. Paper presented at annual conference on Road Construction for County and Township Road Superintendents and Engineers.

CUTTING TOOLS

HARD FIBRE. Tools and Speeds for Cutting Hard Fibre, F. H. Colvin. Am. Mach., vol. 68, no. 16, Apr. 19, 1928, pp. 655, 1 fig. Machinery fibre at Spaulding co.; saws run about 3,300 r.p.m. for 12- to 14-in. saws; turning speeds of from 600 to 800 ft. per min.; threading at same speed as for brass; material punched and drawn or extruded; best materials to use for tools in cutting fibre.

D

DAMS

ARCH AND GRAVITY, OREGON. Design of the Owyhee Irrigation Dam, J. L. Savage. Eng. News-Rec., vol. 100, no. 17, Apr. 16, 1928, pp. 663-667, 5 figs. Geological and engineering investigations; strikingly new features in 405-ft. high arch-and-gravity dam to be built in Oregon; deep fracture fault in floor rock may require cut-off 100 ft. below base; floating ring-shaped spillway gate; elevator in dam; study of alternative designs; special features of structure both arch and gravity action relied upon.

ARCH, DESIGN. Analysis of Arch Dams by the Trial Load Method. Am. Soc. Civ. Engrs.—Proc., vol. 54, no. 5, part 1, May 1928, pp. 1585-1603, 8 figs. Graphic analysis is offered of opening between rock walls similar in form to experimental dam at Stevenson creek; graphic analysis of curved dam, horse mesa dam profile. Discussion of paper by C. H. Howell and A. C. Jacquith, continued from Apr. 1928 issue of Proceedings.

ARCH, INVESTIGATION. Arch Dam Investigation. Am. Soc. Civil Engrs.—Proc., vol. 1, part 3, May 1928, 275 pp., 162 figs. First instalment of experimental study of arch dams conducted by committee composed of members of Am. Soc. of Civil Engrs. to secure experimental data and other information on arch and multiple-arch dams; includes contributions by different members; report of tests on Stevenson creek dam; physical properties of concrete; tests on models at Boulder, Colo.; earthquakes, ice and deterioration of concrete; includes 8-page international bibliography.

CONCRETE, CONSTRUCTION. Problems in Concrete Dam Construction on the Pacific Coast, F. A. Noetzli. Am. Soc. of Civil Engrs.—Proc., vol. 54, no. 5, part 1, May 1928, pp. 1509-1510. Engineering plans and specifications should include as much information as practicable on peculiarities of rock formation, especially as to what extent blasting will be permitted; on stream flow and methods of river diversion, size of temporary flood openings in dam, and methods and anticipated time of closing these openings. Discussion of paper by A. S. Bent, continued from Mar. 1928 issue of Proceedings.

Concreting the Toltec Dam, Zuni Mts., New Mexico, A. F. Schramm. Eng. News-Rec., vol. 100, no. 16, Apr. 19, 1928, pp. 631-633, 2 figs. Study in designing mixes with harsh aggregates; hot water and torch give 85-deg. concrete with frozen aggregates; grouting with converted cement gun; concrete design; concrete was placed by chuting; winter concreting; hot water and torch; general procedure; grouting foundation.

EARTH, SALUDA, S.C.—The Largest Earth Dam in the World. Earth Mover, vol. 15, no. 5, May 1928, pp. 7-9, 5 figs. Saluda dam, 208 ft. high, mile and half long, quarter of mile across at river bottom; diversion of water will be necessary; description of work going on.

EMERGENCY, NEW ORLEANS. Emergency Dam on Inner Navigation Canal at New Orleans, La., T. B. Monniche. Am. Soc. Civil Engrs.—Proc., vol. 54, no. 4, part 1, May 1928, pp. 1569-1578, 3 figs. Comparison of emergency dams in Panama canal with New Orleans dam; refuting statements made by author of paper as to superiority of New Orleans dam. Discussion of paper by H. Goldmark, continued from Apr. 1928 issue of Proceedings.

MASONRY, UPWARD PRESSURE. Calculation of Masonry Dams (Le calcul des barrages en Maçonnerie), G. Pigeaud. Génie Civil (Paris), vol. 92, no. 16, Apr. 21, 1928, pp. 379-381. Opinion of Rabut on effect of uplift diffusion; uplift according to M. Lévy.

OVERFALL, EROSION. Studies on Prevention of Scour Below Overfall Dams, G. G. Dixon. Eng. News-Rec., vol. 100, no. 18, May 3, 1928, pp. 696-698, 3 figs. Review of earlier designs made in design for Mineral Ridge dam; former studies tabulated; comparison of several types of spillways; bibliography of hydraulic-jump papers.

STORAGE, ONTARIO. Storage and River Control at Kakabeka Falls, W. L. Bird. Elec. Light and Power, vol. 6, no. 4, Apr. 1928, pp. 21 and 90, 4 figs. Kaministiquia Power Co. of Fort William, Ontario; extensive system of storage dams; changes and gauge levels are recorded on graphic chart showing tendency and timing of all changes.

UPLIFT PRESSURE. The Theory of Heavy Walls Subject to Uplift Pressures and Its Application to Stability of Dams (Sur la théorie des massifs pesants soumis à des souspressions et son application à la stabilité des barrages), J. Mesnager. Académie des Sciences—Comptes Rendus (Paris), vol. 186, no. 13, Mar. 26, 1928, pp. 845-847. Deals with dams constructed of porous or non-porous masonry.

DIES

PRECISION INDEXING. Precision Indexing Die. Machy. (Lond.), vol. 31, no. 807, Mar. 29, 1928, pp. 836-838, 2 figs. Dies for production of blade with ten small holes; distance between pairs of holes and angle between each pair held to limits of plus or minus 2 min.; indexing die maintained these basic requirements by producing single pair of holes at each stroke of press, blade being pivoted on large central hole while mounted on swinging arm indexed to five punching stations.

DIESEL ENGINES

AUTOMOTIVE. High-Speed Automotive Diesel Engines, W. Riehm. Soc. Automotive Engrs.—Jl., vol. 22, no. 5, May 1928, pp. 523-531, 12 figs. Higher pressures of Diesel cycle necessitate only inconsiderable increase in engine weight, not interfering with use for automotive purposes; M.A.N. has adopted pressure-atomization method which is particularly adapted to use in automotive engines; construction of earlier and recent M.A.N. oil engines with details of fuel injection and control; economy and flexibility make it competitor of gasoline engine for vehicle propulsion, especially where fuel cost is major item.

COMBUSTION CHAMBERS. Diesel Engine Air-Fuel Mixture Improved by New Methods, F. E. Bielefeld. Automotive Industries, vol. 58, no. 16, Apr. 21, 1928, pp. 632-633, 3 figs. Oil injected in such manner as to form "fog net" in neck of combustion chamber and air is driven through this by auxiliary piston, resulting in rapid burning; combustion chamber of entirely different shape; dividing into three sections; speed of injection of very finely atomized fuel oil and speed of turbulence of air of combustion are substituted for propagation.

EXPERIMENTAL. Experimental Diesel Engines, A. Turner. Engineering (Lond.), vol. 125, nos. 3247 and 3248, Apr. 6 and 13, 1928, pp. 425-427 and 462-464, 12 figs. Discusses recent developments that have taken place at Admiralty Engineering Laboratory at West Drayton; types of engines used for study. Apr. 13: Mechanical efficiency; effect on cylinder liner wear has not been at all marked; combustion processes are much more readily carried out in 4-stroke than in 2-stroke engines. Paper read before Instn. Naval Architects. See also Shipbldg. and Shipg. Rec. (Lond.), vol. 31, no. 14, Apr. 5, 1928, pp. 391-392, 5 figs.

SUPERCHARGING. Experimental Study of the Buechi Process of Supercharging Diesel Engines (Leistungsversuche an einem Dieselmotor mit Buechischer Aufladung), A. Stodola. V.D.I. Zeit. (Berlin), vol. 72, no. 13, Mar. 31, 1928, pp. 421-428, 20 figs. Study of process of supercharging Diesel engines by means of turbo-blower operated by gas turbine utilizing exhaust gases of engine; process effects increase of 50 per cent in average capacity and 100 per cent in maximum capacity of Diesel engine, without changing combustion or exhaust temperatures.

The Buechi System of Supercharging. Shipbuilder (Lond.), vol. 35, no. 212, Apr. 1928, pp. 238-240, 5 figs. Outstanding features of system are high degree of supercharge utilized and employment of blower directly driven by exhaust-gas turbine; tests were conducted on 6-cylinder, 4-stroke cycle engine; Diesel engines with Buechi exhaust-turbo charging built or in course of construction.

E

EARTH PRESSURES

THEORY. Some Earth Pressure Theories in Relation to Engineering Practice. Structural Engr. (Lond.), vol. 6, no. 4, Apr. 1928, pp. 112-114 and 115. Discussion of paper by J. Mitchell Moncrieff published in no. 3, Mar. 1928.

ECONOMIZERS

HIGH-PRESSURE. Exhaust-Gas Feedwater Preheaters and Air Heaters for Modern High-Pressure Boilers (Die Bedeutung des Abgasspeisewasservorwaermers und des Lufterhitzers fuer den neuzeitlichen Hochdruckkessel), K. Burwick. Waerme (Berlin), vol. 51, no. 4, Jan. 28, 1928, pp. 64-67, 12 figs. Discusses introduction of more effective and cheaper economizers; connection and calculation of economizer; types; shows scheme of boiler with economizer and air heater, examples of modern economizer installations.

Flue Gas Economizers for High-Pressure Boilers, H. F. Lichte. Eng. and Boiler House Rec. (Lond.), vol. 41, no. 9, Mar. 1928, pp. 446-447. For boilers, working at 25 atmos. and higher pressures, entirely new type of economizer is required; new German rules require economizer to be tested at 1.3 times boiler pressure plus 10 atmos.; describes Stierle economizer, novelty and superiority of which is claimed to lie in use of square ribs forming continuous closed channels. Abstract translated from Waerme, Jan. 7, 1928, p. 3.

ELECTRIC CABLES

UNDERGROUND, HIGH TENSION. Loads from Looped or Tapped High Tension Feeders, H. L. Wallau. Elec. World, vol. 91, no. 15, Apr. 14, 1928, pp. 757-758. Effect of such conditions on one of several paralleled lines, with particular reference to underground cable systems.

ELECTRIC CIRCUIT BREAKERS

OIL. Use of Oil Circuit Breakers on Power Lines, H. J. Lingaal. Power House (Toronto), vol. 22, no. 6, Mar. 20, 1928, p. 49. Important that circuit breaker shall perform its work within very definite limits of time; conditions which require special consideration in breaker application. Abstract.

OIL, STANDARDIZATION. An Attempt to Standardize Oil Circuit-Breaker Ratings by N.E.L.A. Elec. News (Toronto), vol. 37, no. 7, Apr. 1, 1928, p. 42. Tables of uniform oil circuit-breaker interrupting capacity ratings for both indoor and outdoor circuit-breakers, prepared by Sub-station Sub-committee, N.E.L.A., with hope that users of such equipment will co-operate in this programme of standardization.

ELECTRIC CONDUCTORS

INDUCED VOLTAGES. Induced Voltages in Conductors, H. B. Dwight. Elec. Jl., vol. 25, no. 4, Apr. 1928, pp. 173-176, 1 fig. Description of magnetic lines of force and rules for inducing of electromotive forces in conductors in electric power apparatus, which will apply to a.c. generators, transformers, apparatus with sliding contracts, such as d.c. generators, and also to portions of electric circuits; not satisfactory to have present lack of agreement as to rules for calculating induced voltages.

VOLTAGE DROP. Nomograph for the Determination of Voltage Drop in Conductors, C. A. Kulmann. Elec. West, vol. 60, no. 4, Apr. 1, 1928, p. 215, 1 fig. Simplified and accurate determination of various factors related to voltage drop in transmission and distribution conductors may be accomplished through use of nomograph.

ELECTRIC EQUIPMENT

STANARDIZATION. Benefits of Standard Specifications, J. D. Winans. Elec. World, vol. 91, no. 16, Apr. 21, 1928, pp. 814-815. Desirability of enlarging N.E.L.A. guides into complete purchase specifications is pointed out; broader engineering outlook is needed.

ELECTRIC FURNACES

HIGH-FREQUENCY. Steels Made Under New Conditions, F. Wever and H. Neuhauss. Iron Age, vol. 121, no. 16, Apr. 19, 1928, pp. 1073-1075, 6 figs. Results of German tests with high-frequency induction furnace; carbonless, carbon and alloy steels show unusual properties; future possibilities; refining accelerated; steel bath, under normal refining slag, brought from 0.14 per cent carbon to 0.03 per cent in 2 minutes; carbonless steel made in high-frequency furnace. Abstract of paper published in Proceedings of Kaiser Wilhelm Institute for Iron Research.

IRON-FOUNDING. Making Cast Iron in the Electric Furnace, C. E. Williams and C. E. Sims. Franklin Inst.—Jl., vol. 205, no. 4, Apr. 1928, pp. 575-577. Investigation completed by Bureau of Mines; involved year's successful operation of jobbing foundry making miscellaneous grey-iron castings from steel scrap.

ELECTRIC GENERATORS

ALTERNATING CURRENT. The A.C. Generators, R. Pohl. Eng. Progress (Berlin), vol. 9, no. 3, Mar. 1928, pp. 88-89, 5 figs. Details of generators installed in Klingenberg station, Berlin, Germany; each turbine set of 80,000 kw. output is coupled to two a.c. generators of 44,000 kva. at 1,500 r.p.m.; both generators of each main turbine are excited from external source when running up to synchronism; for this purpose, a.c. to d.c. converters are employed, which, at same time, provide excitation in case of emergency.

COMMUTATION. Elements of Commutation, V. E. Johnson. Indus. Eng., vol. 86, no. 4, Apr. 1928, pp. 173-176 and 190, 13 figs. Difficulties that had to be overcome in developing commutator and brushes to their present highly effective form; analysis specifically applied to d.c. generators; use of high-resistance brushes; many attempts made to minimize effect of armature reaction; interpole and compensated machines more sensitive to brush shifting, and rarely should be operated except with brushes on neutral. (To be continued.)

DIRECT CURRENT, TYPES. Selection of Most Suitable D.C. Generators. Power Plant Eng., vol. 32, no. 8, Apr. 15, 1928, pp. 467-469, 5 figs. Discussion of characteristics and application of all types of d.c. generators.

ELECTRIC HEATING

PRINCIPLES. Principles Involved in Electric Heating, N. R. Stansel. Heat Treating and Forging, vol. 14, no. 3, Mar. 1928, pp. 311-314, 7 figs. Apparatus and methods used in converting electricity into heat; principles of heat transfer, conduction, convection and radiation; transfer and absorption of heat; standard surface for heat radiation in balck-body condition.

ELECTRIC LINES

CALCULATION. A General Solution for Short Transmission Lines, C. M. Longbottom. Elec. Engr. (Melbourne), vol. 4, no. 11, Feb. 15, 1928, pp. 405-407, 5 figs. Effect of length of line; effect of load power factor; regulation of short line; effect of power factor upon cost; regulated and unregulated lines; method discussed introduces some new ideas which may be helpful to those handling transmission problems.

HIGH-TENSION, CALCULATION. Bases for Standardizing Calculation of High-Tension Transmission Lines (Bases para la normalizacion del calculo de lineas de transporte a muy altas tensiones), M. G. Quevedo. Anales del la Asociacion de Ingenieros (Madrid), vol. 7, no. 38, Mar. 1928, pp. 130-141, 5 figs. In connection with conferences on production and distribution of electrical energy in Spain, author submits simplified process for calculating long-distance high-voltage lines and conductors for same; graphs and formulas involving costs of material and current, amortization, resistivity, etc. (To be continued.)

HIGH-TENSION, CANADA. Construction of Great Falls-Winnipeg 110-Kv. Transmission Lines, J. C. D. Taylor. Elec. News (Toronto), vol. 37, no. 7, Apr. 1, 1928, pp. 33-36, 13 figs. Field construction work; describing difficulties encountered in muskeg country and methods used in setting footings, erecting towers and stringing cable. (Continuation of serial.)

INTERCONNECTED. The Relaying Problems of Typical Large Interconnection, B. M. Jones. Elec. Jl., vol. 25, no. 4, Apr. 1928, pp. 171-172, 2 figs. One of most important problems is adequate and proper relaying necessary to permit best use of such connections by both parties, and at same time to provide best protection for one system when trouble occurs on other; short-circuit protection; ground relaying.

OVERHEAD, LOADING. A Study of the Strength and Loading of Aerial Line Structures, R. H. Sherlock. Mich. Technic, vol. 41, no. 3, Mar. 1928, pp. 7-9 and 24-25, 4 figs. Investigation to correlate wind velocities with pole stresses and to determine correlation between wind velocities and shielding of back wires by those in front of them; anemometers used for measuring and recording velocities of wind; telemeters transmit electrically to chart house, continuous records of stresses in wires; calibration of motion-transmitting instruments.

SURGES. Transmission Line Surges and Their Effect on Operation, J. H. Cox. Elec. Light and Power, vol. 6, no. 4, Apr. 1928, pp. 24-27, 16 figs. Study of voltage surges by means of klydonograph; principles of operation and description of klydonograph, together with discussion of records obtained by it; characteristics of klydonograph figures. (To be continued.)

VOLTAGE CONTROL. Load Ratio Control, L. F. Blume. Gen. Elec. Rev., vol. 31, no. 4, Apr. 1928, pp. 191-194, 5 figs. Examines somewhat in detail various fields of application for equipments in order to give at least general idea of what is being accomplished by their use; shows that serious limitations are imposed on operation of interconnections by necessity of keeping voltages at various points of network constant for all conditions of load demand; considers briefly conditions involved when transmission line forms loop; fields of application. (Concluded.)

ELECTRIC LOCOMOTIVES

COMBINED BATTERY AND TROLLEY. Combination Switching Locomotive Meets Unusual Requirements. Elec. Ry. Jl., vol. 71, no. 13, Mar. 31, 1928, pp. 530-532, 3 figs. Locomotive of New York Central uses either battery charged by oil engine-generator or external power from overhead or third rail; 300-h.p. engine connected direct to 200-kw. generator arranged for charging battery; storage battery of 218 cells; equipped with four GE-286,600-volt d.c. single-geared commutating-pole motors; develops tractive effort of 34,000 lb.; engine is constant-speed type; has direct fuel injection.

ELECTRIC MACHINERY

RADIO TESTING. Radio Waves Search Out Insulation Faults in Machine Windings, J. L. Rylander. Power, vol. 67, no. 18, May 1, 1928, pp. 768-770, 6 figs. Application of radio waves for detecting insulation faults in coils of motors, generators, induction regulators and other electric machines; method has proved such efficient and vigilant detective that, since enlisting its services for commercial testing of coils, insulation failures have been almost eliminated.

ELECTRIC MOTORS

ENCLOSED. Special Motors Reduce Hazards in Explosive Atmospheres, R. H. Rogers. Chem. and Met. Eng., vol. 35, no. 4, Apr. 1928, pp. 232-233, 9 figs. Describes and illustrates different types of totally enclosed motors.

SQUIRREL CAGE, STARTING. Full-Voltage Motor Starting, C. W. Falls. Am. Mach., vol. 68, no. 15, Apr. 12, 1928, p. 606. High-reactance and high-resistance squirrel cage motors are now being designed for full-voltage starting; chief aim in design is to reduce starting current to roughly 70 per cent of that of ordinary squirrel cage motor; development of high-reactance motors has increased field for full-voltage starting in three ways. Excerpts from paper presented before Am. Inst. Elec. Engrs.

ELECTRIC NETWORKS

LOW VOLTAGE. Low Voltage A.C. Networks, D. K. Blake. Gen. Elec. Rev., vol. 31, no. 4, Apr. 1928, pp. 186-190, 3 figs. Lamp flicker; several tables have been prepared for study of effect of such variables as motor location, network arrangement, secondary cable sizes, transformer reactance and spacing, and use of starting taps upon voltage dip and motor size; such network systems can very well take care of virtually all squirrel cage motor applications utilizing standard starting compensators. (To be continued.)

ELECTRIC POWER FACTOR

IMPROVEMENT. Power Factor Improvement. World Power (Lond.), vol. 9, no. 52, Apr. 1928, pp. 200-204. Recent practice in France by L'Ouest Lumière, based on annual report of company's control department; goes into problem of economic choice of improvement plant and describes, with special attention to smaller plant, operation of commercial department and development engineers of that company. (To be concluded.)

ELECTRIC POWER RECORDERS

NEW PATTERN. Synchronous Motor-Driven Averaging Recorder for Electric Power Supply. Engineering (Lond.), vol. 125, no. 3246, Mar. 30, 1928, p. 393, 3 figs. New pattern of averaging recorder, in which self-contained, self-starting motor is used for operating mechanism and for driving chart.

ELECTRIC RESISTANCE, GROUND

TESTING. Ground Resistance Testing, W. B. Craigmile. Elec. World, vol. 91, no. 17, Apr. 1928, pp. 861-862, 3 figs. New method of investigation described; instruments and test procedure; results of tests and analysis of operation.

ELECTRIC TRANSFORMERS

THREE-WINDING. Three-Winding Transformer Banks and Some Features of Their Operation in Parallel, G. D. Floyd. Elec. News (Toronto), vol. 37, no. 7, Apr. 1, 1928, pp. 37-39, 5 figs. Theoretical study of simple cases of parallel operation of typical transformer banks, showing effect of various methods of operation on maximum load that can be carried on windings and consequent reduction in transformer-bank capacity.

DESIGN. Theory of Transformer Design (Zur Entwurfstheorie des Transformators), M. Vidmar. Elektrotechnik u. Maschinenbau (Vienna), vol. 46, no. 16, Apr. 15, 1928, pp. 349-358, 2 figs. Original method for computing weights of parts directly; gives formulæ for weights, costs and losses of parts.

ERRORS. The Relation of Errors in Current Transformers to the Accuracy of Watt-Hour Meters at Abnormal Loads, L. S. Carter. Purdue Eng. Rev., vol. 23, no. 3, Mar. 1928, pp. 7-8, 24 and 30, 4 figs. Study of errors of transformers throughout range of one-tenth to ten amperes secondary current; character of errors; method of Silsbee transformer test set; made for use with standard transformers whose errors are known; current transformer to operate on upper range of current rating and at overloads rather than at very light loads.

HEATING. Predetermination, Through Calculation, of Transformer Heating (Prédétermination par le calcul de l'échauffement des transformateurs), Lapine. Revue Générale de l'Electricité (Paris), vol. 23, no. 14, Apr. 7, 1928, pp. 621-625, 4 figs. Shows how to define rules for given transformer by formula giving heating in function of time.

LOAD RATIO CONTROL. Load Ratio Control Transformers, M. Cornudet. Elec. World, vol. 91, no. 16, Apr. 21, 1928, p. 823. It is claimed that transformers with voltage taps, and electro-mechanical arrangement for change of taps without load interruption, will give apparatus less expensive than induction voltage regular or synchronous converter; Swedish concern has developed such transformer tap-switching arrangement or load-ratio control for voltages up to 77 kv. and 350 amperes. Abstract translated from Bul. de la Société Française des Electriciens, vol. 77, 1928.

ELECTRIC TRANSMISSION AND DISTRIBUTION

CONSTRUCTION. The Corner Stone of a Power System, E. M. Lebkuecher. Elec. Light and Power, vol. 6, no. 4, Apr. 1928, pp. 28-32 and 93, 8 figs. Construction of 66,000-volt transmission line on steel towers; necessary to construct two substations; both to be provided with supervisory control so arranged that all oil circuit-breakers in either substation may be controlled either from 66-kv. substation or from remote station at power plant switchboard.

BRITISH COLUMBIA. The Fraser Valley Power Centre. A. Vilstrup. Elec. News (Toronto), vol. 36, no. 8, Apr. 15, 1928, pp. 27-28, 2 figs. Matsqui substation of British Columbia Electric Railway Co. is hub of power network in valley; has interesting history; important link in international chain of power connection; two systems consolidated; additional equipment installed.

ELECTRIC WELDING

ALUMINUM. Welding Aluminum and Its Alloys, W. M. Dunlap. Iron Trade Rev., vol. 82, no. 17, Apr. 26, 1928, pp. 1066-1068 and 1116, 6 figs. Allowance for higher speed of welding and for greater expansion and contraction distinguishes aluminum welding from that of steel; finishing important; flux to dissolve aluminum oxide so that coalescence may occur; selection of welding rod; avoiding contraction strains when welding duralumin; filling holes in welding castings; removing flux. Abstract from paper presented before Am. Welding Soc.

GAS PIPE LINES. High-Pressure Natural Gas Line Electrically Welded 45 Miles, B. K. Smith. Oil and Gas Jl., vol. 26, no. 45, Mar. 29, 1928, pp. 119, 122 and 126, 2 figs. Line is 7-in. pipe, pressure 1,000 lb. preliminary work tested to 1,250 lb.; no leak developed; equipment, 3 Lincoln stablearc engine-driven welders; each weld in two layers to avoid pinholes; each joint stamped with number of operator, bonus for good work; piecework on last 15 miles; in 11,000 joints only 14 pinholes found and readily sealed.

WATERWHEEL CASING. Reclaiming a Cast Iron Waterwheel Casing, C. W. Babcock. Am. Welding Soc.—Jl., vol. 7, no. 3, Mar. 1928, pp. 19-22, 3 figs. Because of extreme thinness of iron inside radius of worn section it was impossible to weld, or deposit metal, on casing itself; space bridged by series of steel rings welded together and to casing, and then remaining area welded in; high spots ground off welded section by portable grinding wheel.

ELECTRICITY ON FARMS

CONSUMPTION. Electricity Consumption on the Farm, F. D. Paine. Elec. World, vol. 91, no. 16, Apr. 21, 1928, p. 821. From records of rural electrification project at Garner, Iowa, there is presented analysis of consumption of electricity for various uses on dairy farm of 195 acres.

EXCAVATING MACHINERY

MISSISSIPPI RIVER. Earth Moving in Mississippi Flood Control, G. B. Massey. Eng. News-Rec., vol. 100, no. 15, Apr. 12, 1928, pp. 592-595, 5 figs. Available equipment types and capacities appraised in light of volumes to be handled and available sources of levee material; character of work to be done; present government floating plant; hydraulic pipe-line dredges of two general types, non-propelling and self-propelling dredges; present land plant; appraisal of machine types; costs.

F

FIRECLAY

CANADA. Saskatchewan Fire Clays, G. M. Hutt. Can. Min. Jl. (Gardenvale, Que.), vol. 49, no. 14, Apr. 6, 1928, pp. 290-291, 3 figs. Most important deposits yet known of refractory and related clays in Canada occupy several areas in southwestern Saskatchewan; from viewpoint of railway facilities, there are three main areas of superior clays in southwestern Saskatchewan; Cypress Hills, valley of Lake-of-the-Rivers and vicinity of Claybank.

FLOW IN PIPES

VISCOUS LIQUIDS. The Flow of Viscous Liquids Through Pipes. Engineering (Lond.), vol. 125, no. 250, Apr. 27, 1928, pp. 498-499, 3 figs. Oils of various degrees of viscosity are frequently pumped through pipes to ships or to distant storage tanks; to determine power required in given case and to choose most economical pumping plants and pipes, frictional resistance encountered by liquids when so transported must be known; presents formula and charts by C. H. Lee for determining viscous or turbulent flow, and describes method of using them.

FLUIDS

FRICTION OF ROTATING DISKS. Study of Friction of Disks Rotating in a Viscous Fluid (Etude sur le frottement des disques en rotation dans en fluide visqueux), C. Hanocq. Revue Universelle des Mines (Liège), vol. 18, no. 1, Apr. 1, 1928, pp. 8-28, 14 figs. Analysis of experiments and determination of coefficients of formulas and application to efficiency of pump or turbine; verification of curves obtained from centrifugal pump, pumping viscous liquids.

FOUNDRIES

STEEL, PROGRESS IN. Hot Blast, Powdered Coal in Cupolas. Iron Age, vol. 121, no. 15. Apr. 12, 1928, pp. 1027-1028. Phases of recent advance of science in foundry considered; rapid changes affecting steel foundries; marked progress in sand-testing devices; late method for measuring permeability; methods that have been used effectively in Wilson Foundry; experience with hot blast and powdered coal; alloys for high-strength castings. Review of Detroit Chapter meeting of Am. Soc. Steel Treating.

FUELS

See Coal; Pulverized Coal.

FURNACES

ANNEALING, CIRCULAR. Circular Annealing Furnace Produces Good Results, J. Strauss. Foundry, vol. 56, no. 8, Apr. 15, 1928, pp. 299-300 and 303, 6 figs. Furnace erected in steel-foundry department, U.S. Naval Gun factory; one-piece roof, 26 ft. in diam. overall and weighing about 25 tons; outlets for products of combustion arraged to permit close temperature control; burners supplied with fuel oil; flue construction; improvements secured from construction.

G

GAUGES

SCREW-THREAD, MANUFACTURE OF. Manufacture of Thread Gauges (Die Herstellungsgenauigkeit der Gewindelchren und ihre Messtechnische erfuellung), G. Berndt. Werkstattstechnik (Berlin), vol. 22, no. 5, Mar. 1, 1928, pp. 131-136, 5 figs. Describes special microscopes, gauges and measuring devices; methods used in making thread gauges in accordance with German (DIN) standards.

GAS TANKS

HORTONSPHERES. Erecting Gas Storage Tanks at Windsor. Can. Engr. (Toronto), vol. 54, no. 17, Apr. 24, 1928, pp. 465-466, 5 figs. Windsor Gas Co. erects four Hortonspheres in transmission system to maintain adequate supply of gas for industries at peak periods; each sphere is 56 ft. diameter with capacity of 250,000 cu. ft. of gas at 50 lb. pressure; operation of Hortonspheres is entirely automatic.

GEAR-CUTTING MACHINES

HELICAL-GEAR. A Large Double Helical Gear Generating Machine. Engineer (Lond.), vol. 145, no. 3772, Apr. 27, 1928, pp. 462-468, 10 figs. (partly on p. 462). Built on Sykes principle; designed to cut turbine and other gear wheels up to 9 ft. 6 in. in diam. and 30 in. wide; it can be set to cut not only double-helical, but also single-helical gearing.

GEARS

HELICAL. The Accuracy of Large Hob-Cut Helical Gears, G. A. Tomlinson. Engineering (Lond.), vol. 125, no. 3249, Apr. 20, 1928, pp. 465-466, 6 figs. Results of investigation made at National Physical Laboratory into errors likely to occur in process of hobbing large helical gears; errors fall under three heads; errors inherent in hobbing process, errors produced in gear by errors present in hob and errors caused by certain errors in hobbing machine.

NOISE ELIMINATION. Eliminating Noise in High-Speed Gearing, I. Short. Power, vol. 67. no. 18. May 1, 1928, pp. 761-764, 2 figs. Adjustable resonating "stethoscope" tells number of clicks per revolution of gear; hobber noise can be avoided by perfecting hobbing machine; contact noise is reduced by designing gear with proper relation of pitch and face width; gear noise due to pump pulsations may be cured by proper couplings.

PHENOLIC LAMINATED. Laminated Phenolic Gears Show Safety Factor of 15 to 20, P. M. Heldt. Automotive Industries, vol. 58, no. 17, Apr. 28, 1928, pp. 654-657. Brief review of meeting of American Gear Mfrs'. Assn.; report of E. Buckingham relating to tests made on pinions; factor of safety of gears made of laminated phenolic materials, instead of being between three and four is actually between 15 and 20; other papers; keyway standards; gear-tooth profile modification; effect of resilience; gear lubrication; rear-axle lubrication; tooth contact in worm gears.

SPROCKETS, HOBBING. The Hobbing of Chain Wheels, B. S. Clevely. Machy. (Lond.), vol. 32, no. 809, Apr. 12, 1928, pp. 41-45, 9 figs. Cutting of chain wheels on hobbing machines, and first principles involved; for roller chain tooth, slight variation in flank accuracy is not important; for inverted tooth chain, angle must be as accurate as possible, and flank of teeth must be flat; in this case universal hob may be ruled as being out of question; opinion expressed that for high-speed chain transmissions hobbing is somewhat doubtful proposition.

GEOPHYSICAL EXPLORATION

DESCRIPTION OF. Some Applications of Potential Methods to Structural Studies, E. G. Leonardon and S. F. Kelly. Am. Inst. Min. and Met. Engrs.—Tech. Pub., no. 115, Apr. 1928, 18 pp., 13 figs. Schlumberger electric prospecting methods; notes on study of syncline in Normandy, France, salt domes in Alsace, oil prospecting in Roumania, etc; erroneous to assume potential methods limited to search for metallic ores; electrical conductivity, entirely independent of gravity, elasticity and magnetism.

Geophysical Methods of Prospecting. Modern Min., vol. 5, no. 4, Apr. 1928, p. 110. Mention of U.S. Bur. of Mines Tech. Paper No. 420 and announcement of organization of "American Society of Geophysics," as United States branch of "Int. Soc. for Advancement of Geophysics."

GOLD MINES AND MINING

BRITISH COLUMBIA. Alluvial or Placer Mining in British Columbia, H. J. Robertson. Can. Min. Jl. (Gardenvale, Canada), vol. 59, no. 13, Mar. 30, 1928, p. 268, 2 figs. Many rich superficial deposits worked out; deeply buried deposits still untouched; low-grade deposits also still unworked; only few isolated instances of suitable conditions for dredging, as narrow, steep valleys are rule, with gold-bearing gravel capped by glacial drift.

ONTARIO. Gold Mining Camps. Imperial Inst.—Bul. (Lond.), vol. 26, no. 1, Apr. 1928, pp. 53-60. Kirkland lake and Porcupine fields; gold was only discovered in Kirkland lake field in 1911; gold ores of this camp are much richer than those of Porcupine; milling practice; Porcupine field dates from 1908; milling is divided into four stages.

GRINDING

NON-METALLIC MATERIALS. Grinding Non-Metallic Materials. Am. Mach., vol. 68, no. 15, Apr. 12, 1928, p. 610, 3 figs. Three half-tones illustrating methods of grinding non-metallic materials, each cut accompanied by brief description; battery of three double head grinding machines facing six sides of insulating bricks; grinding hexagon floor-tile to tolerance of 0.007 in. of squareness; china syrup-jars being ground on four sides to make tight-fitting surfaces.

H

HIGH-SPEED STEEL

CUTTING. Tests in Machining Manganese Steel, A. S. Martin. Heat Treating and Forging, vol. 14, no. 3, Mar. 1928, pp. 282 and 296. High-speed tool steel has been found effective in machining material hitherto practically unmachineable; other applications suggested; cutting operations; with tools made of steel under test, manganese steel can be commercially machined using cutting speeds from 7½ to 15 ft. per min. with depths of cuts up to 5/32 in. and feeds of 1/60 in. to 1/50 in.

HOUSES

STEEL. Steel-Frame Construction for Residence Buildings. Eng. News-Rec., vol. 100, no. 18, May 3, 1928, pp. 690-691, 4 figs. Trusses and braced vertical members formed by shearing and stretching standard angles and I-beam sections; first building of this type has been erected and others are under construction.

HUMIDITY

PSYCHROMETRIC CHART. Revised Psychrometric Chart Assists High Temperature Design, I. Lavine and R. L. Sutherland. Chem. and Met. Eng., vol. 35, no. 4, Apr. 1928, pp. 224-228. Properly constructed humidity chart is found especially valuable in making air calculations such as in design of drying apparatus; in connection with experimental work in drying lignite, it was deemed advisable to construct high temperature psychrometric chart along conventional lines; chart represents mixtures of dry air and water vapour, total pressure of mixture being taken as 29.92 in. of mercury.

HYDRAULIC PRESSES

FORGING. Hydraulic Forging Presses (Die hydraulichen Schmiedepresseinrichtungen), A. Deutsch. Foerdertechnik u. Frachtverkehr (Wittenberg), vol. 21, no. 5, Mar. 2, 1928, pp. 95-99, 9 figs. Details of construction, pumps, valves, etc.; materials of construction and mode of operation; commercial types by Haniel & Lueg and others.

RAPID-PRODUCTION. The Most Rapid Hydraulic Press in the World (La presse hydraulique la plus rapide du monde). Revue des Matériaux de Construction et de Travaux Publics (Paris), no. 222, Mar. 1928, p. 117, 1 fig. New hydraulic press of French make gives 20,000 compressions in 8 hours; assembly of several presses which turn around fixed axis.

HYDRAULIC TURBINES

AXIAL-FLOW. Flow of Water in the Casing of An Axial Flow Turbine, K. Kanesige. Soc. Mech. Engrs. of Japan—Jl. (Tokio), vol. 31, no. 131, Mar. 1928, pp. 71-104, 25 figs. Flow of water in free whirling chamber of head casing for axial-flow turbine treated as irrotational and symmetrical with respect to vertical axis of central core rotating with constant angular velocity; ratio of radius of central core to that of circular exit of casing expressed as function of direction of flow determined by guide vanes and ratio of height of casing cover above circular exit to its radius.

HIGH-HEAD (FRANCIS). High-Head Spiral Turbines in Syria and Mexico (Die Hochdruck-Spiralturbinen der Anlagen Arnstein in Steiermark und Tepexic in Mexiko), G. von Troeltsch. V.D.I. Zeit. (Berlin), vol. 72, no. 15, Apr. 14, 1928, pp. 491-494, 7 figs. Describes horizontal-shaft Francis turbines, by J. M. Voith, of Heidenheim, installed in Teigitsch plant, at Arnstein, Austria (head, 246 m., capacity, 21,300 h.p.) and at Tepexic plant, on Necaxa river, Mexico (head, 210 m., capacity, 15,200 h.p.); acceptance tests; Allen chemical gauging apparatus used.

HYDRO-ELECTRIC PLANTS

VOLTAGE REGULATORS. Regulator Protects Penstock on Fluctuating Loads, S. C. Lindsay. Elec. World, vol. 91, no. 17, Apr. 28, 1928, pp. 858-859, 4 figs. Feeder regulator mechanism actuates water rheostat to maintain minimum water velocity in long penstock of small hydro plant; problem was to find regulating mechanism that would operate automatically to maintain minimum load on generators as function of trail-load kilowatt demand; installation was made at cost not exceeding $1,500, as compared with estimated costs of from $10,000 to $12,000 for other schemes considered.

HYDRO-ELECTRIC POWER DEVELOPMENTS

MANITOBA. Report on the Seven Sisters Power Site, T. H. Hogg. Can. Engr. (Toronto), vol. 54, no. 14, Apr. 3, 1928, pp. 417-419. Reports against development of power site at Seven Sisters Falls on Winnipeg river by Manitoba provincial government as being economically unsound; cost of alternative developments and obligations that would have to be assumed if undertaken by government; final expenditure for complete utilization of full flow of river would require total of $23,370,000 for necessary works; additional $6,500,000 for Pinawa plant.

QUEBEC. Quebec Advances Rapidly with Water-Power Development, E. G. Wilson. Power, vol. 67, no. 15, Apr. 10, 1928, pp. 636-637, 2 figs. Has estimated total of over 13,000,000 h.p., of which over 2,000,000 have been developed; among projects or extensions under active construction are 65,000-h.p. development by Montreal Island Power Co. on des Prairies river; addition of two 10,000-h.p. units to Canada Northern Power Co.'s plant on Quinze river; and 300-h.p. plant by Cie d'Enterprises Publiques near Rivière à Pièrre.

I

INDUSTRIAL MANAGEMENT

COST CONTROL. Basic Data for Setting Standard Costs, H. J. Bock. Mfg. Industries, vol. 15, no. 3, Mar. 1928, pp. 191-193. Prerequisites are thorough account classification and tie-up between cost records and general ledger; burden standards and department budgets help greatly in reducing costs with foreman's co-operation.

PRODUCTION BUDGET. Production and Inventory Budgets, T. R. Jones. Am. Mach., vol. 68, no. 14, Apr. 5, 1928, p. 587. Proper background for production budget is supplied by sales-expectancy estimate; three classes of burden; triple classification of expense, together with reduction of burden charges to dollars per labour-hour basis, permits quick adjustment of budget to production in event of unforeseen business fluctuation; inventory analysis.

PRODUCTION BUDGET. Production and Inventory Budgets, T. R. Jones. Am. Mach., Machy. (Lond.), vol. 32, no. 809, Apr. 12, 1928, pp. 54-57 and (discussion) 57-58. Single- and multi-purpose tools; antiquation factor in machine tools; jig as necessary evil; production and preparation of material; position of foundry; pressings and stampings; factory layout; economy of idle machines; high-grade goods by multiple not mass production; elasticity of transport and finance. Abstract of lecture before Inst. of Production Engrs.

TIME STUDY. Smoothing the Wrinkles from Management. Time Study the Tool, S. E. Thompson. Taylor Soc.—Bul., vol. 13, no. 2, Apr. 1928, pp. 69-80 and (discussion) 80-86, 4 figs. Present fundamental principles and practical method of using time studies in various functions of business and shows specifically place in industry to time measurement and job analysis as tool of management; fixing time standards in shoe shop; time standards in production control; rules for time study.

INTERNAL-COMBUSTION ENGINES

See Airplane Engines; Diesel Engines.

INSULATORS, ELECTRIC

PUNCTURE TESTING. Puncture Tests Affected by Strength of Oil, J. T. Littleton, Jr., and W. W. Shaver. Elec. World, vol. 91, no. 15, Apr. 14, 1928, pp. 759-760. Experiments made to determine effect of dielectric strength of oil on puncture voltage of insulator under oil; 14 Pyrex insulators with rated dry flashover of 82 kv. were selected for tests.

J

JOURNALS

DESIGN. The Design of Sliding Neck Journals (Zur Berechnung von Gleittragzapfen), E. Wellner. V.D.I. Zeit. (Berlin), vol. 72, no. 13, Mar. 31, 1928, pp. 435-440, 7 figs. On basis of Reynolds theory and Guembel studies, author analyzes conditions of sliding journal friction and works out curves for design of elements of sliding-neck journals, also curves for maximum unit surface pressure for various speeds of revolution.

K

KLYDONOGRAPHS

STUDY OF. Transmission Line Surges and Their Effect on Operation, J. H. Cox. Elec. Light and Power, vol. 6, no. 4, Apr. 1928, pp. 24-27, 16 figs. Study of voltage surges by means of klydonograph; principles of operation and description of klydonograph, together with discussion of records obtained by it; characteristics of klydonograph figures. (To be continued.)

L

LATHES

MANUFACTURE. Mass Manufacture of Lathes, B. Finney. Iron Age, vol. 121, no. 16, Apr. 19, 1928, pp. 1067-1072, 10 figs. Production-control system, routing and mechanical handling and special-purpose equipment reduce costs at Monarch Machine Tool Co.; raw materials needs estimated on basis of pending business; work tag and move card; cost record of all subassemblies; monorail and lift trucks; drilling holes in lathe beds while resting on small flat cars; toolroom system.

LOCOMOTIVE BOILERS

DESIGN. The Design and Proportion of Locomotive Boilers and Superheaters, C. A. Brandt. Can. Ry. Club—Proc. (Montreal), vol. 27, no. 2, Feb. 1928, pp. 20-58 and (discussion) 58-64, 32 figs. Boiler and superheater relation to cylinder efficiency and capacity; steam consumption; high steam pressures; water-tube firebox; grate area and furnace volume; length of flues for proper efficiency; results obtained with engines fitted with type "E" superheater; feedwater heaters; effect on boiler evaporating capacity.

NICKEL-STEEL. Nickel-Steel for Locomotive Boilers, C. McKnight. Ry. Mech. Engr., vol. 102, no. 4, Apr. 1928, pp. 193-198, 7 figs. Possesses high strength and ductility; physical properties at high temperatures and after aging superior to carbon steel; 3 per cent nickel-steel boiler plate of 70,000 lb. per sq. in. minimum tensile strength; comparison of nickel- and carbon-steel plates; high temperature characteristics of nickel-steel; uniformity; manufacture; possibility of higher strengths with nickel-steels; boiler tubes and staybolts. Paper presented before Am. Soc. Steel Treating.

LOCOMOTIVE REPAIR SHOPS

EQUIPMENT. Special Fixtures for Railroad-Shop Work, F. H. Colvin. Am. Mach., vol. 68, no. 17, Apr. 26, 1928, pp. 687-688, 5 figs. Devices for smoke box and boiler work at Delaware & Hudson Colonie Shops; fixture for drilling smoke box rings and boiler front for smoke boxes; specially shaped clamp to hold boiler front on table of less diameter; fixtures holding long string of shoes or wedges planed at once; laying out driving boxes for machining.

LOCOMOTIVES

CANADIAN NATIONAL RAILWAYS. 4-8-4 Type Locomotives for the Canadian National Railways. Engineering (Lond.), vol. 125, no. 3245, Mar. 23, 1928, pp. 347-348, 13 figs. partly on supp. plate and p. 354. Intended for handling either fast freight or passenger service and for long runs over two or three divisions; all engines are designed to take boosters.

DIESEL. Geared Diesel and Diesel-Electric Locomotive Trials, N. Dobrowolski. Engineering (Lond.), vol. 125, no. 3250, Apr. 27, 1928, p. 504. Information regarding geared Diesel locomotive of 4-8-2 type built by Firma Hohenzollern A.-G. of Dusseldorf, for use in Russia; result of trials of similar train journeys, Moscow-Baku-Moscow, with Diesel-electric locomotive and geared Diesel locomotive. Abstract translated from V.D.I. Zeit., June 18, 1928, p. 873.

ELECTRIC. *See Electric Locomotives.*

GASOLINE-ELECTRIC. Mack Develops Line of Gas-Electric Railcars and Locomotives. Automotive Industries, vol. 58, no. 14, Apr. 7, 1928, pp. 544-548, 6 figs. Numerous original features embodied in design; system of control similar to that of steam engines; new method of cooling; car seats 75; use of more than single power plant; engine is 6-cylinder one, of 5-in. bore and 6-in. stroke, with single inlet and exhaust valve and single spark-plug per cylinder; reason for larger generator; battery for starting; engine is protected against high temperature; long compressor life.

Oil-Electric. Performance Records of Oil-Engine Locomotives, H. Lemp. Power, vol. 67, no. 18, May 1, 1928, pp. 784-785, 1 fig. Reviews experiences of last three years; oil-electric locomotive is only locomotive on standard-gauge tracks that has any service records to offer in United States; used exclusively for switching purposes; passenger and main-line freight service is to be inaugurated by N.Y. Central on Putnam Division; in Europe, main-line operation is considered satisfactory; oil locomotives with mechanical transmission. Abstract of paper read before Metropolitan Sec., Am. Soc. Mech. Engrs.

Pulverized Coal Burning. Locomotives Fired by Coal Dust, D. W. Kleinmow. Colliery Guardian (Lond.), vol. 136, no. 3509, Mar. 30, 1928, p. 1237, 2 figs. Best results achieved with lignite dust, which contains high percentage of volatile constituents; fuel utilized better than in grate firing, as less than half excess air is required to heat; in one boiler, saving over 20 per cent; new type of A.E.G. dust-fired locomotive represents efficiency of 67.5 per cent; saving of fuel as compared with grate-fired boiler is 23 per cent. Abstract from Braunkohle.

Steam-Turbine (Ljungstrom). Tests of Ljungström Turbine Locomotives (Essais de locomotives à turbines Ljungström). Revue Générale des Chemins de Fer (Paris), vol. 47, no. 4, Apr. 1928, pp. 312-314, 1 fig. Test results on turbine locomotive in Sweden and in Argentina; tests of comparison with piston locomotives.

LUBRICATION

Theory and Practice. The Theory and Practice of Lubrication, J. E. Southcombe. Machy. Market (Lond.), nos. 1429 and 1430, Mar. 23 and 30, 1928, pp. 265-266 and 287-288, 6 figs. Mar. 23: Comprehensive theory of friction and lubrication for use in application of lubricants and design of bearing surfaces; theory of boundary lubrication; oiliness is property of interface. Mar. 30: Experimental work done; rotational motion at slow speed; machine for comparing lubricating value of oils; reciprocating motion and pistons; boundary friction; disturbing action of water. Paper read before North-East Coast Instn. Engrs. and Shipbldrs.

M

MACHINING METHODS

Shock Absorbers. Tooling That Is Unusual, F. H. Colvin. Am. Mach., vol. 68, no. 16, Apr. 19, 1928, pp. 657-660, 12 figs. Methods used in making Houde hydraulic shock absorbers; use of dial indicators on turret lathes; swaging splined holes to taper; body of reservoir of shock absorber contains two stationary abutments and has two moving wings; boring tools; cutting slot for abutments; finishing ends of movable wings on grinder; drilling holes in wing shaft; broaching splined holes.

METALS

Corrosion. Corrosion of Metals, G. D. Bengough. Iron and Coal Trades Rev. (Lond.), vol. 116, no. 3134, Mar. 23, 1928, p. 425. Standard test should be acceleration test; should be easily reproducible in two different laboratories, sufficiently simple to form part of ordinary works laboratory's routine and readily interpretable in terms of conditions of practice; chief factors relative to corrosion; only hope of obtaining standard test is research work of more accurate type than usually published in technical journals. Abstract from paper read before Inst. of Metals.

Machinability. Machinability of Metals, O. W. Boston. Univ. of Mich., Dept. of Eng. Research, no. 2, Feb. 1928, 38 pp. and (discussion) 38-47, 30 figs. Methods used to designate machinability; measurement of force on tool; measurement of power or energy required to remove given chip; ability of standardized tool to cut; measurement of finish left; penetration of standardized drill; torque developed by drill; cutting speed for certain tool life; hardness numbers; measurement of heat generated and hardness induced. Paper presented at Am. Soc. Steel Treating.

Pickling. Practical Features of Pickling, W. G. Imhoff. Iron Trade Rev., vol. 82, nos. 15 and 17, Apr. 12 and 26, 1928, pp. 943-945 and 978, 1 fig., and 1069-1071, 3 figs.

Surface Hardening of. New Process of Surface Hardening of Metals. The Cloud Burst Process (Un nouveau procédé de durcissement superficiel des métaux). Pratique des Industries Mécanique (Paris), vol. 11, no. 1, Apr. 1928, pp. 23-26, 9 figs. Not a chemical process but based on surface hardness from repeated blows; describes process and method of controlling hardness.

MINERAL RESOURCES

Canada. The Valuable Ore-Bearing Materials of Canada (Les richesses minières du Canada), V. Forbin. Nature (Paris), nos. 2782 and 2783, Apr. 1 and 15, 1928, pp. 289-293 and 360-364, 13 figs. Figures on mineral production of Canada for 1925; geology and physiography; description of nickel regions; Cobalt deposits; exploitation; gold deposits and exploitation. (To be continued.)

New Brunswick. Recent Development of New Brunswick Mineral Resources, C. Price-Green. Can. Chem. and Met. (Toronto), vol. 12, no. 4, Apr. 1928, pp. 94-95. Government should engage geologist to investigate boundaries of igneous intrusions in western portion of province and vicinity of pre-Cambrian along southern boundaries; rich deposits found in Ontario, Quebec and in Manitoba are in pre-Cambrian; manganese in northeastern part of province; in north, manganese is partly displaced by antimony; copper between Millidgeville and Dorchester; trial shipments made on copper development at Annidale.

MINING INDUSTRY

British Columbia. Present Status and Future Possibilities of the Mining Industry in British Columbia, V. Dolmage. Imperial Inst.—Bul. (Lond.), vol. 26, no. 1, Apr. 1928, pp. 69-74. Silver, lead, zinc and coal; copper and gold; great part of metal comes from comparatively few large mines; only two reduction works in province; coal is produced mainly from three districts.

Nova Scotia. The Mining Industry in Nova Scotia, G. S. Harrington. Imperial Inst.—Bul. (Lond.), vol. 26, no. 1, Apr. 1928, pp. 65-69. Coal mining is one of chief branches of industry; sharp revival in gold mining during past year; numerous large deposits of gypsum; deposit of rock salt.

N

NICKEL MINES AND MINING

Ontario. The Nickel Mines and Metallurgical Works. Imperial Inst.—Bul. (Lond.), vol. 26, no. 1, Apr. 1928, pp. 45-49, 1 fig. Companies chiefly engaged in working and treating ores of Sudbury are International Nickel Co. and Mond Nickel Co., who together supply 90 per cent of world's demand for nickel; visit to Creighton mine.

O

OIL FUEL

Canada. Auxiliary Sources of Liquid Fuels, A. W. Nash. Indus. Australian and Min. Standard (Melbourne), vol. 79, no. 2036, Mar. 15, 1928, pp. 273-275. Northern Alberta asphaltic material mixed with sand; 7 to 20 per cent recoverable oil; extracted by super-heated steam, resembles soft pitch with water in suspension and varying sulphur content; low-temperature carbonization of coal; Berginization; discussion of processes described; methods for utilization. Extract from paper read before Min. & Met. Congress. See reference to original paper in Eng. Index, 1917, p. 586.

ORE TREATMENT

Flotation. Fundamentals in the Flotation of Sulphidized Oxidized Ores, F. A. Bird. Eng. and Min. Jl., vol. 125, no. 16, Apr. 21, 1928, pp. 652-654. Flotation of oxidized ores frequently discussed; important references, excluding patent literature are given; author believes that type of grinding media used is important in preparation of oxidized ore for flotation process; use of activating chemical in connection with normal sulphide benefits recoveries; cites serial no. 2811, U.S. Bureau of Mines, discussing flotation of oxidized copper ores.

P

PAINTING

Mechanical—Mass Production. Mechanical Painting Processes Used in Mass Production (Anstreichverfahren im Grossbetrieb), H. Hettner. Werkstattstechnik (Berlin), vol. 22, no. 6, Mar. 15, 1928, pp. 167-171, 8 figs. Describes processes used in painting, varnishing, lacquering of grass mowers, motorcycles, iron bedsteads, automobile bodies, etc.

PAVEMENTS

Asphalt Block. Asphalt Blocks for Pavements, T. Salkield. Can. Engr. (Toronto), vol. 54, no. 15, Apr. 10, 1928, p. 432. Composition and method of manufacture; easily handled, noiseless and impervious to moisture; composition of blocks; method of laying blocks; advantages of asphalt blocks. Reprinted from Surveyor.

Asphaltic Concrete, Construction. Mechanical Spreading, Raking and Finishing of Asphaltic Concrete Pavement, C. S. Pope. West. Constr. News, vol. 3, no. 7, Apr. 10, 1928, pp. 246-247, 2 figs. Description; machine consists essentially of motor-driven steel framework running on flanged wheels resting on side forms; paving operation; advantages.

Black Base. Construction of Black Base Pavements, W. H. Booker. Can. Engr. (Toronto), vol. 54, no. 15, Apr. 10, 1928, pp. 441-443. Triaxial diagram for concrete base or black base; outstanding characteristics; improving subgrade; economy; other features. Paper presented at Sixth Annual Asphalt Paving Conference.

Concrete. Design and Construction of Concrete Pavements, G. E. Hawthorn and H. O. Root. Am. Soc. Civ. Engrs.—Proc., vol. 54, no. 5, part 1, May 1928, pp. 1617-1621, 1 fig. Calls attention to one feature of design, namely, width to which edge thickness should be extended toward centre. Discussion of paper by C. Older, continued fram Mar. 1928 issue of Proceedings.

Concrete, Curing. Curing Cement-Concrete Pavement in Los Angeles, J. C. Shaw. Am. City, vol. 38, no. 4, Apr. 1928, pp. 119-120, 3 figs. New method of curing concrete called Hunt process has been devised which has been used successfully on several paving jobs in Los Angeles; method of curing; process produced concrete of strength equal to that obtained by usual method of curing by banking and puddling.

PHOSPHATE ORE TREATMENT

Flotation. Flotation of Low-Grade Phosphate Ores, H. M. Lawrence and F. D. DeVaney. Pit and Quarry, vol. 16, no. 1, Apr. 11, 1928, pp. 54 and 78. Phosphate recovery in Florida is simple washing and screening operation; flotation has been applied to Spanish phosphates; investigation of flotation for Florida phosphates under way; work reported has been largely confined to screen-undersize products rejected by washers.

PHOTOGRAPHIC SURVEYING

Lecture on. Swedish-Danish Railway Construction in Asia Minor (De Svensk-Danske jaernbaneanlaeg i lilleasien), O. Lerche. Ingenioren (Copenhagen), vol. 37, no. 11, Mar. 17, 1928, pp. 133-144, 25 figs. Describes organization and working methods for construction of line and branch from Angora to Eregli (on Black Sea) and from Deller to Diarbekir; use of surveying instruments and of most modern makes; stereo-autograph used to show curves and grades. Lecture held at Danish Eng. Soc.

PIPE

Concrete, High-Pressure. Concrete High-Pressure Pipe at Riverside, Calif., E. R. Bowen. Water Works, vol. 67, no. 4, Apr. 1928, pp. 170-171. Specifications for pipe; tests; fabrication and construction; sections of Riverside pipe are 42 in. inside diameter, 8 ft. long and have shell thickness of 3¾ in.; installation of Hume centrifugal pipe. Paper read before Calif. Sec., Am. Water Works Assn.

Cast Iron, Manufacture. New Method of Making Cast Pipe. Iron Age, vol. 121, no. 15, Apr. 12, 1928, pp. 999-1003, 6 figs. Hand labour eliminated in McWane mechanical process; unique multiple-lip ladle pours metal; ladles equipped with 14 spouts; two 6-in. or two 8-in. pipes poured at same time; conveyors and cranes handle materials; plant scheduled like rolling mill; features of continuous operation and flexibility of output; sand handling all done by conveyors; moulds and cores handled by cranes.

Wrought, Manufacture of. Bethlehem's New Pipe Mills, G. A. Richardson. Iron Age, vol. 121, no. 16, Apr. 19, 1928, pp. 1084-1089, 7 figs. Sparrows Point plant turns out wide range of butt and lapweld product; materials move minimum distances; pipe-mill layout; automatic operation of gas-producer unit; elimination of water dip for galvanized pipe; welding rolls driven by 400-h.p. electric motor; driven roller conveyors for handling pipe from operation to operation in lap-weld mills and control system.

PIPE LINES

Calculations. The Next Size Larger, J. Blansjaar. Heating and Vent. Mag., vol. 25, no. 4, Apr. 1928, pp. 76-79 and 81-82, 3 figs. Points out uselessness of calculating exact pipe diameters when pipes of calculated sizes are not available; principles involved in water heating; principal causes of resistance to flow of steam or water; figuring typical installation; chart for figuring pipe diameter based on Brabbee friction tables; how to use curves; point of divergence between European and American practice.

Welding. *See Electric Welding, Pipe Lines.*

PLATES

FLAT, STRESSES IN. The Stresses in Flat Plates, H. H. Gorrie. Rensselaer Polytechnic Inst.—Eng. and Science Series, Apr. 1928, pp. 20-60, 29 figs. Results of investigation to determine variation in intensity of strains that occur in flat steel plates subjected to uniform loads, to determine actual principal axes of strain for various points on plates, and by actual measurement, and from theoretical considerations, to find strain along these axes. Bibliography.

POLES

REINFORCED CONCRETE. Reinforced Concrete Poles for High-Tension Transmission Lines (Eisenbetonmaste fuer Hochspannungsleitungen), A. Kleinlogel. Beton u. Eisen (Berlin), vol. 27, nos. 6 and 7, Mar. 20 and Apr. 5, 1928, pp. 120-123 and 140-144, 27 figs. Advantages of reinforced concrete transmission line poles; examples of special designs adopted in France, Norway, etc.; methods of erection of reinforced concrete poles; recent Swedish and German designs of solid and hollow poles and towers.

POTASH MINES AND MINING

SHAFT SINKING. Shaft Bored by Freezing. Institut du Froid (English Edition)—Monthly Bul. (Paris), vol. 8, no. 11, Nov.-Dec. 1927, p. 1117. In potash mine of Alsace, new shaft had to be bored to 732 m. depth, where it was necessary to go through different aqueous layers each of which gave over 3,000 litres per hour; Poetsch method was employed to overcome this difficulty; freezing machine worked with ammonia; solution of calcium chloride was used as refrigerant. Abstract translated from Iberica, Nov. 12, 1927, p. 278.

POWER PLANTS

OIL-ENGINED. Heavy-Oil Engines in Power Stations. Engineering (Lond.), vol. 125, no. 3250, Apr. 27, 1928, p. 514. Editorial remarks on place of heavy-oil engines in power generation; in one important respect, for dealing with peak loads, Diesel engines have advantage of being able to start up almost instantaneously; refers to work of Diesel Engine Users' Assn. and Prime Movers' Committee of National Electric Light Assn.

STEAM, HIGH-PRESSURE. High-Pressure Steam Generation by Superheated Steam (Hochdruckdampferzeigung durch ueberhitzten Dampf), S. Loeffler. Waerme (Berlin), vol. 51, no. 4, Jan. 28, 1928, pp. 52-54, 5 figs. Details of trial plant erected at Vienna Locomotive Works according to author's system; operates according to so-called indirect process of evaporation, distinguished by water in boiler proper not being heated by flue gases, but by superheated steam; large plant, equipped with Bruenn high-pressure turbine, is being erected at Witkowitz Iron Works in Moravia; German Rys. Co. have ordered locomotive to operate on this principle.

Story of First Commercial 1,200-Lb. Steam Plant, I. E. Moultrop. Power, vol. 67, no. 17, Apr. 24, 1928, pp. 712-718, 8 figs. Why this pressure was chosen; operating experiences at Edgar Station, Boston; results that have justified decision; regenerative cycle made 1,200 lb. worth while; why live-steam heater was not used. Abstract of paper read before Eng. Inst. of Canada and Philadelphia Sec., A.S.M.E.

STEAM-ELECTRIC, BERLIN, GERMANY. The Klingenberg Super-Power Station (Berlin, Germany), M. Rehmer. Eng. Progress (Berlin), vol. 9, no. 3, Mar. 1928, pp. 57-58, 2 figs. At present peak load of 130,000-kw., following machines and station equipment are in operation: main turbine sets working at 72 per cent of their rated load, 9 boilers, 5 coal pulverizing mills; station can be proclaimed as one of most economical producers of electrical energy, having energy consumption of only 15,600 B.t.u. per kw.-hr. of gross production.

STEAM-ELECTRIC, DETROIT, MICH. The Trenton Channel Station of the Detroit Edison Company. Engineering (Lond.), vol. 125, no. 3248, Apr. 13, 1928, pp. 433-437, 16 figs. (partly on p. 448 and supp. plate). Details of pulverized fuel preparation plant.

POWER PLANTS

ELECTRIC—SUBSTATIONS, AUTOMATIC. Induction Motor and Exciter Added to Converter for Automatic Control. R. C. Newman. Coal Age, vol. 33, no. 4, Apr. 1928, pp. 215-216, 4 figs. Full-automatic 200-kw., 275-volt, rotary-converter substation embodying new starting and operating principles; if a.c. source of supply is correct and all bearing and transformer thermostat contacts are closed, set will start by closing starting snap switch; this operation closes circuit through heating coil of thermostat relay in motor circuit and coil of motor-starting contactor which starts induction motor, driving converter armature and exciter at same speed.

HYDRO-ELECTRIC, AUTOMATIC. Largest Automatic Hydro-Electric in Canada Goes Into Operation. Power, vol. 67, no. 17, May 1, 1928, pp. 789-790, 2 figs. British Columbia Elec. Railway Co. has completed construction of 12,500-h.p. plant at Alouette, in British Columbia; plant is automatically controlled from Stave Falls plant of company, situated approximately 12 miles away.

PREFERRED NUMBERS

WAGE-RATE APPLICATION. American System of Preferred Numbers. Mfg. Industries, vol. 15, no. 3, Mar. 1928, p. 232-233. Working Committee of Am. Eng. Standards Committee, after period of study, recommended adoption of system based on German practice, reason being its simplicity of detail; application in development of wage scales; presents table of preferred numbers informally approved by Committee.

PRESSURE VESSELS

HEADS, DESIGN OF. Design of Unstayed Dished Heads of Pressure Vessels for Internal Pressure (Die Berechnung ankerloser gewoelbter Boeden von Druckbehaeltern auf Innendruck), E. Hoehn. Schweizerische Bauzeitung (Zurich), vol. 91, no. 10, 1928, pp. 128-131, 4 figs. Design of dished heads on basis of rise of meridian arch and on basis of stresses in spherical wall; shapes of dished heads.

OXY-ACETYLENE WELDING OF. Procedure Control Methods Used in Pressure Vessel Welding, H. E. Rockefeller. Boiler Maker, vol. 28. no. 2, Feb. 1928, pp. 41-42, 1 fig. Welding head seams of high-pressure tank; methods of testing pressure vessels; providing ventilation; test of tank; regular hydrostatic test 600 lb. per sq. in.; fibre stress at test pressure was 27,000 lb. per sq. in.; discussion of factor of safety; strength of welded vessels. Paper read before Int. Acetylene Assn.

PULVERIZED COAL

SAFETY REGULATIONS. Special Hazards in Pulverizing of Coal and in Firing with Pulverized Coal (Betriebsgefahren der Kohlenstaub-Aufbereitung und Kohlenstaub-Feuerung), F. Schulte. Archiv. fuer Waermewirt-schaft (Berlin), vol. 9, no. 4, Apr. 1928, pp. 107-110. Report of pulverized coal committee of Coal Council of Germany; review of special American and German reports on fire and explosion hazards of coal pulverization and firing with pulverized coal; statistics of accidents and results of questionnaire investigation in Prussia; special instructions for producers and users of pulverized coal.

PUMPS

GEARED, DESIGN OF. The Design of Geared Pumps, E. Buckingham. Am. Mach., vol. 68, no. 15, Apr. 12, 1928, pp. 603-606, 6 figs. Limitations of conventional involute form of tooth for pumping service; helical gears of segmental tooth form are proposed and calculations of form of basic rack to generate them given; tooth action must avoid trapping; gears used successfully in gas compressors on small refrigerating units, as they operate quietly and effectively at high speeds.

PUMPS, CENTRIFUGAL

FEEDWATER. Boiler Feedwater Centrifugal Pumps for High-Pressure (Kesselspeise-Krieselpumpen fuer hohen Druck), Weyland. Waerme (Berlin), vol. 51, no. 4, Jan. 28, 1928, pp. 68-71, 9 figs. Economic advantages obtained by high-temperature feedwater preheating; design of hot water pumps for large power plants; introduction of hot condensates in high-pressure stage of feedwater pump.

SUBMERGED. Submerged Pumps (Unterwasserpumpen), H. Sauveur. V.D.I. Zeit. (Berlin), vol. 72, no. 13, Mar. 31, 1928, pp. 441-444, 12 figs. Reviews early designs of submerged pumps, coupled to vertical axes, by Schorch, Gscheidlen and Cooper; problem of packing ring, especially in case of fluctuating water levels; details of recent models of submerged pumps, particularly Garvens type.

R

RADIO BROADCASTING STATIONS

DESIGN AND DISTRIBUTION. The Design and Distribution of Wireless Broadcasting Stations for a National Service, P. P. Eckersley. Experimental Wireless (Lond.), vol. 5, no. 55, Apr. 1928, pp. 189-197, 11 figs. Limitation of wave-length; linking together of stations; design of broadcasting transmitters; types of transmitter discussed; comparison between two methods described. Abstract of paper read before Instn. Elec. Engrs.

RADIO CIRCUITS

INDUCTION. Mutual Inductance in Radio Circuits, L. Hartshorn. Experimental Wireless (Lond.), vol. 5, no. 55, Apr. 1928, pp. 184-188, 2 figs. Discusses most useful properties of ordinary impure mutual inductance and points out their bearing on most common forms of mutual inductance in radio work; mutual inductance equations; application to variometers.

RAILROADS

SIGNALS AND SIGNALLING—POWER SUPPLY. Principles and Maintenance of the A.C. Floating Battery System, E. Bishop. Ry. Signaling, vol. 21, no. 4, Apr. 1928, pp. 144-145, 4 figs. Hydraulic analogy given to explain meaning of "floating charge"; proper charging voltages recommended; maintaining a.c. floating-battery system; condensed suggestions for maintainers.

TERMINALS. Modern Yards and Terminals, J. S. Morris. Ry. Age, vol. 84, no. 16, Apr. 21, 1928, pp. 919-921, 1 fig. Discusses various improvements necessary in modernizing yards and terminals; over-estimates; yard and terminal improvements; power plants; unit coal pulverizer. Abstract of paper read before West. Ry. Club.

STATIONS, TORONTO. The Viaduct Structure at the New Union Station, Toronto, A. R. Ketterson. Eng. Jl. (Montreal), vol. 11, no. 4, Apr. 1928, pp. 251-262, 16 figs. General description; lateral distribution of track live load; comparison with results based on joint committee formula; construction; foundations; concrete; plant.

RAILWAY MOTOR CARS

DIESEL. New Design of Railroad Motor Car Equipped with Compressionless Diesel Engine (Eine neue Triebwagenbauart mit kompressorlosem Dieselmotor und ihre Versuchsergebnisse), Nolde. Organ fuer die Fortschritte des Eisenbahnwesens (Munich), vol. 83, no. 6, Mar. 16, 1928, pp. 109-112, 5 figs. General description of Wegmann railroad motor car; details of six-cylinder, 75- to 90-h.p. compressionless M.A.N. Diesel engines; results of tests.

GASOLINE-ELECTRIC. Gas-Electric Unit for Rail Cars. Ry. Age, vol. 84, no. 15, Apr. 14, 1928, pp. 866-870, 11 figs. Important features of gas-electric unit designed and put in service by Mack International Motor Co., Plainfield, N.J.; for use in three sizes of rail motor cars and three sizes of locomotives; construction of base; engine develops 152 b.h.p. at 1,800 r.p.m.; cooling system; control; electrical equipment; operating data.

Rail-Cars and Their Operation, W. C. Sanders. Soc. Automotive Engrs. —Jl., vol. 22, no. 5, May 1928, pp. 541-548 and (discussion) 548-549, 4 figs. Railroads of future will supplement through passenger trains with self-propelled local cars and motor coaches; definite figures for savings from substituting gasoline propelled trains for steam trains; ideals of rail-car design; definite requirements for many units; maintenance organization of New Haven Railroad; adequate training is required for rail-car operators.

RECTIFIERS, MERCURY-ARC

INSPECTION. Mercury-Arc Rectifier Inspections, O. M. Ware. Elec. World, vol. 91, no. 18, May 5, 1928, p. 908. Presents report form of Milwaukee Electric Railway and Light Co. for mercury-arc rectifier stations.

REFRIGERATING MACHINES

IMPROVEMENT. Increasing Efficiency of Refrigerating Systems, G. Hilger. Ice and Refrig., vol. 74, no. 4, Apr. 1928, pp. 403-406, 11 figs. Apparatus and methods for increasing efficiency of refrigerating machines; relationship of temperatures and pressures of working refrigerants; effect of non-condensable gases; control and regulation of evaporators; describes and illustrates various apparatus and methods which may be used to increase operating efficiency of compression refrigerating system. (To be continued.) Abstract of paper read before Nat. Assn. Practical Refrig. Engrs.

MULTI-STAGE. Utilization of Multi-Stage Refrigerating Machines, O. Wagner. Institut du Froid (English Edition)—Monthly Bul. (Paris), vol. 8, no. 11, Nov.-Dec. 1927, pp. 1073-1078. Discusses advantages which can be hoped for from multi-stage compression of cold vapours and conditions under which it is convenient to choose machine with several stages; real field of utilization is that of very low temperatures. Abstract translated from Zeit. fuer die gasamte Kaelte-Industrie, Sept. 1927, p. 160.

REFRIGERATING PLANTS

DESIGN. The Design of Refrigeration Plants, G. W. Daniels. Can. Chem. and Met. (Toronto), vol. 12, no. 4, Apr. 1928, pp. 92-93 and 104. Ideal operations: (1) taking up, isothermally, heat from body to be cooled; (2) adiabatic compression; (3) isothermal cooling of refrigerant in condenser; (4) adiabatic expansion of refrigerant from condenser to refrigerator; in practice, ideals cannot be realized entirely; precooling of liquid refrigerant; multi-pressure systems; cascade system; choice of refrigerants; heat transmission. Abstract from Instn. Chem. Engrs.

RETAINING WALLS

ANALYSIS. The Pressure Exerted on Retaining Walls by Materials Possessing Some Cohesive Strength, C. N. Ross. Instn. Engrs., Australia (Sydney), vol. 8, no. 7, 1927, pp. 190-216, 5 figs. Analysis made of forces acting on assumed mean wedge of rupture in material at back of retaining wall; curves are plotted which give pressure exerted on wall by filling for all possible cases when top of filling is level; interesting conclusions are drawn and suggestions are made as to future experimental work on retaining walls.

DESIGN. New Methods for Determination of Earth Pressure (Neue Wege in der Erddruckforshung), F. Kann. Zentralblatt der Bauverwaltung (Berlin), vol. 48, no. 13, Mar. 28, 1928, pp. 210-215, 15 figs. Quotes criticism of old Coulomb theory of earth pressure; reviews recent investigations and theories of Krey, Petersen, Fellenius, Terzaghi and others.

RIVERS

IMPROVEMENT, ST. LAWRENCE. The Canalization of the St. Lawrence River (La canalisation du St. Laurent), R. Tanghe. Revue Trimestrielle Canadienne (Montreal), vol. 14, no. 53, Mar. 1928, pp. 82-94. Résumé of project; development of hydro-electric power; reduction of transhipment at Montreal; reasons why Montreal opposes project.

National Advisory Committee Report. Can. Engr. (Toronto), vol. 54, no. 17, Apr. 24, 1928, pp. 471-475. Dominion Government is agreeable to main proposals for joint control from head of lakes to sea; proposal to internationalize Welland and St. Lawrence canals; correspondence and report of National Advisory Committee tabled in House of Commons by Premier; technical features discussed; power development feature.

RIVETS

TESTING. Rivets in Tension—Another Formula Based on the University of Toronto Tests, W. R. Osgood. Eng. and Contracting, vol. 67, no. 3, Mar. 1928, p. 114, 1 fig. In this discussion it is assumed that parts connected by rivet are rigid; refers to article by C. R. Young published in Dec. issue of same journal and in Eng. News-Rec., Feb. 2, 1928, on tensile working stress for rivets; reproduces Young's table, but new formula has been used and values in last column are those obtained from it. See also comment by H. E. Wessman in Eng. News-Rec., vol. 100, no. 15, Apr. 12, 1928, p. 602, 2 figs.

ROADS

CONCRETE, FIELD TESTING. The Use of Field Cylinders on Concrete Construction, O. V. Adams. Good Roads, vol. 71, no. 3, Mar. 1928, pp. 161-162. Means of determining whether concrete as produced in field actually comes up to designed strength; field data furnished included project date when cylinders were made, structure and station where concrete was placed, mix and method of field storage; summary of data obtained.

CORRUGATION. A Study of Road Corrugation. Contract Rec. (Toronto), vol. 42, no. 17, Apr. 25, 1928, pp. 433-436 and 440. Definition of corrugation; effects; weaknesses of subsoil; corrugation during rolling; weight of roller; faults of mechanical vehicles; load acts as brake; corrugation of wood and sett paving; corrugation on curves; corrective measures; importance of sound sub-structure; handling tar-macadam.

GRAVEL, SURFACE TREATMENT. Bituminous Treatment of Gravel Roads, F. G. Lang. Pit and Quarry, vol. 15, no. 13, Mar. 28, 1928, pp. 69-72. Bituminous surface treatments are now in experimental or developing stage; becoming very popular for following reasons: (1) eliminate dust; (2) conserve material; (3) lower maintenance and vehicle operating costs; (4) better riding surface; (5) gradually build up surface crust which will provide better foundation for pavements; three classes of roads discussed. Presented at 14th annual Michigan Conference on Highway Engineering.

SNOW FENCES. The Possibility of Natural Snow-Fences, R. A. Drought. Am. City, vol. 38, no. 4, Apr. 1928, p. 314, 1 fig. Constructive thinking of problems of snow removal and snowdrift prevention on highways; cost of tree planting and maintenance for five-year period would be $41.30, or 13 2/3 cents per linear ft.

SURFACE TREATMENT. Surface Treatment of Roads—Need Methods and Costs, C. N. Conner. Am. City, vol. 38, no. 4, Apr. 1928, pp. 97-98. Discusses three principal methods of surface treatment, as follows: skin surface treatment, or penetration method, which for first year costs from $1,000 to $2,500 per mi. for 18-ft. widths; mixed-in-place method cold—18-ft. width costs range from $700 to $1,200 per mi. to $5,000 or $6,000; premixed method hot or cold which aims to secure top will cost less than $1 per sq. yd. or about $10,000 per mi. of 18-ft. width.

Surface Treatments Used on Highways, B. E. Gray. Can. Engr. (Toronto), vol. 54, no. 18, May 1, 1928, pp. 488-489. Methods and materials used in handling several types of surface treatment, with particular reference to specification of material, cost, traffic and annual maintenance cost; penetration macadam pavements; cold asphalt patch. Paper presented at Sixth Annual Asphalt Paving Conference.

ROLLING MILLS

ELECTRIC DRIVE. Electric Drives for Rolling Mills, L. A. Umansky. Mech. World (Manchester, Eng.), vol. 83, no. 2151, Mar. 23, 1928, p. 218. Recent improvements; when mill requires number of adjustable-speed drives d.c. motor drive used; only method of obtaining adjustable speed with a.c. motor of size involved in steel-mill work is to use slip-ring induction motor, and to regulate its speed by acting on its secondary circuit. From Am. Inst. Elec. Engrs.

OPERATION. Timken Heat Treating and Metal Working Methods Reduce Costs, F. W. Manker. Mfg. Industries, vol. 15, no. 3, Mar. 1928, pp. 217-218, 3 figs. Timken Roller Bearing Co., at its Canton plant, makes its own steel alloy in five Heroult electric furnaces which turn out 235 tons daily; steel is poured into moulds and ingots, after being heated uniformly in gas-fired soaking pits, are bloomed in 35-in., 3-high blooming mill; in piercing mill red hot rods are rotated and pulled over plug which pierces hole through them longitudinally; novel method of reclaiming scrap material.

PLATE MILLS, DRIVE. New Drive for Three-High Plate Mills, J. Taylor. Iron Age, vol. 121, no. 15, Apr. 12, 1928, p. 1004, 1 fig. Driving centre roll at high speed gives large torque with increased flywheel stored energy; customary pinions and pinion housing replaced by light nest of gears between flywheel and mill spindles; saving in first cost and in renewals; 75 per cent added momentary power; rolling power consumption is reduced; only mill provided with slip drive can make use of this method for operating three-high mill.

STRIP, COLD-ROLLING. The Cold-Rolling of Strip Steel, H. C. Uhl. Iron and Steel Engr., vol. 5, no. 4, Apr. 1928, pp. 171-177 and (discussion) 177, 12 figs. Advantage of cold rolling; uses of cold rolled strip steel; classification as to quality and finish; preparation for rolling; trend in new mills; description of mills and method of rolling; electrical equipment for cold-rolled strip steel mills; motors and control; motor sizes required for various sizes of mills; drives for reels.

S

SAND BLASTING

COSTS. The Labour and Air-Power Cost of Sand-Blasting, E. H. Stehman. Am. Ceramic Soc.—Jl., vol. 11, no. 4, Apr. 1928, pp. 227-234, 6 figs. Efficiency data are given from experience on adjustment of air and sand quantities, size and shape of nozzle from work; production data on blasting of large ware and barrel cleaning of small ware; data are shown in curves.

SAND CLASSIFIERS

DESCRIPTION OF. Sand Settling and Devices for Settling and Classifying Sand, E. Shaw. Rock Products, vol. 31, no. 7, Mar. 31, 1928, pp. 38-40, 2 figs. Commonest settling device in rock-products industry is box designed to settle out concrete fine aggregate from stream of water carrying clay and silt; example illustrated and details described; in practice, boxes seldom built except by guesswork; usually too large, but area may be reduced by partitions. (Continuation of serial.)

SEWAGE DISPOSAL

ACTIVATED SLUDGE METHOD. The North Side Sewage Treatment Plant, H. E. Larson. Armour Engr., vol. 19, no. 2, Jan. 1928, pp. 49-50 and 56, 2 figs. World's largest activated sludge plant cost will be $28,000,000; sewage, largely domestic, from north section of Chicago and suburbs; agitation, 4 to 6 hr. in tanks, air blown through batch to provide oxygen for bacteria; resultant activated sludge, alive with bacteria, hastens purification of incoming sewage; main features of plant.

SEWAGE DISPOSAL PLANTS

OPERATION. Operation of Sewage Works. Pub. Works, vol. 59, no. 4, Apr. 1928, pp. 138-139. Report of committee of American Society of Civil Engineers; funds for operation; how most sewage works that are owned and operated by municipalities and other communities are financed; question of importance pertains to qualifications and adequate compensation of personnel employed; control analysis.

SEWERS

VENTILATION. Some Investigations Into Ventilation of Sewers and Deodorization of Sewer Gases, J. M. C. Corlette. Instn. Engrs., Australia (Sydney), vol. 8, no. 3, 1927, pp. 71-86, 5 figs. Emanation of offensive smells from sewer ventilating shafts; recount steps taken to meet difficulty; investigation of extent of influence of exhaust fans along main sewers; methods of deodorizing and results attained.

SILVER MINES AND MINING

ONTARIO. Silver Mining. Imperial Inst.—Bul. (Lond.), vol. 26, no. 1, Apr. 1928, pp. 49-51. Output from Cobalt camp in 1926 totalled 4,797,832 ounces; silver occurs not only along with niccolite and other arsenides of nickel and cobalt but as native silver in lumps and plates; area is called "Cobalt" from fact that silver ores carried metal of that name as one of constituents.

SLABS

DESIGN. Stresses at the Edges of Flat Slabs Not Supported by End Beams (Yober die Randbeanspruchung von Deckenstreifen ohme Randbalken), H. Marcus. Beton u. Eisen (Berlin), vol. 27, no. 6, Mar. 20, 1928, pp. 123-128, 6 figs. Mathematical analysis, based on higher theory of elastic plates, applied to usual cases occurring in design of buildings. (To be continued.)

SLUDGE TANKS

CALCULATING CAPACITY OF. Calculating the Capacity of Sludge Digestion Tanks, K. Imhoff. Am. City, vol. 38, no. 5, May 1928, pp. 124-125, 2 figs. Determine upon correct design values for sludge-digestion tanks; size of digestion chamber must be so proportioned that sufficient time is allowed for digestion in accordance with each particular set of conditions; population; temperature; mixing or seeding; sludge liquid; special allowances.

SOILS

BEARING CAPACITY. Bearing Capacity of Soil, C. Terzaghi. Eng. News-Rec., vol. 100, no. 16, Apr. 19, 1928, pp. 629-630. Restatement of basis for rules as to bearing capacity of cohesionless and cohesive materials; variation between numerical values furnished by different theories.

SPRINGS

COIL, RECTANGULAR-SECTION. The Compression Spring of Rectangular Section, G. Ashworth. Inst. Civil Engrs.—Sessional Notices (Lond.), no. 3, Mar. 1928, pp. 88-90. Deals with helical and volute spring, particularly of sizes in general use on railway rolling stock; account of investigation which determined internal distribution of shear stress and strain for overstrained circular section. Abstract.

SPIRAL, DYNAMICS OF. Dynamic Properties of Spiral Springs (De dynamiska engenskapma hos spiralfjadrar), W. Weilbull. Ingeniors Vetenskaps Akademien—Handlingar (Stockholm), no. 70, 1927, 25 pp., 19 figs. Existing formulæ for calculating strain in springs exposed to impact loading not satisfactory; proposes new formulæ for helical springs; formulæ verified by photographically registering various movements of turns of spring.

STEAM ENGINES

HEAT TRANSMISSION IN. Heat Transmission in Reciprocating Engine Cylinders (Der Waermeuebergang zwischen Arbeits mittel und Zylinderwand in Kolbenmaschinen), W. Nusselt. V.D.I. Zeit. (Berlin), vol. 72, no. 6, Feb. 11, 1928, p. 172. Review of earlier investigations; facts indicated lead to conclusion that heat transmission during condensation with superheated steam is definitely less than with saturated steam; this fact clearly contradicts author's work; states that much further research is necessary to clear up many uncertain aspects on subject. See translated abstract in Mar. Engr. and Motorship Bldr. (Lond.), vol. 51, no. 608, Apr. 1928, p. 157.

STEAM HEATING SYSTEMS

CORROSION. Corrosion in Steam Heating Systems, F. N. Speller. Am. Soc. Heat. and Vent. Engrs.—Jl., vol. 34, no. 4, Apr. 1928, pp. 390-392, 4 figs. Series of tests carried out in Department of Metallurgy and Research of National Tube Co., using small experimental steam boiler, to getermine acidity of condensed steam with and without boiler water treatment; description of boiler and method of operation; method for testing boiler water in steam-heating plants for alkalinity; method for determining carbon dioxide in steam condensate.

STEAM TURBINES

VIBRATION. Curing Resonant Vibration in Turbine Units, T. C. Rathbone. Power, vol. 67, no. 15, Apr. 10. 1928. pp. 629-632, 5 figs. Methods of correcting resonance conditions when encountered in operating units; vibration reduced by changing supports; effect of change in foundation loading; floor vibrations; internal and external friction retards vibration.

ZOELLY. Steam Consumption of a 12,000-Kw. Zoelly Turbine (Dampfverbrauchs-Messungen an einer 12,000-Kw. Zoelly-Dampfturbine im staedtischen Kraftwerk in Leiden), D. Dresden. Schweizeizerische Bauzeitung (Zurich), vol. 91, no. 15, Apr. 14, 1928, pp. 181-183, 4 figs. Description of Zoelly steam turbine of 1,750 mm. maximum diameter, installed in municipal power plant of Leyden, Holland; details of test showing steam consumption of 4.35 to 4.71 kg. per kw.-hr.

STEEL

ALLOY. *See Alloy Steels.*

CHROMIUM STEEL. *See Chromium.*

HARDENING. Hardening by Reheating After Cold Working, M. A. Grossman and C. C. Snyder. Can. Machy. (Toronto), vol. 39, nos. 7 and 8, Apr. 5 and 19, 1928, pp. 38-39 and 75-76, and 33-34 and 73, 18 figs. Apr. 5: Theory explaining phenomenon of hardening of cold-worked and quenched steel by reheating at low temperatures; thin layer of interblock material, which increases gradually in thickness as reheating temperature is raised. Apr. 19: Decrease in toughness due to transformation of retained austenite to non-ductile alpha iron.

HIGH-SPEED. *See High-Speed Steel.*

STEEL MANUFACTURE

SEMI-DIRECT METHOD. Latest Process of Making Steel Reduces Manufacturing Cost. West. Machy. World, vol. 19, no. 3, Mar. 1928, pp. 127-128. Semi-direct method of making steel independent of coking coal and at cost of pig iron announced by American Research Corp.; first converts iron ore into sponge, which is chemically treatd, then fed continuously to retort of unique design, melted and finally alloyed.

STEEL CASTINGS

HEAT TREATMENT. A Modern Plant for the Heat Treatment of Miscellaneous Steel Castings, A. W. Lorenz. Am. Foundrymen's Assn.—Reprint, no. 28-10, for mtg. May 14, 1928, pp. 141-152, 9 figs. Describes plant, uniquely equipped for full quenching and tempering of miscellaneous steel castings; with this plant output of over 500 tons per month may be obtained at cost of about one-half cent per pound.

SHRINKAGE. The Contraction of Steel Castings, Koerber and Schitzkowski. Metallurgist (Supp. to Engineer, Lond.), Apr. 27, 1928. pp. 55-56. Investigation of shrinkage phenomena in castings carried out at two steel foundries in Dusseldorf district; relates not only to measurement of contraction in simple test bars but also to study of actual casting and especially of large wheels and pulleys. Abstract translated from Stahl u. Eisen, Feb. 2 and 9, 1928.

STOKERS

CHAIN-GRATE. Roller Bearings on Chain-Grate Stokers. Power Plant Eng., vol. 32, no. 9, May 1, 1928, p. 526. Tests were made at Moabit central station, Berlin, to determine how roller bearings would work under heavy service of old chain-grate stokers, how much fuel could be saved and how well lubrication with dry graphite would satisfy. Abstract translated from Archiv. fuer Waermewirtschaft.

UNDERFEED. Detroit Edison Company Selects Stokers for New Plant at Delray. Power, vol. 67, no. 18, May 1, 1928, pp. 788-789, 1 fig. Underfeed stokers for first six boiler units of new plant, now in course of construction; lack of ash-disposal facilities influenced decision to use stokers; experience with pulverized coal at Trenton Channel satisfactory.

STORAGE BATTERIES

LEAD. The Lead-Acid Storage Cell, H. G. Brown. Elec. Rev. (Lond.), vol. 102, no. 2627, Mar. 30, 1928, p. 549 and (discussion) 549. Electric accumulator and some of its uses; Plante and Faure types of lead cell; storage batteries used in modern telephone exchanges were largest; use of secondary batteries in submarines for propulsion; application of batteries to traction; two-battery locomotives. Abstract of paper presented at Royal Soc. of Arts.

STANDARDS. Storage Batteries. Am. Inst. of Elec. Engrs. Standards, no. 36, Feb. 1928, 4 pp. Standards in this section apply to storage batteries of lead-acid type and of nickel-iron alkaline type; they are suitable for large and small batteries in either stationary or portable service.

STREAM FLOW

DISCUSSION OF. Stream Flow in General Terms, F. S. Bailey and C. E. Pearce. Am. Soc. Civ. Engrs.—Proc., vol. 54, no. 5, part 1, May 1928, pp. 1605-1616, 4 figs. Writers, calculating flood discharge through Exchequer dam and power house in 1926. used step-by-step process, with Chezy's formula; obtaining proper elements by trial and error; Casler's method is much shorter and more direct and gives clearer vision of whole problem. Discussion of paper by M. D. Casler, published in Jan. 1928 issue of Proceedings.

STREET LIGHTING

CARRIER-CURRENT CONTROL. Carrier-Current Control, R. R. Cowles. Elec. World, vol. 91, no. 17, Apr. 28, 1928, pp. 863-866, 8 figs. Although remote control of street-lighting circuits by carrier-current has been under development for more than four years, one of first commercial installations has just been completed in San Francisco by Pacific Gas and Electric Co.; system consists essentially of transmitting set in substation and receiving set centrally located with respect to circuits to be controlled; carrier-current equipment operates over one phase of three-phase, 4,000-volt feeder through capacitor couplers in substation and out on line.

STREETS

MAINTENANCE AND REPAIR. Street Maintenance in Small City, C. Draper. Mun. News, vol. 74, no. 3, Mar. 1928, pp. 62-63. Methods employed at Lafayette, Ind.; filling pot holes with oiled gravel; resurfacing old pavement with rock asphalt; effect of tire chains on pavements; repairs along street railway tracks; importance of competent inspection. Paper presented at Purdue Road School.

STRUCTURES

EARTHQUAKE EFFECT. Effect of Earth Shocks on Structures, M. DeBussy. Am. Soc. Civil Engrs.—Proc., vol. 54, no. 5, part 1, May 1928, pp. 1449-1463, 11 figs. Study of stresses that affect simple structures as result of movements caused by earthquake shocks; problem in general, attacking easiest questions first with methods of computation that are available so as to attain better understanding of phenomena that occur; after obtaining this result, author considers more complicated cases.

WELDED STEEL. Examples of Arc Welded Steel Construction, G. B. Fish. Am. Welding Soc.—Jl., vol. 7, no. 3, Mar. 1928, pp. 10-19, 7 figs. Tests of arc-welded structural steel joints; cost savings in welded construction; Sharon Building; complete continuity of floor beams and girders obtained by welded joints of cantilever type; saving of 100 tons; continuity tested with hydraulic jacks; Derry Building; Chicopee falls bridge; plate-girder railroad bridge.

T

TELEGRAPH, CARRIER

CANADA. Carrier Telegraph in Canada, J. C. Burkholder. Bell Laboratories Rec., vol. 6, no. 2, Apr. 1928, pp. 248-252, 7 figs. Complete carrier system consisting of five terminal stations, twelve repeater stations and repeatered telephone circuit between Montreal and Winnipeg by way of Toronto, all to operate on same pair of wires; carrier has almost complete immunity from auroral disturbances, due to its being ungrounded system operating through transformers; tests and inspections made.

THERMIT WELDING

PROCESS. The Science and Applications of the Thermit Welding Process. Can. Machy. (Toronto), vol. 39, no. 6, Mar. 22, 1928, pp. 35-36 and 38-39, 6 figs. Thermit process adapted to uniting ferrous material, where large sections are involved; history thermit is mixture of finely-divided aluminum and iron oxide; high chemical affinity of aluminum for oxygen; kinds of thermit for welding; making thermit weld; sand mould and wax pattern; thermit single- and double-burner preheater; locomotive repairs.

TUNGSTEN ORES

REDUCTION. The Gaseous Reduction of Tungsten and Molybdenum, E. W. Engle. Am. Electrochem. Soc.—Advance Paper, no. 35, for mtg., Apr. 28, 1928, pp. 345-349. Non-gaseous reduction methods are used for producing tungsten and molybdenum where extreme purity is not essential; for pure metals reduction is from oxides with hydrogen; proper physical structure of reduced metals is necessary; intermittently operating processes in tube furnaces have advantages over continuously operating units.

V

VACUUM TUBES

CAPACITY MEASUREMENT. Measurement of Vacuum-Tube Capacities by a Transformer Balance, H. A. Wheeler. Inst. Radio Engrs.—Proc., vol. 16, no. 4, Apr. 1928, pp. 476-481, 3 figs. Complete portable equipment for measurement of direct capacities of vacuum tubes in laboratory or factory testing; tube capacity is compared with standard variable condenser by means of transformer-balance (Neutrodyne) circuit, whose balance is independent of frequency, about 1,500 kc. being preferred.

HIGH-VOLTAGE. Some Past Developments and Future Possibilities in Very High-Voltage Vacuum Tubes, W. C. Coolidge. Gen. Elec. Rev., vol. 31, no. 4, Apr. 1928, pp. 184-185, 3 figs. Describes experiments on discharge from tube operating at 900,000 volts.

VOLTAGE REGULATION

METHODS. Voltage Regulation Systems, G. Rattenbury. Elec. Rev. (Lond.), vol. 102, no. 2628, Apr. 6, 1928, pp. 586-589, 8 figs. Methods of voltage regulation on a.c. systems compared; tapped-transformer principle; synchronous condenser in industrial plants, for power-factor correction, where suitable mechanical load is available; induction regulator minimizes switchgear and gives smooth regulation, but is not as robust as tapped transformer; tapped transformer is most suitable for transmission purposes generally.

W

WELDING

ELECTRIC. *See Electric Welding; Pressure Vessels.*

WIND POWER

UTILIZATION. Electric Current from Wind. Compressed Air Mag., vol. 33. no. 4, Apr. 1928, p. 2380, 1 fig. Unique contrivance has been erected in southern California; wind motors are capable of developing 200 h.p.; structure is mounted on circular track base so that it may be swung in direction of wind; second plant of this kind now in course of construction and is designed to produce 1,400 h.p.

WIRE ROPE

RESEARCH. Wire Ropes Research, A. W. Scoble. Engineering (Lond.), vol. 125, no. 3250. Apr. 27, 1928, pp. 522-525, 7 figs. Third report of Wire Ropes Research Committee. All specimens were of 80 to 90 tons per sq. in. tenacity, four being made of 0.021 in. and three of 0.036 in. diameter wire; ropes were made in pairs, one of which was of Lang's and other of ordinary lay; repeated bending tests; comparison of all ropes of both tensile strengths; reversed bending of ropes; experiments with single wires.

WATER CHLORINATION

DISCUSSION OF. Is Prechlorination Worth Using? J. S. Whitener. Am. City, vol. 38, no. 5, May 1928, p. 123. Chlorination of raw water and of coagulated water; clear, sparkling effluent was first advantage charged to prechlorination; after prechlorination, samples of filtered water, tested for B. coli in lactose broth, showed no gas.

WATER FILTRATION PLANTS

DESIGN. The Design and Construction of Small Filtration Plants, H. K. Bell. Water Works, vol. 67, no. 4, Apr. 1928, pp. 149-153, 8 figs. Principal design factors; probable demand; character of supply; operating force; character of power for pumping; new layout or addition to old plants; topographic characteristics of site; special features in design of small plants; gauges, controllers and meters; filter wash; settling basins.

The Design of Small Filtration Plants. Contract Rec. (Toronto), vol 42, nos. 17 and 18, Apr. 25 and May 2, 1928, pp. 430-432 and 459-460. Factors that modify arrangement of works serving municipalities under 10,000 population; funds for such plants are usually limited and consequently design is restricted; principal design factors; character of supply; reservoir storage; operating force; topographic characteristics of site; fire services; design of small filtration plant differs entirely from that of large plant.

WATER PIPE LINES

SUBAQUEOUS, LAYING. Laying a Subaqueous Water Supply Pipe Line Under the Maas (Meuse) River at Rotterdam (Verlegung eines Duekers durch die Maas), Wirtz. Gas- u. Wasserfach (Munich), vol. 71, no. 9, Mar. 3, 1928, pp. 200-203, 7 figs. Describes equipment and method of laying 60-cm. Mannesmann seamless pipe line in 50-m. lengths, across river channel about 400 m. long; details of flexible joints.

Ingenious Method of Laying Pipe Under Water. Concrete Products, vol. 34, no. 4, Apr. 1928, pp. 35-36, 3 figs. 512 ft. of pipe laid; pipe was double ring reinforced concrete 5½ in. thick, 48 in. diam., 4 ft. long and weighed 1,900 lb. per section.

WATER POWER

CANADA. Water Power Resources in Dominion. Can. Engr. (Toronto), vol. 54, no. 15, Apr. 10, 1928, pp. 433-436. Review of Dominion Water Power and Reclamation Service of Developed Water Powers; during 1927, 221,000 h.p. was installed; basis of computation; available and developed totals; utilization of developed water power; central electric station industry; pulp and paper industry.

WATER SUPPLY

LONDON, CANADA. London Municipal Water Works System, E. V. Buchanan. Can. Engr. (Toronto), vol. 54, no. 11, Mar. 13, 1928, pp. 123-126, 6 figs. Water supply obtained from wells in sand and gravel strata motor-driven turbine pumps at both plants; distribution system; Beck Wells plant has 3 two-million gallon 2-stage turbine pumps at 750 r.p.m. against pressure of 115 lb.; all driven by 550-volt synchronous motors; bearings equipped with thermostats; Springbank Station electrified by installation of two 3,000,000-gal. turbine pumps driven by 2,300-volt synchronous motors.

WATER TANKS

ELEVATED. The Uses of Elevated Tanks in Water Supply Systems, G. H. Fenkell. Am. Water Works Assn.—Jl., vol. 19, no. 4, Apr. 1928, pp. 347-357. Tanks are used quite generally by large consumers to guard against interruption of service; method for control of flow in and out of tank; design of elevated tanks.

STEEL, CONSTRUCTION. Steel Tank Construction, I. E. Flaa. Am. Water Works Assn.—Jl., vol. 19, no. 4, Apr. 1928, pp. 374-381, 3 figs. San Francisco has 14 tanks; four are of steel or iron, one of reinforced concrete and remainder are wood; design of Forest Hill steel tank was influenced by fact that company had on hand sufficient plates, rivets and material to build 45-foot diameter by 40-foot high tank; cost of Forest Hill tank.

WATER TREATMENT

DECOLOURIZATION. The Decolorization of Soft, Coloured Waters, R. S. Weston. Am. Water Works Assn.—Jl., vol. 19, no. 4, Apr. 1928, pp. 416-427, 2 figs. Account of certain detached experiences in treating soft, coloured waters in laboratory and in practice; nature of colour; methods of colour removal; range in dose of chemicals.

WEIRS

MEASUREMENTS. Precise Weir Measurements, R. E. Ballester and G. S. Williams. Am. Soc. of Civil Engrs.—Proc., vol. 54, no. 5, part 1, May 1928, pp. 1493-1500, 2 figs. Writer has determined formula for discharge over broad-crested weir with cylindrical up-stream face and present results of his observations as to influence of velocity of approach and determination of Bazin's coefficient; weir is located in main canal of Rio Negro irrigation works, Argentina. Discussion of paper by E. W. Schoder and K. B. Turner, continued from Apr. 1928 issue of Proceedings.

Z

ZINC ORE

LEACHING. Recent Developments in Ammonia Leaching for Zinc Ores, H. M. Lawrence. Assn. of Chinese and Am. Engrs.—Jl. (Pekin), vol. 9, no. 3, Mar. 1928, pp. 29-37. Deals with history of development of process; reviews present-day operations and gives tables showing results of experiments on roasted zinc ores, zinc-lead fume and effect of improper roasting on zinc extractions; conclusions are that ammonia leaching has certain possibilities, of which number are listed.

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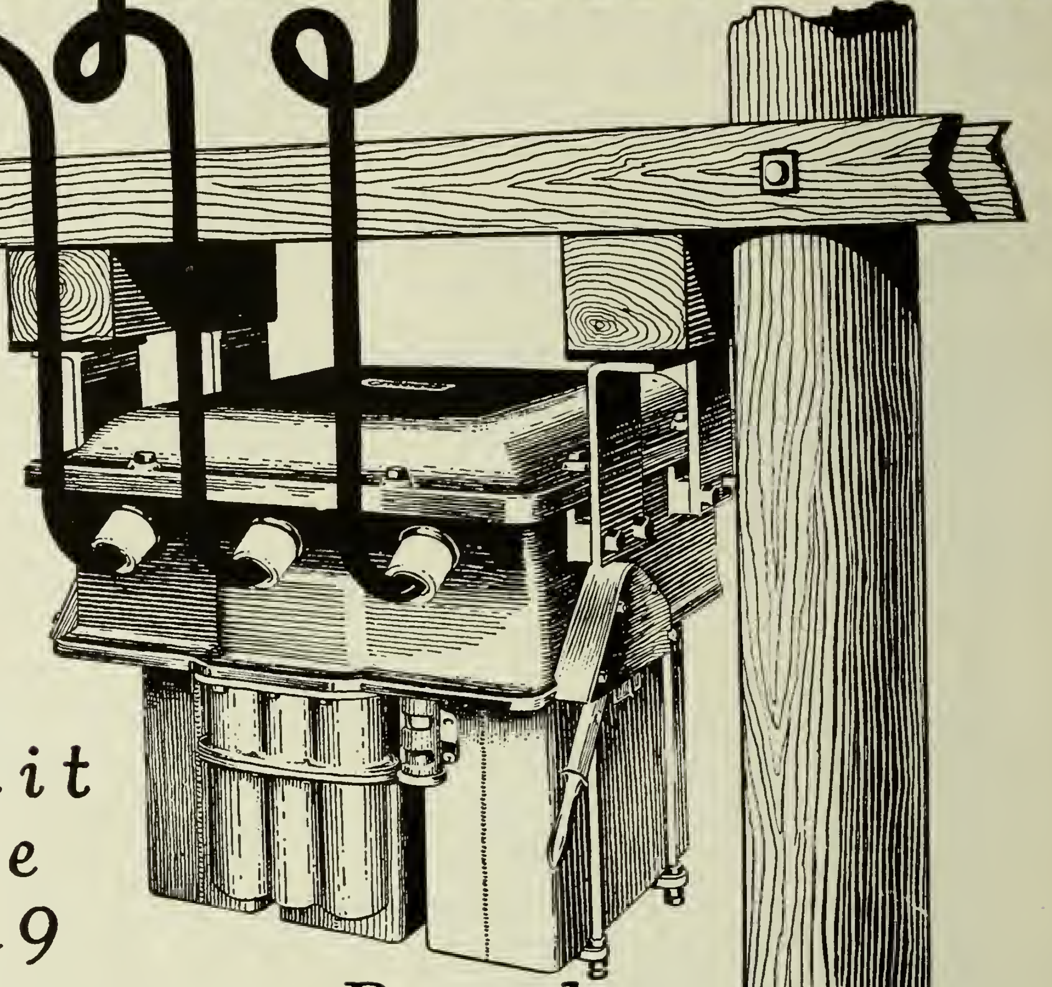

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A

AIRPLANE ENGINES

MAGNETOS. New Special Light-Weight Magneto Developed by Splitdorf Engineers, E. B. Nowosielski. U. S. Air Services, vol. 13, no. 5, May 1928, p. 36, 1 fig. New special lightweight magneto Model NS-9; improved inductor type producing four equal sparks per revolution.

SUPERCHARGERS. Superchargers Are Standard on New Aircraft Engines. Aero Digest, vol. 12, no. 5, May 1928, p. 808. Superchargers especially designed by General Electric Co. will be built as standard equipment into three new types of Wright aircraft engines; maximum efficiency in operation is expected; supercharger arranged so that it can be used to maintain sea level power when flying at moderate altitudes.

AIRPLANE PROPELLERS

EFFICIENCY. Efficiency of Aircraft Propellers (Der Wirkungsgradbegriff beim Propeller), A. Betz. Zeit. fuer Flugtechnik und Motorluftschiffahrt (Munich), vol. 19, no. 8, Apr. 28, 1928, pp. 171-177, 12 figs. Theoretical report from Kaiser Wilhelm Institute for Research in Dynamics of Fluids.

NEW TYPE. Novel Airscrew. Times Trade and Eng. Supp. (Lond.), vol. 22, no. 514, May 12, 1928, p. 218. Brief reference to airscrew designed to make use of energy of exhaust gases from engine.

VARIABLE PITCH. The Hele-Shaw—Beacham Variable Pitch Airscrew, Hele-Shaw and Beacham. Aeroplane (Lond.), vol. 34, no. 16, Apr. 18, 1928, p. 562, 1 fig. Also Flight (Lond.), vol. 20, no. 16, Apr. 19, 1928, pp. 265-270. Airscrew developed by Gloster Aircraft Co.

AIRPLANES

GIANT—DESIGN. Prospective Development of Giant Airplanes, B. Von Roemer. Nat. Advisory Committee for Aeronautics—Tech. Memorandums, no. 463, May 1928, 7 pp., 6 figs. Survey of latest German projects shows giant airplane is being sought.

HELICOPTERS. *See Helicopters.*

STREAMLINING. Streamlining Adjustments While in Flight as Illustrated by the Behavior of Birds, J. Prentice. U. S. Air Services, vol. 13, no. 5, May 1928, pp. 25-27, 4 figs. Flow of air around airplane of today is turbulent and indicates waste of energy.

STRESS ANALYSIS. Stress Analysis of Commercial Aircraft, S. Klemin and G. F. Titterton. Aviation, vol. 24, nos. 20, 21, and 22, May 14, 21, and 28, 1928, pp. 1367 and 1404-11, 4 figs., 1455 and 1472-75, 3 figs., and 1524-25, 34 and 1536-38, 7 figs. May 14.

WING PRESSURE DISTRIBUTION. Study of Pressure Distribution Data. Air Corps Information Cir., vol. 7, no. 604, Nov. 1, 1927, 24 pp., 20 figs. Study to determine extent to which available pressure-distribution data justify rules for computation of external loads on wing cellule now in use by Air Corps and Bureau of Aeronautics; effect of air speed on pressure distribution; factors affecting distribution along span; effect of taper, tip shape, aileron movement, and of change in airfoil section; outline of proposed research. Bibliography.

WINGS, SLOTTED. The Slotted Wing and Safety of the Airplane (L'aile à fente et la securité de l'avion). Aeronautique (Paris), vol. 10, no. 107, Apr. 1928, pp. 117-120, 6 figs.

ALLOYS

AGE-HARDENING OF. Age-Hardening of Alloys, Hay. Iron and Steel of Canada (Gardenvale, Que.), vol. 11, no. 5, May 1928, pp. 148-150. General mechanism of age hardening depended upon size of particles present in alloy; depression after quenching and before hardening commenced; temperature of precipitation caused difference in amount of hardening; time of soaking at high temperature before quenching; size of article influences degree of hardness age-hardening attainable; volume change due to precipitation of compound from solution caused by age-hardening. Paper read at Inst. of Metals.

ALUMINUM. *See Aluminum Alloys.*
CHROMIUM. *See Chromium Alloys.*
NICKEL-COPPER. *See Nickel-Copper.*

ALUMINUM ALLOYS

ALMELEC. Almelec, A New Light Alloy for Wires and Cable Conductors. Mech. World (Lond.), vol. 83, no. 2158, May 11, 1928, p. 347. Details of physical constants of aluminum alloy developed in France for aerial power-transmission and telephone lines; contains 98.5 per cent pure aluminum and 1.2 per cent of magnesium and silicon and is subjected to special heat treatment in addition to being hard drawn; resistance to corrosion under atmospheric conditions is stated to be comparable with that of pure aluminum. Brief abstract translated from Revue Générale d'Electricité.

AMMONIA CONDENSERS

HEAT TRANSFER IN. Heat Transfer in Ammonia Condensers. Power, vol. 67, no. 20, May 15, 1928, pp. 862-863, 1 fig. Results of research undertaken at Univ. of Illinois in order to correlate and give proper weight to various factors entering into design and operation of outstanding types of ammonia condensers. Abstracted from Univ. of Illinois Bul. No. 25.

AUTOMOBILE ENGINES

CYLINDERS, CHROMIUM STEEL. Nitrated Chrome Steel Cylinders, L. Guillet. Foundry Trade Jl. (Lond.), vol. 38, no. 611, May 3, 1928, p. 314. According to experiments, employment of nitrated steel for cylinders gives results never before attained.

CRANKSHAFTS. Some Notes on Crankshafts, F. Strickland. Automobile Engr. (Lond.), vol. 18, no. 241, May 1928, pp. 182-184, 10 figs. Strength necessary to provide against fracture; rigidity to prevent distortion when running; bearing surface to give durability; distortion due to springing thin webs is likely to be serious matter; two-bearing 4-cylinder crankshaft; enormous advantage of two-bearing shaft; engines with more than four cylinders; method of balancing engine; worth while to machine crankshaft all over.

AUTOMOBILE PLANTS

HEAT TREATING DEPARTMENT. Heat Treating at Dodge Brothers Plant, H. E. Martin. Heat Treating and Forging, vol. 14, no. 5, May 1928, pp. 525-528, 2 figs. Electric furnaces of various types are successfully used in many heat-treating operations.

Modernized Equipment for Heat Treating, F. W. Manker. Heat Treating and Forging, vol. 14, no. 4, Apr. 1928, pp. 386-387, 3 figs. Mechanization in handling pieces in process of heat treating in forge and treating departments of Willys-Overland Co.; hardening miscellaneous parts; annealing after drop forging.

AUTOMOTIVE FUELS

DETONATION. Comparison of Methods of Measuring Knock Characteristics of Fuels, G. Edgar. Am. Petroleum Inst.—Bul., vol. 9, no. 7, Jan. 31, 1928, pp. 90-99 and (discussion) 99-102, 4 figs. October 1926, conference for discussing present methods of measuring knock characteristics.

B

BEARINGS

LUBRICATION. An Experimental Determination of the Distribution and Thickness of the Oil-Film in a Flooded Cylindrical Bearing, J. Goodman. Instn. Civil Engrs.—Sessional Notices (Lond.), no. 3, Mar. 1928, pp. 79-80. Mathematical theory of lubrication as set forth by Reynolds and extended by Sommerfeld is now very widely recognized, but, owing to lack of data when theory was first set forth, it is considered that some of assumed conditions are not altogether justified; account of recent experiments made with object of supplying such data.

BELTS

STRETCH. Measurement of Elastic Stretch of High-Speed Belts (Messung der elastischen Nachdehnung des laufenden Riemens), O. Kammerer. Maschinenbau (Berlin), vol. 7, no. 9, May 3, 1928, pp. 413-414, 3 figs. Brief report on experimental studies of belt stretch, made at Berlin Institute of Technology.

BOILER FURNACES

FLUE DUST, ELECTRIC PRECIPITATION. Flue Dust Recovery, H. W. C. Henderson. World Power (Lond.), vol. 9, no. 53, May 1928, pp. 284-289, 5 figs. Application of electric precipitation to powdered-fuel installations; general principles of process; Trenton Channel plant; results of tests made to determine efficiency; coal-drying operations.

BOILER PLATE

PROPERTIES. Investigations of Boiler Plate (Untersuchungen an Kesselblechen), A. Pomp. Stahl u. Eisen (Duesseldorf), vol. 48, no. 21, May 24, 1928, pp. 681-689, 17 figs. Results of tests show that the harder boiler plates, especially those of nickel steels, are superior to plates poorer in carbon, with regard to behavior at elevated temperatures, aging properties, and tendency to coarse-grained recrystallization.

BOILERS

DESIGN. Modern Boiler Problem, A. G. Christie. Power, vol. 67, no. 22, May 29, 1928, pp. 946-949. Boilers must now be designed for both convection and radiant-heat transfer and for much higher ratings; regulation of boiler feed-water; radiant heat.

ELECTRIC. 147,000 kw. in Electric Steam Boilers at Gatineau Paper Mill, W. P. Muir. Elec. News (Toronto), vol. 37, no. 10, May 15, 1928, pp. 55-57, 1 fig. Largest installation and largest units ever constructed produce practically dry saturated steam; installation consists of four units, three of 42,000 kw. each, and one of 21,000 kw.; boilers deliver 190 lb. of steam to steam accumulator from which it is drawn at 125 lb.; high-grade porcelain insulators; new type of electrodes.

EFFICIENCY DIAGRAMS. The Low-Range Reflex-Ordinate Boiler-Efficiency Diagram. Power Engr. (Lond.), vol. 23, no. 266, May 1928, pp. 204 and 209, 1 fig. on supp. plate. Presents diagram having pressure lines which have been carried down to points opposite their corresponding saturation temperatures, and these points have been joined up to form "saturation curve."

FEED CONTROLLERS. A Boiler Feed Controller for High Pressures. Engineer (Lond.), vol. 145, no. 3776, May 25, 1928, p. 582, 2 figs. Improved type of feed controller specially designed for service on high pressure boilers; known as "Stets" feed controller, and is already in use in number of largest power stations in America.

HEADS, DESIGN. Boiler-Head Calculation According to Latest German Specifications (Die Kesselbodenberechnung nach den neuesten Vorschriften), G. Hoennicke. Waerme (Berlin), vol. 51, nos. 16 and 17, Apr. 21 and 28, 1928, pp. 297-300 and 322-327, 6 figs. Supplement of specifications of Oct. 1926; pressure stages; points in which revised specifications differ from those of 1926; recommendations for retention of Goldesberger formula; the best basket-head meridian.

Calculation of Strength and Most Favorable Shape of Dished Heads of Cylindrical Boilers of Uniform Plate Thickness (Ueber die guenstigste Gestalt des vollen, gewoelbten Bodens zylindrischer Kesseltrommeln gleicher Dicke und ihre Festigkeitsberechnung), A. Muggenberger. Schweizerische Bauzeitung (Zurich), vol. 91, nos. 17 and 18, Apr. 28 and May 5, 1928, pp. 203-208 and 217-221, 27 figs. Theoretical mathematical analysis checked by precise tests in which deformations were measured by means of special electro-magnetic extensometers; derives formulas for most convenient shape and maximum stresses.

HEAT TRANSMISSION IN. Process of Heat Transmission in Boilers (Processus de la transmission de la chaleur dans les chaudières modernes, etc.), Roszak and Veron. Génie Civil (Paris), vol. 92, no. 8, Feb. 25, 1928, pp. 195-196. Authors show how laws of transmission of heat explain and coördinate phenomena observed in boilers, and justify success of methods which have resulted in radical modifications in design; data on proportions of heat absorbed by radiation and convection in boilers of various types. See translated abstract in Eng. and Boiler House Rev. (Lond.), vol. 41, no. 10, Apr. 1928, p. 504.

LOCOMOTIVE. *See Locomotive Boilers.*

BOLTS

THIN-HEADED DESIGN. The Design of Thin Bolt Heads, W. Richards. Machy. (Lond.), vol. 32, no. 812, May 3, 1928, pp. 137-138, 2 figs. Discussion of how far thinning of head may proceed without actual loss of strength to whole bolt; untreated bolts produced from ordinary commercial bright-drawn hexagon mild steel; formulas required to determine proportions of bolt having equal strength in both shear and tension.

BUILDINGS

HEAT LOSSES IN. Determination of K Coefficients in Calculation of Heat Losses from Heated Buildings (Détermination des coefficients K employés dans le calcul des déperditions de chaleur des batiments chauffés), G. Prud'hon. Jl. des Usines à Gaz (Paris), vol. 52, no. 9, May 5, 1928, pp. 204-209, 3 figs. Description of apparatus for measuring calories absorbed by wall under test for obtaining value of coefficient K in formula for heat losses from walls of building; when and how apparatus is used.

C

CABLEWAYS

DESIGN. The Design of Cableways (Il calcolo delle funivie), U. Vallecchi and C. Carretto. Rivista Technica delle Ferrovie Italiane (Rome), vol. 33, no. 17, Apr. 15, 1928, pp. 152-176, 2 figs. Extensive compilation on theoretical principles and practical methods of design of cableways, telphers, etc., based on works of Isaachsen, Findeis, Stabilini and others.

CAST IRON

HIGH-TEST, MANUFACTURE OF. Developments in Furnace Practice for Production of High-Test Cast Iron, R. Moldenke. Fuels and Furnaces, vol. 6, no. 5, May 1928, pp. 726-730.

NICKEL. Economic Value of Nickel in Gray Cast Iron, D. M. Houston. Can. Foundryman (Toronto), vol. 19, no. 5, May 1928, pp. 33-36, 18 figs. Wide gulf existing between laboratory and foundry practice; problem of uniformity; structure building.

CASTING

VACUUM SYSTEM. Casting Metals by the Vacuum System. Metal Industry (N.Y.), vol. 26, no. 5, May 1928, p. 228, 1 fig. Vacuum principle, which is basis of methods used in casting glass automatically, has been applied to permanent-mold casting of metals in machine developed by A. Kadow, chief engineer of Owens Bottle Co., who applied his knowledge of glass casting to perfection of metal-casting machine that would embody vacuum-casting idea.

CHIMNEYS

HEAT LOSSES. A Simplified, Exact Method of Calculating Stack Losses (Eine vereinfachte und eine genaue Berechnung des Schornsteinverlustes), H. Kolbe. Brennstoff und Waermewirtschaft (Berlin), vol. 10, no. 5, Mar. 1, 1928, pp. 91-98, 8 figs. Formulas, tables of constants and charts for exact computation of loss of heat through smoke stacks; several of numerical examples.

CHROMIUM ALLOYS

WELDING. Welding of High Chromium Alloys. Heat Treating and Forging, vol. 14, no. 5, May 1928, pp. 502-504 and 524, 7 figs. Review of procedure for welding various types of corrosion resisting alloys.

CHROMIUM PLATING

AUTOMATIC. Chromium Plating Applied Automatically, F. W. Curtis. Am. Mach., vol. 68, no. 19, May 10, 1928, pp. 765-767, 5 figs. Chromium plating of brake cams on production basis, by means of conveyor-type unit is being carried out by Chevrolet Gear and Axle Co.

CHROMIUM STEEL

HEAT RESISTING. Heat Resisting Steels—Mechanical Properties, W. H. Hatfield. Iron and Steel Inst.—advance paper (Lond.), no. 6, May 1928, 22 pp. Deals with mechanical strength of steels at high temperature, as affected by introduction of special elements; steels investigated include chromium, silicon-chromium, chromium-nickel, chromium-nickel-silicon and chromium nickel-tungsten series. See abstract in Engineering (Lond.), vol. 125, nos. 3252 and 3253, May 11 and 18, 1928, pp. 589 and 622 and discussion on pp. 601-602.

CLUTCHES

ELECTROMAGNETIC. Electro-magnetic Clutches, H. T. Wright. Machy. (Lond.), vol. 32, no. 812, May 3, 1928, pp. 132-134, 7 figs. Methods of calculation and practical examples of designs; for large powers, refinement in design is necessary.

COAL

CARBONIZATION, LURGI PROCESS. Features of Construction and Process Application of Lurgi Methods at Wyoming Coal Briquetting Plant. Min. Rec., vol. 30, no. 2, Apr. 30, 1928, pp. 13-15, 3 figs. Résumé of article published in Mar. 31 issue of same journal; reproductions of drawings and charts showing what plant is designed to accomplish and how it is to function; economies of Lurgi process are based on efficient utilization of gas mixtures by means of circulatory system; claims made for processed Wyoming lignite fuel.

COAL HANDLING

CONVEYORS. Long Distance Coal Conveying on Belt Conveyors, E. C. Auld. Cassier's Indus. Mgmt. (Lond.), vol. 15, no. 5, May 1928, pp. 160-161. Data for 3½ years' operation of equipment handling total of 9,390,000 tons of coal; daily capacity as high as 13,866 tons; length 15,398 ft.; total lift 353.3 ft.; 57 per cent of belts originally supplied are still in service. Abstract of paper before Am. Inst. of Min. and Met. Engrs.

CONTAINERS

DESIGN. The Building of Containers for Severe Service, T. M. Jasper. Indus. and Eng. Chem., vol. 20, no. 5, May 1928, pp. 466-470, 8 figs. Containers used in chemical, oil-cracking, and steam engineering are required to carry increasingly high pressures, withstand great variations of temperature, and resist corrosive effects of great variety of conditions; problem divides itself into four parts; knowledge of working conditions and materials; design of apparatus to insure strength; protection of vessels during construction; testing vessels.

CORES

ELECTRIC BAKING. Core Baking With Electric Heat, J. S. Keenan. Can. Foundryman (Toronto), vol. 19, no. 5, May 1928, pp. 36-37, 3 figs. Heat-treatment process in core making is dual operation of drying and baking.

COPPER ALLOYS

HEAT TREATMENT. The Effect of Heat Treatment on Some Mechanical Properties of 90:6:3:1 Copper-Tin-Zinc-Lead Alloy, R. J. Anderson. Am. Metal Market, vol. 35, no. 55, Mar. 22, 1928, pp. 3-5, 19 figs. Selected bibliography.

D

DIES

FORGING. Die Design for Progressive Deep Piercing, E. R. Frost. Heat Treating and Forging, vol. 14, no. 5, May 1928, pp. 507-512, 30 figs. Method of forming hot-forged articles directly from bar stock by progressive piercing operations. Abstract of paper read before Am. Soc. Steel Treating.

DIESEL ENGINES

AIRLESS INJECTION. First Airless Injection, Double Acting Engine. Mar. Eng. and Shipg. Age, vol. 33, no. 6, June 1928, pp. 326-327, 3 figs. Built on Hesselman system of fuel injection designed to develop 4500 b.hp. at 90 r.p.m. in normal service; six cylinders 700 mm. in diameter with piston stroke of 1200 mm.; new cylinder construction.

AUTOMOTIVE. The Automotive Full-Diesel Engine, R. J. Broege. Ry. Age (Motor Transport Sec.), vol. 84, no. 21, May 26, 1928, pp. 1245-1248, 6 figs. Operating performance compared with gasoline engine. Abstract of paper presented before Soc. Automotive Engrs.

DESIGN. Co-operative Design, C. E. Cox. Am. Mach., vol. 68, no. 22, May 31, 1928, pp. 869-871, 2 figs. Factors influencing design of bearings, gears, drives and lubrication of Diesel engines.

HIGH-SPEED. High-Speed Diesel Engines, O. D. Treiber. Eng. Soc. of Buffalo—Bul., vol. 8, no. 3, Mar. 1928, pp. 3-9 and (discussion) 9-12. Air injection; solid injection; self-ignition; semi-self-ignition; mechanics of Diesel engine.

POWER PLANTS. High Powered Diesel Engines for Peak Loads, M. Gercke. Engineer (Lond.), vol. 145, no. 3773, May 4, 1928, pp. 496-497, 2 figs. Deals with aspects of peak load problem and its solution by adoption of Diesel engine of high power; economic effect of peak loads on efficiency of steam power plants; installation of peak-demand Diesel engines.

RESEARCH. Automobile Pioneer Develops New Diesel Engine. Oil Engine Power, vol. 6, no. 5, May 1928, pp. 314-317, 10 figs. Exhaustive investigation in producing high-speed two-cycle engine conducted by F. B. Stearns.

DRILLING MACHINES

MULTIPLE-SPINDLE. Archdale Motor-Driven Units Multi-Drilling and Multi-Tapping Machines. Brit. Machine Tool Eng. (Lond.), vol. 5, no. 51, May and June 1928, pp. 49-52, 4 figs. Advantages of standardization, although only capable of being applied in limited way, are very evident in construction of multi-spindle drilling machines described; each drilling or tapping head is complete unit with self-contained motor drive.

E

ECONOMIZERS

GALLOWAY. The Galloway Supermiser. Mech. World (Manchester), vol. 83, no. 2156, Apr. 27, 1928, pp. 310-311, 3 figs. Invention designed to abstract maximum amount of heat from boiler-fuel gases before they are discharged into chimney; feature of design is use of concentric tubes; hot gases pass through annular space between inner and outer tubes; feed-water passes through inner tubes, while air to be heated sweeps over outer surface of outer tubes.

ELECTRIC FURNACES

HEAT TREATING. Furnaces for Continuous Heat Treatment, W. C. Stevens. Heat Treating and Forging, vol. 14, no. 4, Apr. 1928, pp. 423-424, 2 figs. Construction and operation of electric furnace for hardening small parts of quantity production.

ELECTRIC LOCOMOTIVES

FRANCE. High-Speed Electric Locomotives (Locomotive électrique à grande vitesse). Génie Civil (Paris), vol. 92, no. 2386, May 5, 1928, pp. 429-433, 12 figs. Constructed by Société Alsacienne de Constructions Mécaniques for P. L. M. Railroad Co.; feed wire current 1300 volts; length 21 m.; weight 130 tons; motors have forced ventilation; eight motors in four groups of 550 hp. each, revolving 630 r.p.m. for speed of 50 km. per hr.; recuperative braking is used.

INDIVIDUAL AXLE DRIVE. Locomotive with Vertical Motors, H. Furst. Elec. World, vol. 19, no. 22, June 2, 1928, p. 1158. Austrian Federal Railways operate novel type of express locomotive of their electrified valley lines, which has given unusually good performance.

ELECTRIC WELDING, ARC

DEVELOPMENTS. A Brief History of Arc-Welding, A. Churchward. Heat Treating and Forging, vol. 14, no. 5, May 1928, pp. 522-524, 1 fig. Steps in development of art that is now indispensable.

NEW PROCESS. A New Principle Applied to Carbon-Arc Welding. Am. Mach., vol. 68, no. 22, May 31, 1928, pp. 891-892, 4 figs. Clean ductile welds produced by Electronic Tornado process.

F

FLOW OF GASES

ORIFICES. Flow of Gases Through Small Orifices, E. L. Rawlins. Oil and Gas Jl., vol. 26, no. 51, May 10, 1928, pp. 111-112, 125-126 and 128, 5 figs. Bureau of Mines completes careful study of various conditions of flow under high and low differential pressures; summary of important information contained in Technical Paper of U. S. Bureau of Mines.

FLOW OF WATER

PIPES. An Experimental Study of the Flow of Water in Pipes of Rectangular Section, S. J. Davies and C. M. White. Roy. Soc.—Proc. (Lond.), vol. 119, no. A781, May 1, 1928, pp. 92-107, 3 figs. Investigation to determine range over which equations of viscous flow could be applied to flow of fluids in small clearances between moving and fixed parts of certain machine tests made in Engineering Laboratories, King's College, London; 400 tests on pipes varying in section from 2.54 cm. broad by 0.0154 cm. deep to 2.54 cm. broad by 0.0681 cm. deep.

FLUIDS

RESISTANCE TO MOVING SPHERES. Fluid Resistance to Moving Spheres, R. G. Lunnon. Roy. Soc.—Proc. (Lond.), vol. 118, no. A780, pp. 681-684, 6 figs. Timing falls of metal spheres in water through distances up to two meters, resistance if fluid at high speeds was measured both for accelerated and for uniform motion; during accelerated motion resistance is increased in regular way; effect of cylindrical walls measured; motion of fluid behind sphere.

FORGINGS

STEEL, HEAT TREATMENT OF. Mass Effect in the Heat-Treatment of Large Forgings, J. A. Jones. Metallurgist (supp. to Engineer, Lond.), May 25, 1928, pp. 70-72. Influence of mass in heat treatment of alloy steels can be illustrated by tests taken from properly treated forgings of different compositions, gives tables of mechanical properties at middle of wall and at outside, and mechanical properties of large forgings and of small pieces which have received same treatment. (To be continued.) Communication from Research Department, Woolwich.

FURNACES

ANNEALING—NORMALIZING. New Type Sheet Normalizing Furnaces Installed at Newton Steel Company, C. P. Mills. Fuels and Furnaces, vol. 6, no. 5, May 1928, pp. 603-606 and 646, 2 figs. Two continuous furnaces of sectional construction, each 155 ft. long, equipped with special insulated disk rollers and arranged for burning gas or oil, normalize deep drawing steel sheet with fuel consumption of 5,525 cu. ft. coke-oven gas per ton. From paper presented before Engrs. Soc. West. Pa.

The Kathner Normalizing Furnace, C. P. Mills. Heat Treating and Forging, vol. 14, no. 4, Apr. 1928, pp. 428-431, 4 figs. Continuous-type gas furnace for sheets. Abstract of paper presented before Am. Soc. Mech. Engrs. and Engrs.' Soc. of West. Pa. See also Blast Furnace and Steel Plant, vol. 16, no. 4, Apr. 1928, p. 502.

FORGING, PULVERIZED-COAL. Forging Furnaces Operated with Powdered Coal, W. C. Rehfuss. Ry. Mech. Engr., vol. 102, no. 5, May 1928, pp. 279-282, 8 figs. Method has reduced maintenance costs and number of furnaces required.

HEATING. The Mechanization of Heating Furnaces, J. R. Miller. Heat Treating and Forging, vol. 14, no. 5, May 1928, pp. 546. Devices for handling material into and out of furnace and for manipulating pieces in furnace lead to labor and fuel saving as well as better quality; earlier progress made in steel mills; mechanization in forge shop.

HEAT-TREATING, CONTINUOUS. Mass-production Heat Treatment, J. W. Urquhart. Machy. (Lond.), vol. 32, no. 812, May 3, 1928, p. 155. Continuous-action automatic furnace.

G

GEARS

HELICAL. The Accuracy of Large Hob-Cut Helical Gears, G. A. Tomlinson. Engineering (Lond.), vol. 125, nos. 3251 and 3253, May 4 and 18, 1928, pp. 531-532 and 598-600, 9 figs. May 4: Number of hob teeth engaged; distribution of cutting work; effects of errors in hob. May 18: Effect of certain errors in hobbing machine.

INTEGRAL-CONTACT. Mechanical Resonance One Cause of Gear Noise and Wear, A. B. Cox. Am. Mach., vol. 68, no. 21, May 24, 1928, pp. 848-851, 7 figs. Integral contact gears are proposed to eliminate torsional vibration.

TEETH, FINISHING. A New Process of Finishing Gear Teeth, E. Sheldon. Am. Mach., vol. 68, no. 20, May 17, 1928, pp. 810-814, 11 figs. Process of finishing teeth of unhardened gears in exact conformity with theoretically correct involute curve, developed by Pratt and Whitney Co.

GRAIN HANDLING

PNEUMATIC. Pneumatic Handling of Grain. Modern Transport (Lond.), vol. 19, no. 478, May 12, 1928, pp. 2627, 2 figs. Pneumatic plants recently installed for discharging large grain ships at new Beaufort Road Mills, Birkenhead.

H

HEAT, FLOW OF

FLUCTUATING TEMPERATURE. Temperature and Flow of Heat in Periodically Heated Bodies (Temperaturverlauf und Waermestroemungen in periodisch erwaermten Koerpern), H. Groeber. Forschungsarbeiten auf dem Gebiete des Ingenieurwesens (Berlin), no. 300, 1928, pp. 3-13, 8 figs. General mathematical theory of thermal storage in bodies located in media of regularly fluctuating temperatures; considers case of infinitely thick body bounded by planes and case of infinitely long cylinder; comparison between cylinder and plate. Paper read at session of Committee on Thermodynamic Research of German Society of Engineers. (V.D.I.)

HEAT PUMPS

APPLICATIONS. Heat Pumps for the Operation of Evaporators (Vapor Compressors) and as Steam-Pressure Converters (Die Waermepumpe fuer den Betrieb von Verdampfern (Bruedenkompression und als Dampfdruckumformer), A. Oetken. Waerme (Berlin), vol. 51, no. 17, Apr. 28, 1928, pp. 315-321, 16 figs. Discusses principle of design and different types of heat pumps; their significance in comparison with single-effect and multiple-effect evaporators; application of heat pump and examples of actual installations; advantages of steam-pressure conversion.

HEAT TRANSMISSION

ENGINE CYLINDERS. Heat Transfer Between Working Substance and Cylinder Walls of Reciprocating Engines (Der Waermeuebergang zwischen Arbeitsmedium und Zylinderwand in Kolbenmaschinen), W. Nusselt. Forschungsarbeiten auf dem Gebiete des Ingenieurwesens (Berlin), no. 300, 1928, pp. 15-32, 5 figs. Summarizes European theoretical and experimental studies of heat transfer in cylinders of steam engines, gas compressors and liquefiers and internal combustion engines. Paper read at session of Committee on Thermodynamic Research of German Society of Engineers. (V.D.I.)

HELICOPTERS

LIFTING PROPELLERS, THEORY OF. The Theory of Lifting Propellers (Theorie der Hubschraube), O. Flachsbart. Zeit. fuer Flugtechnik und Motorluftschiffahrt (Munich), vol. 19, no. 8, Apr. 28, 1928, pp. 177-183, 8 figs. Theoretical report from Kaiser Wilhelm Institute for Research in Dynamics of Fluids, on helicopter propellers; formulas and curves of capacities, thrust stresses, effect of hub, etc.; numerical example illustrating method of design.

HYDRAULIC TURBINES

HIGH-HEAD. Application of Impulse and Reaction Turbines to Modern Hydroelectric Installations, E. M. Breed. Hydraulic Eng., vol. 4, no. 5, May 1928, pp. 255-257 and 264-267, 10 figs. Lubrication; water lubrication; design of draft tube; primary control; governor actuator; low-head turbines; automatic and remote control; application of various types of units thoroughly discussed and relative efficiencies of impulse and reaction types indicated. (Concluded.)

VERTICAL vs. HORIZONTAL SHAFTS. Note on the Comparative Advantages and Disadvantages of Hydraulic Machines with Vertical or Horizontal Axes (Note sur les avantages et les inconvénients comparés des groupes hydroélectriques à axe vertical et à axe horizontal), E. Dusaugey. Revue Générale de l'Electricité (Paris), vol. 23, no. 17, Apr. 28, 1928, pp. 395-396. Notes of turbine construction, from hydraulic, mechanical and civil-engineering standpoints.

I

INDICATORS

INTERNAL-COMBUSTION-ENGINE. A New High Speed Engine Indicator, K. J. De Juhasz. Instruments, vol. 1, no. 4, Apr. 1928, pp. 179-185, 5 figs. New indicator for taking accurate pressure diagrams of internal-combustion engines up to highest speeds; principle of De Juhasz indicator; consists of pressure measuring indicator, valve element, phase timing planetary gear, and drum actuating gear; small pressure variations in intake manifold, or carbureter jet, or high pressures in Diesel engine measured.

INDUSTRIAL MANAGEMENT

APPRAISALS. The Scope and Application of Certified Appraisals, G. B. Waterstraat. Jl. of Accountancy, vol. 45, no. 5, May 1928, pp. 335-350. Fundamentally appraisal of today is inventory of plant assets and if properly applied and followed will serve as plant record; appraiser's practice; considers how cost of production would be affected by depreciation.

INVENTORY CONTROL. Ready means for Inventory Control, L. I. Thomas. Mfg. Industries, vol. 16, no. 1, May 1928, pp. 33-36, 3 figs. Methods of operating purchasing and stores departments to assure adequate stocks with small inventories, minimum records and low costs.

PRODUCTION CONTROL. Modern Production Methods, E. W. Hancock. Automobile Engr. (Lond.), vol. 18, no. 241, May 1928, pp. 179-181. Present trend and future possibilities of work of production engineer.

PRODUCTION PLANNING, FORD PLANT. Planning and Mass Production Coordinated, F. L. Faurote. Factory and Indus. Mgmt., vol. 75, no. 5, May 1928, pp. 984-987, 5 figs. Channels of parts-supply kept open to insure even flow at assembly line.

TOOL-ROOM PRACTICE. How the Ford Tool Rooms are Organized, F. I. Faurote. Mill and Factory Illustrated, vol. 1, no. 2, Feb. 15, 1928, pp. 21-25, 9 figs.

INGOT MOLDS

DESIGN. Trend in Ingot Mold Design, R. H. Watson. Iron Age, vol. 121, no. 22, May 31, 1928, pp. 1579-1580, 2 figs.

INTERNAL COMBUSTION ENGINES

VIBRATION. Vibration from Internal Combustion Engines, J. M. Bloomfield. Power House (Toronto), vol. 22, no. 10, May 20, 1928, pp. 35-36. Causes of vibration are subsoil, periodic forces and misfiring; primary and secondary forces.

See also Airplane Engines; Automobile Engines; Diesel Engines.

IRON CASTINGS

DEFECTS. Hidden Defects in Iron Castings, P. R. Ramp. Iron and Steel (Gardenvale, Que.), vol. 11, no. 5, May 1928, pp. 140-143, 4 figs. Method of localizing shrink cavities and blowholes to places where they cannot harm casting.

L

LOCOMOTIVE BOILERS

CORROSION PREVENTION. Prevention of Sub-Aqueous Corrosion by Electro-Chemical Polarization Process, O. W. Carrick. Am. Water Works Assn.—Jl., vol. 19, no. 6, June 1928, pp. 704-713, 3 figs. Development stages of electro-chemical polarization system as applied to locomotives; effectiveness of anti-corrosion scheme polarization system installed in engines; workings of this system of protection described; process is being applied to all Chicago and Alton Railroad Company's locomotives.

DESIGN. The Design and Proportion of Locomotive Boilers, C. A. Brandt. Ry. Mech. Engr., vol. 102, no. 5, May 1928, pp. 254-258, 12 figs. Discussion of boiler ratios, firebox heating surface, superheaters and feedwater heaters; gas area through boiler; length of flues for proper efficiency.

LOCOMOTIVE REPAIR SHOPS

MONTREAL. Montreal Locomotive Erection and Machine Shop, Canadian National Railway. Can. Ry. and Mar. World (Toronto), no. 363, May 1928, p. 253, 2 figs.

LOCOMOTIVES

DESIGN. The Locomotive as a Factor in Fuel Economy, A. W. Bruce. Ry. Age, vol. 84, no. 20, May 19, 1928, pp. 1153-1155, 3 figs. Possibilities of future and of designs now available; suggested basis for retirements.

DIESEL. Diesel Locomotives. Ry. Age, vol. 84, no. 19, May 12, 1928, pp. 1107-1108. Committee on Diesel locomotives presented very complete report of developments in Diesel locomotive field during past year.

Diesel Locomotives with Schwartzkopff-Huwiler Hydraulic Gears (Diesellokomotive mit Fluessigkeitsgetriebe, Bauart Schwartzkopff-Huwiler), K. Vetter. V.D.I. Zeit. (Berlin), vol. 72, no. 18, May 5, 1928, pp. 603-604, 4 figs.

ELECTRIC. *See Electric Locomotives.*

INTERNAL-COMBUSTION (KITSON-STILL). The Kitson-Still Locomotive. Engineer (Lond.), vol. 145, no. 3773, May 4, 1928, pp. 484-485, 4 figs. Results of trial runs with complete train; on neither run did engine maintain schedule times, but on both she demonstrated her ability to haul train and ease with which she can be handled. See editorial comment on pp. 491-492.

STEAM-TURBINE. Report on Steam Turbine Locomotives. Ry. Age, vol. 84, no. 19, May 12, 1928, pp. 1106-1107, 2 figs. Condensing turbo-locomotives show horsepowers ranging from 4,000 to 8,000 with tractive forces from 78,000 to 191,000 lb.; advantages of turbo-electric locomotive; high tractive force at low speeds; bibliography of articles in American and European technical journals covering design and development of steam-turbine locomotive.

LUBRICATION

LOW TEMPERATURES. Lubrication Problems at Low Temperatures. Chem. and Met. Eng., vol. 35, no. 5, May 1928, pp. 275-276. Petroleum and industrial divisions of American Chemical Society hold joint session on recent developments of interest to maker and user; account of investigation carried out for determining effects of viscosity and pour test upon performance characteristics of automotive-engine oils; results of similar investigation carried out by Atlantic Refining Co.; results of research along different line with lightly loaded bearings operated at very high speeds; possibility of improving locomotive-journal lubrication.

M

MACHINE DESIGN

ERRORS. Common Errors in Machine Design. Machy. (Lond.), vol. 32, no. 813, May 10, 1928, pp. 174-175. Centrifugal force, vibration, gravity, friction, distortion, variation in product, expansion and contraction, and in accessibility for repairs and adjustment are common factors responsible for failure of machines to function properly; factors that cause vibration; failure of gravity as usable force; expansion caused by heat; avoiding trouble caused by variations in stock.

MACHINE TOOLS

LABOR-SAVING DEVICES. Time-Saving Devices in the Landis Shop. Machy. (Lond.), vol. 32, no. 812, May 3, 1928, pp. 148-150, 6 figs. Number of time and labor-saving devices, tools, and fixtures employed in shops of Landis Machine Co.

MATERIALS HANDLING

FOUNDRIES. Revising Handling Methods in a Modern Foundry, F. D. Campbell. Can. Machy. (Toronto), vol. 39, no. 9, May 3, 1928, pp. 50, 52, 54 and 56, 3 figs. Describes conversion of job-shop steel-foundry work to mass-production basis.

MATERIALS

X-RAY ANALYSIS. Analysis of Minerals, Ores and Industrial Products by Means of X-Rays (La détermination à l'aide des rayons X des minéraux minérals et de quelques produits industriels), R. van Aubel. Revue de l'Industrie Minérale (Paris), no. 177, May 1, 1928, pp. 189-195, 8 figs. Qualitative analysis, how made; identification, minerals; alloys, colloidal materials; ceramic products. Bibliography.

METALS

CORROSION RESISTANCE. Effect of the Testing Method of the Determination of Corrosion Resistance, H. S. Rawdon and E. C. Groesbeck. U. S. Bur. Standards—Tech. Paper, vol. 22, no. 367, Mar. 6, 1928, pp. 409-446, 25 figs. Determination of corrosion resistance of metals; tests were carried out on copper-nickel series, consisting of copper, nickel, and three copper-nickel alloys; methods tried out were simple immersion in non-aerated and aerated solutions repeated immersion both continuous and intermittent, spray, and accelerated electrolytic test.

The Application of Oxygen and Hydrogen to Industrial Operations, F. P. Wilson. Gen. Elec. Rev., vol. 31, no. 5, May 1928, pp. 279-282, 1 fig. Selection of fuel gas for metal cutting; discussion of economic factors involved in selection of gas for this purpose; nature of cutting work classified; substitute fuel gases available; time study of cutting activities; cost of oxygen and source of supply; comparative tests on laboratory basis.

FLOW. Effect of Average Principal Stress on the Flow of Metals (Der Einfluss der mittleren Hauptspannung auf das Fliessen der Metalle), W. Lode. Forschungsarbeiten auf dem Gebiete des Ingenieur-wesens (Berlin), no. 303, 1928, 15 pp., 12 figs. Reports of study, suggested by Nadai, made at Institute of Applied Mechanics of University of Goettingen; review of German, English, French and American work on plasticity of metals and on stresses causing metals to flow; author's original experimental study of flow of iron and copper; speed of flow of metals.

FORGING PROPERTIES. Behavior of Metals and Alloys in Forging, W. L. Kent. Heat Treating and Forging, vol. 14, no. 4, Apr. 1928, pp. 393-398, 5 figs. Investigations made on aluminum, copper and brasses are described showing properties of these materials during and after hot working; forging test as measurement of malleability at high temperatures investigated mechanism of hot forging; effect of quenching hot-forged samples effect of annealing cold-worked samples.

PICKLING. Practical Features of Pickling, W. G. Imhoff. Iron Trade Rev., vol. 82, no. 19, May 10, 1928, pp. 1206-1209, 10 figs. Pickling for black tinning, tinning of copper and enameling.

X-RAY ANALYSIS. X-ray Inspection in the Machine Shop. Machy. (Lond.), vol. 32, no. 815, May 24, 1928, pp. 233-235, 9 figs. New x-ray inspection device profitably used in machine shop; x-rays produced at 100,000 volts may penetrate inch of steel, several inches of aluminum or foot or more of wood.

N

NICKEL-COPPER ALLOYS

EFFECT OF HIGH STEAM TEMPERATURES ON. Change Occurring in a Nickel-Copper Alloy in Superheated Steam of 350 to 400 deg. (Altération profonde d'un alliage nickel-cuivre dans la vapeur d'eau surchauffée vers 350 à 400 deg.), J. F. Saffy. Académie des Sciences—Comptes Rendus (Paris), vol. 186, no. 17, Apr. 23, 1928, pp. 1116-1118, 3 figs. Effects produced by exposing alloys for several weeks to steam temperatures of 350 to 500 deg.; investigations were made with view to selecting best material for steam-turbine blades.

NICKEL STEEL

PROPERTIES. The Properties of Nickel Steel, With Special Reference to the Influence of Manganese, J. A. Jones. Iron and Steel Inst. (Lond.)—Advance Paper, no. 8, May 1928, 36 pp., 20 figs. Steels containing carbon 0.2 to 0.55 per cent and nickel 3 to 12 per cent were examined; with low manganese contents there is no advantage in increasing nickel beyond 6 per cent; effect of manganese up to 0.8 per cent is small; manganese has marked influence on mass effect in 3 to 4 per cent nickel steel; bibliography. See Iron & Coal Trades Rev., vol. 116, no. 3141, May 11, 1928, p. 706, and Foundry Trades Jl., vol. 38, no. 613, May 17, 1928, p. 362.

P

PIPE JOINTS

NEW METHOD. A New Method of Making Joints, E. E. Thum. Iron Age, vol. 121, no. 19, May 10, 1928, pp. 1305-1308, 5 figs. New automatic method of making gaspipe joints in fitted assemblies of smaller steel parts developed by General Electric Co.; assemblies of simple parts, snugly fitted, are heated in hydrogen atmosphere; powdered copper, painted on, runs into joints, alloys, and makes tight weld; hydrogen atmosphere cleans steel and protects copper; smaller furnaces for intermittent working; metallurgical considerations.

PNEUMATIC TOOLS

TESTING. Apparatus and Methods for Testing Compressed-Air Machines (Pruefmethoden und Messvorrichtungen fuer Pressluftmaschinen), E. Pallas. Zeit. des Oesterr. Ingenieur-u. Architekten-Vereines (Vienna), vol. 80, no. 19-20, May 11, 1928, pp. 162-166, 9 figs. Reviews papers by Wilson and Pallas on methods and apparatus for testing of pneumatic riveting hammers and similar tools; calibration of testing of friction brakes.

POWER PLANTS

INSTRUMENTS. Power House Measurements. World Power (Lond.), vol. 9, no. 53, May 1928, pp. 290-292, 5 figs. Automatic control systems; feedwater regulators; steam flow meters; indicating and recording instruments; water-measuring devices.

POWER PLANTS, HYDRO-ELECTRIC

DATA ON. Some Remarks on Hydroelectric Stations (Quelques remarques sur les centrales hydrauliques), V. Clerin. Union des Ingénieurs Sortis Des Ecoles Spéciales De Louvain—Bul. Technique (Louvain), vol. 55, no. 1928, pp. 73-86, 13 figs. Discusses radius of action of hydroelectric plants and variation of power in course of year; efficiency of plant; charges for hydraulic kw-hr.

MARYLAND. Conowingo Hydro-electric Development. Power Plant Eng., vol. 32, no. 11, June 1, 1928, pp. 632-638, 9 figs. Exceptional speed of construction is feature of great Susquehanna River development.

OPERATION. Operation and Maintenance of Hydroelectric Power Plants (Die Betrieb und die Instandhaltung von Wasserkraftanlagen), F. Kammerer. Zeit. des Bayerischen Revisions-Vereins (Munich), vol. 32, nos. 7 and 9, Apr. 15 and May 15, 1928, pp. 77-80 and 109-112.

QUEBEC. The Paugan Falls Power Plant. Engineer (Lond.), vol. 145, no. 3774, May 11, 1928, pp. 522-524, 7 figs.

TRASH RACKS, ELECTRIC HEATING OF. Electric Heating of Rack Bars in Hydro-Electric Plants. Eng. Jl. (Montreal), vol. 11, no. 5, May 1928, pp. 330-331. Discussion of paper by C. R. Reid published in Apr. 1928 issue of same journal.

POWER PLANTS, INDUSTRIAL

INTERCONNECTION. Economies of Combining Industrial Power Plants, W. W. Gaylord. Power Plant Eng., vol. 32, no. 10, May 15, 1928, pp. 551-555. Advantages to be gained by providing central power and heating plant for several adjacent industries are set forth.

POWER PLANTS, STEAM

HIGH-PRESSURE. Solvay Process Company Uses High Pressure. Power Plant Eng., vol. 32, no. 7, Apr. 1, 1928, pp. 401-402, 2 figs. Probably most interesting industrial power plant has yet been installed is at Solvay Process Co., Solvay, N.Y.

POWER PLANTS, STEAM AND GAS

COMBINED. A Combined Boiler and Producer Plant, C. Longenecker. Blast Furnace and Steel Plant, vol. 16, no. 5, May 1928, pp. 642-645, 4 figs. Steam and gas generated in central building at Sharon Steel Hoop Co.; arrangement assures sufficient service and is economically attractive; coal-handling equipment; method of firing boilers with powdered coal; gas-producer department; boiler and gas-house equipment; labor required at producers and boilers; electric control.

PAPER MILLS. Process Steam for Paper Mill Produced by Hog Fuel and Oil, P. Sandwell. Power, vol. 67, no. 20, May 15, 1928, pp. 849-852, 4 figs. At newsprint plant of Powell River Co., Powell River, B.C., modern 12-boiler plant supplies daily 5,000,000 lb. of process steam to paper mill; all necessary power is generated hydroelectrically; hog fuel, burned in Dutch ovens on either flat or inclined grates, supplied 30 per cent of steam and rest is supplied by fuel oil, burners being mounted on rear wall of common combustion chamber.

POWER PLANTS, STEAM-ELECTRIC

ASH HANDLING. Recent Progress in Methods of Ash Handling in Power Plants (Die neuere Entwicklung der Einrichtungen und Anlagen zur Entaschung von Kraftwerken), Neumann. Brennstoff- und Waermewirtschaft (Berlin), vol. 10, no. 3, Feb. (1st no.) 1928, pp. 54-56, 6 figs. Describes recent types of scraper and bucket conveyors, pneumatic and hydraulic methods for removal of ashes, representing modern European and American power-plant practice.

COAL STORAGE. Methods of Storing Coal (Zur Frage der zweckmaessigsten Kohlenlagerung), M. Schmelzer. Brennstoff- und Waermewirtschaft (Berlin), vol. 10, no. 3, Feb. (1st no.) 1928, pp. 59-63, 4 figs. Describes bunker arrangement of Tiefstack (Hamburg) power plant; details of gage for indicating level of coal stored in bunker.

DETROIT. The Trenton Channel Station of the Detroit Edison Co. Engineering (Lond.), vol. 125, no. 3250 and 3251, Apr. 27 and May 4, 1928, pp. 499-502 and 532-536, 42 figs. (partly on p. 512 and supp. plate). Apr. 27: Details of boiler plant.

The Trenton Channel Station of the Detroit Edison Co. Engineering (Lond.), vol. 125, nos. 3253 and 3254, May 18 and 25, 1928, pp. 603-606 and 629-631, 22 figs. partly on p. 608 and supp. plate. May 18: Details of turbine house.

GERMANY. The Cuno High-Pressure Steam-Electric Plant at Hagen in Westphalia [Das Cunowerk, ein Hochdruckdampfkraftwerk des Kommunalen Elektrizitaetswerkes Mark A. G. Hagen (Westfalen)], O. L. Kollbohm. Elektrizitaetswirtschaft (Berlin), vol. 27, no. 455, Apr. 1, 1928, pp. 153-163, 23 figs.

HOLLAND, N. J. Holland Plant, N. J., to Operate at 1,200 lb. Pressure. Power, vol. 67, no. 21, May 22, 1928, pp. 932-933. New Jersey Power & Light Co. is building first 50,000-kw. unit of 200,000-kw. ultimate-capacity plant on Delaware River, 8 miles below Easton, Pa.

RIVER BEND, N.C. $12,000,000 Unit of Power Project. Mfrs. Rec., vol. 93, no. 21, May 24, 1928, p. 65, 1 fig. Steam plant of Duke system to be located on Catawba river in North Carolina; one of largest steam stations in southeast; its ultimate capacity probably to be 600,000 hp. in 8 units of 75,000 hp. each; each turbine will be of single-cylinder, impulse-reaction type, operating at 1,800 r.p.m.

ST. LOUIS. Operating Experience with Latest Section of Cahokia Station, E. H. Tenney and H. G. Thielscher. Power Plant Eng., vol. 32, no. 11, June 1, 1928, pp. 600-606, 6 figs. Fifth unit, with capacity of 50,000 kw., brings total capacity to 195,000 kw.

TORONTO, ONT. Toronto Station Doubles Generating Capacity, G. S. Coffin. Power Plant Eng., vol. 32, no. 11, June 1, 1928, pp. 613-620, 7 figs. Performance record for 2½ years shows steady improvement to present low value of 15,000 B.t.u. per kw. sendout; in 1927, first extension was completed, increasing capacity of station 33,000 kw.; auxiliary turbine for this unit is 2,000-kw. machine, and two boilers with total heating surface of 21,620 sq. ft. each; in 1928 fourth 33,000-kw. turbine, 2,000-kw. auxiliary turbine and two additional boilers will be installed.

PUMPS, CENTRIFUGAL

INSTALLATION. The Installation of Centrifugal Pumps, J. H. Jones. Blast Furnace and Steel Plant, vol. 16, no. 5, May 1928, p. 649. Correct procedure in installing and operating centrifugal pumps to secure efficient and satisfactory service.

R

RAILWAY MOTOR CARS

DIESEL-ELECTRIC. Diesel Oil Electric Train Development. Modern Transport (Lond.), vol. 19, no. 478, May 12, 1928, pp. 3-4, 9 figs. Four-coach unit converted from electric rolling stock into Diesel oil-electric train for London, Midland and Scottish Railway.

GASOLINE ELECTRIC. Gas-Electric Car, Manitoba Power Co. Can. Ry. and Mar. World (Toronto), no. 363, May 1928, pp. 249-250, 2 figs. Known as type AS; electric generator, driven by engine is of 5-kw. capacity; motors on power truck are suspended by patented Mack rubber shock insulators.

Gas-Electric Unit for Rail Cars. Ry. Mech. Engr., vol. 102, no. 5, May 1928, pp. 250-253, 10 figs. High-compression, compact engine operated at full torque at varying speed.

OIL-ELECTRIC. 500 B.H.P. Oil-Electric Train. Engineer (Lond.), vol. 145, no. 3774, May 11, 1928, pp. 514-516, 8 figs. partly on p. 518. Description of new oil-electric train which, after undergoing official inspection by London, Midland and Scottish Railway officials, ran successful trial between Manchester and Blackpool.

ROLLING MILLS

ROLLER BEARINGS. Timken Roller Bearings for Steel Mills, F. Waldorf. Blast Furnace and Steel Plant, vol. 16, no. 5, May 1928, pp. 611-614, 5 figs. Information is presented from tests run on 22-in. bar mill, 10-in. rod mill, 26-in. tube mill and 4-high mills; lubrication and life of bearings considered; loads determined by Brinell tests; bearings on tube mills; life from antifriction bearings. Abstract of paper read before Engrs. Soc. of West. Penn.

ROTORS

INERTIA. Measuring Moments of Inertia of Heavy Rotors, H. W. Ritchie. Engineering (Lond.), vol. 125, no. 3253, May 18, 1928, pp. 614-615. Refers to article by Wall in Feb. 24 issue of same journal; describes two methods which are sufficiently accurate for general problems of acceleration, and are essentially practical and speedy.

S

SAND, FOUNDRY

TESTING. The Influence of Ferric Hydrogel in the Bond of Natural Moulding Sands, C. C. de Witt and G. G. Brown. Am. Foundrymen's Assn.—Reprint, no. 28-16, for mtg. May 14, 1928, pp. 247-276, 9 figs.

STEAM ACCUMULATORS

FLASH-TYPE. High-Pressure Flash-Type Accumulator, C. M. Garland. Power, vol. 67, no. 23, June 5, 1928, pp. 1014-1015, 2 figs. Designed primarily for high pressures, with water divided up into large areas of small volume, this accumulator flattens out sudden and intermittent demands for steam, such as are imposed by steam hammers, hoisting and rolling-mill engines, maintains uniform load on boilers and reduces boiler capacity otherwise necessary for this class of work.

STEAM CONDENSERS

DESIGN. Economic Condensation for Power Plants (Kondesatwirtschaft fuer Kraftanalgen), Blacke. Waerme (Berlin), vol. 51, nos. 14 and 15, Apr. 7 and 14, pp. 260-268 and 281-285, 26 figs. Discusses conditions underlying design and construction of modern steam condensers, and describes modern condensation plants and their auxiliaries.

STEAM GENERATORS

ELECTRIC. Steam Generation—Electric Boilers and Steam Accumulators, C. J. Wharton. World Power (Lond.), vol. 9, no. 53, May 1928, pp. 256-260, 4 figs. Shows that in circumstances of very cheap current, steam generation for process purposes by use of electric boilers is economic proposition. Abstract of paper read before Instn. Eng. Inspection.

STEAM TURBINES

DESIGN. Practical Experiences with Steam Turbines (Betriebserfahrungen mit Dampfturbinen), F. Gropp. Waerme (Berlin), vol. 51, no. 13, Mar. 31, 1928, pp. 230-231. Discusses materials and shapes of blades; important details proper starting and overload capacity.

STEEL

CASE-HARDENING. A New Free-Cutting Case-Hardening Steel. Machy. (Lond.), vol. 32, no. 814, May 17, 1928, pp. 213-214. Samples of new mild steel under name of Jalcase have been tested at City of Birmingham Industrial Research Laboratories and results of these tests, together with comments made thereon are reproduced.

CHROMIUM. *See Chromium Steel.*

NICKEL. *See Nickel Steel.*

STEEL CASTINGS

HEAT TREATMENT. How a Milwaukee Plant Heat Treats Miscellaneous Steel Castings, A. W. Lorenz. Iron Trade Rev., vol. 82, no. 20, May 17, 1928, pp. 1269-1272, 7 figs. Experience of Bucyrus-Erie Co. with heat-treated steel castings; one-third of foundry's output is quenched and tempered in electrically heated furnaces having novel charging devices; furnaces and equipment used; loading racks; entire cycle, including opening of doors, handled by one man on platform of charging machine.

CASTING TEMPERATURE. Casting Temperature and Speed (Ueber Giesstemperature und Giessgeschwindigkeit), F. Beitter. Stahl u. Eisen (Duesseldorf), vol. 48, no. 18, May 3, 1928, pp. 577-583 and (discussion) 583-585, 11 figs. Points out that casting temperature is in close relationship with casting speed; determination of melting temperature in furnace; cooling of steel to proper casting temperature; temperature drop of steel while in ladle; control of casting speed.

STEEL, HEAT TREATMENT OF

ELECTRIC. Hardening and Tempering by Electricity. Heat Treating and Forging, vol. 14, no. 4, Apr. 1928, pp. 400-404. Heat-treatment and application of electric heat as medium. Abstract of serial report of Industrial Heating Committee 1926-1927, Nat. Elec. Light Assn.

STRAIN GAUGES

MAIHAK. New Maihak Acoustical Strain Gauge. Instruments, vol. 1, no. 5, May 1928, pp. 251-252, 2 figs. Designed to measure strain and accompanying stress induced in machine parts (flywheels, propellers, shafts), steel structures, foundations, bridges, etc., acted upon by live loads or superimposed loads and dynamic forces.

T

TOLERANCES

SKODA VS. D.I.N. SYSTEM. Is an International Tolerance Standard Possible? (Ist Internationale Vereinheitlichung der Passysteme moeglich?). Werkstattstechnik (Berlin), vol. 22, no. 8, Apr. 15, 1928, pp. 217-260, 5 figs. Symposium containing paper on Skoda tolerance system, by its originator N. N. Sawin; also number of discussions and reports from machine-building, automobile-manufacturing and other plants on working of German D.I.N. and Skoda tolerance systems in practice.

TOOLS, METAL-CUTTING

CHROMIUM PLATING. Chromium-plating Metal-working Tools, P. Cattucci. Machy. (N.Y.), vol. 34, no. 10, June 1928, pp. 764-766, 2 figs. Hardness of chromium plate; chromium plated cutting tools show greatly increased resistance to wear; dies and metal-spinning tools; building up worn plug gauges; experience is necessary factor; cleaning work to be plated; electric-current requirements; cost of chromium plating.

HIGH-SPEED, TESTING. Endurance of High-Speed Cut-off Tools in Relation to Magnetic and Other Measurements, H. Styri. Am. Soc. Testing Matls.—Reprint, no. 30, for mtg. June 25, 1928, 10 pp. Number of standard cut-off tools hardened in groups from different temperatures have been used in cutting off rings of high-carbon chromium steel having Brinell hardness of about 180; magnetic and electric tests, and Rockwell hardness and duroscope readings were made on these tools, and relation between these values and number of rings cut per grind are shown; methods of measurement are described and possible reasons for irregularities in results are indicated.

NEW METAL FOR. New High-Speed Cutting-Tool Metals Interest British Metal Workers. Am. Mach., vol. 68, no. 21, May 24, 1928, p. 868b. Some records established by German and English products; metal cutting at unusually high speeds shown at recent Leipzig Fair; in Great Britain, new material B. V. introduced which can be heat treated and machined in much the same manner as ordinary 18 per cent tungsten high-speed steel.

TURBO-GENERATORS

BROWN-BOVERI. 20,000-kw. Brown-Boveri Turbo-Generator at Rotterdam. Engineer (Lond.), vol. 145, no. 3774, May 11, 1928, pp. 506-508, 11 figs. and diagram on supp. plate. Three-cylinder turbo-generator installed in Schiehaven power station at Rotterdam has speed of 3,000 r.p.m.; turbine was designed for steam at pressure of 170 lb. per sq. in. at stop valve, superheated to 350 deg. cent.

W

WATER TREATMENT

DEVELOPMENTS. Developments in Water Treatment, J. R. Baylis. Contract Rec. (Toronto), vol. 42, no. 20, May 16, 1928, pp. 508-510. Progress made recently in science of water purification; public more appreciative of efforts of water-works engineers and chemists; improvements in mechanical equipment; proper chemical balance; hydrogen-ion test; mechanical mixers; settling basins; filter improvements; filter-bed troubles; improved instruments; aeration; excess lime treatment and recarbonation.

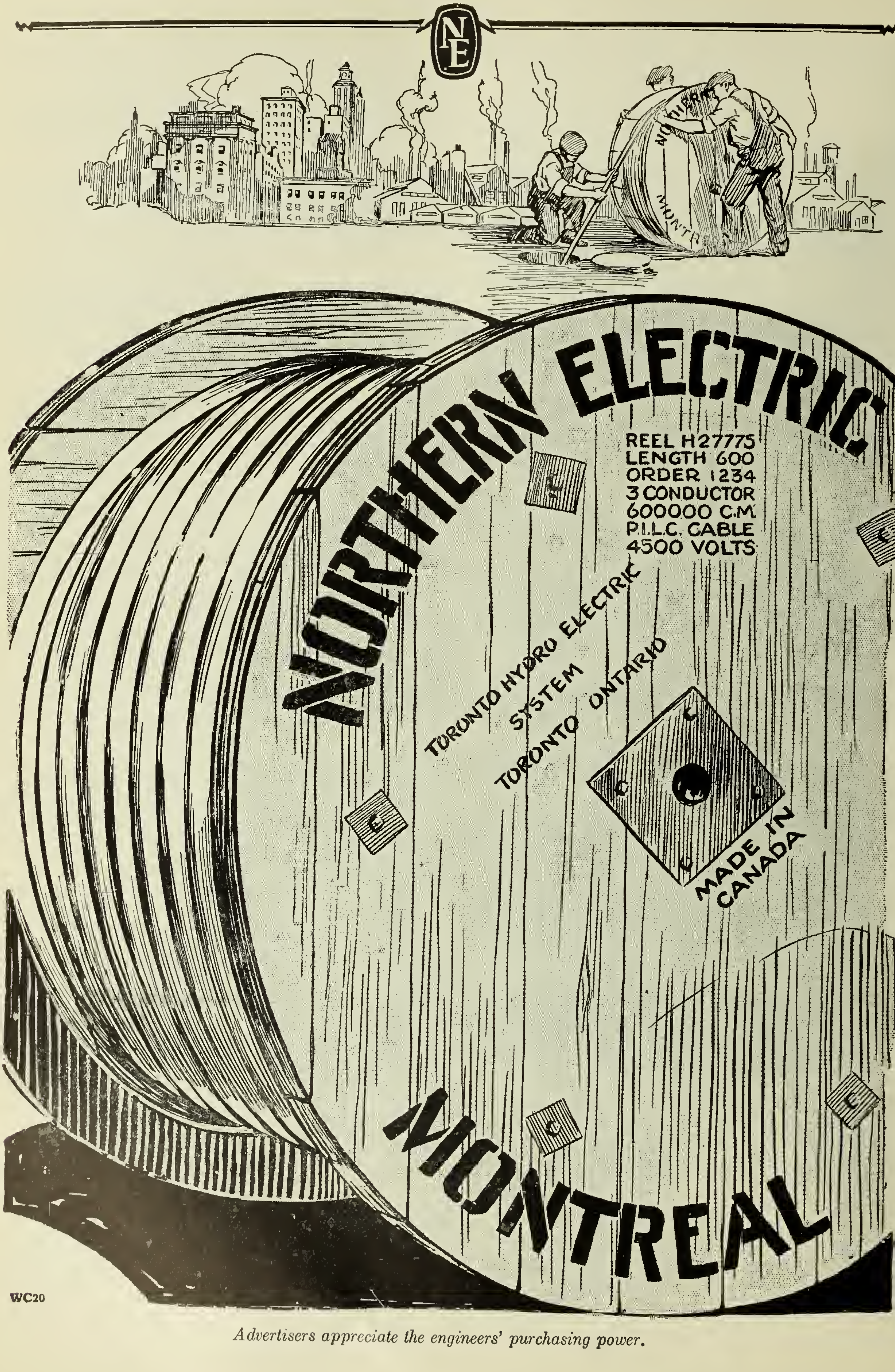
WELDING

ELECTRIC. *See Electric Welding, Arc.*

INFLUENCE ON DESIGN. The Influence of Welding on Design. W. Hoenisch. Eng. Progress (Berlin), vol. 11, no. 4, Apr. 1928, pp. 111-116, 32 figs. Electric resistance welding; spot and line welding; most important kinds of fusion welding are: oxyacetylene and electric arc welding; in both processes, temperatures of more than 3,000 deg. cent. are developed; 5,432 deg. fahr.; welding replaces riveted joints; welding in aircraft and structural work; pipe welding; welded material to replace castings; padding.

WOODWORKING PLANTS

WASTE ELIMINATION. Waste Reduction with Greater Unit Production in Woodworking Plants, C. M. Bigelow. Mfg. Industries, vol. 16, no. 1, May 1928, pp. 29-32, 3 figs. Six steps of prime importance in economical utilization of lumber previously discussed; remaining four steps are: determination of past average percentage of waste and production, decide on bonus and construct bonus chart, preparation of report outlining plan, and maintain graphic chart of results; improper piling and kiln drying causes considerable wastage of lumber. (To be Continued.)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A

AERIAL TRANSPORTATION

Costs. Information as to Cost of Aerial Transportation, H. V. Shebat. Stone and Webster Jl., vol. 42, no. 6, June 1928, pp. 792-796. Planes which have been most successful in recent demonstrations; cost of operating airplane 200,000 mi., 250 round trips; aerial transportation is justified on basis of economy alone if it is required that eight persons travel over line in each direction each month.

AERONAUTICAL INSTRUMENTS

Design. Modern Developments in Aircraft Instruments, C. J. Stewart. Roy. Aeronautical Soc.—Jl. (Lond.), vol. 32, no. 210, June 1928, pp. 425-465 and discussion 465-481, 35 figs.

AERONAUTICS

Military and Naval. Military Aviation, W. E. Gillmore. Am. Soc. Mech. Engrs. —Aeronautic Division—advance paper for meeting, June 28, 29, 1928, 7 pp., 13 figs. Survey of development of engineering material for aviation uses, air-cooled engine, and bombing equipment; engine materials; laboratory performance and endurance tests of aircraft engines; standard Air Corps endurance test; attack and observation airplanes; radio communications.

AIRCRAFT ENGINES

Progress. Airplane Engine Designers Following Diverse Lines, A. F. Denham. Automotive Industries, vol. 58, no. 25, June 23, 1928, pp. 952-956 and 985, 7 figs. Experimental work undertaken by various aircraft-engine manufacturers discussed; progress made in air-cooled Vee and incline engines; chief problems involved are to obtain adequate cooling for rear cylinders and location of accessories so as not to interfere with cooling system; nearly all such engines are of inverted type; anti-friction bearings; serious effort made to lower production costs.

AIRCRAFT MANUFACTURE

Gluing. Gluing Wood in Aircraft Work, T. R. Truax. Am. Soc. Mech. Engrs. —Aeronautic Division—advanced paper for meeting, June 28, 29, 1928, 3 pp., 3 figs.

AIRCRAFT METALLURGY

Progress of. Metallurgy and Influence on Aeronautics (Progrès de la metallurgie et leur influence sur l'aéronautique), G. Py. Société des Ingénieurs Civils de France (Paris), Mémoires, vol. 81, nos. 1 and 2, Jan. and Feb. 1928, pp. 113-170, 29 figs. partly on supp. plates. Metallurgy in general, working and use of metals with particular application to metallic construction of airplanes; steels for engines.

AIRCRAFT PARTS

Standardization. Many Changes are Recommended in S.A.E. Standards. Automotive Industries, vol. 58, no. 26, June 30, 1928, pp. 1007-1009, 4 figs. Discussion of reports of Standards Committee of Soc. of Automotive Engrs., submitted at Quebec meeting, which were ratified with few exceptions; revisions made in small aircraft parts in accordance with latest Army-Navy practice.

AIRCRAFT PROPELLERS

Reed. The Technical Development of the Reed Metal Propeller, S. A. Reed. Am. Soc. Mech. Engrs.—Aeronautic Division—advance paper for meeting, June 28, 29, 1928, 10 pp. Reed aircraft propeller has solid, thin, and almost knifelike blades of forged or rolled duralumin, or other similar aluminum alloys; development of metal propellers; propeller and its function; advantage of Reed type over wooden propeller; types of Reed metal propellers; materials of construction; methods of manufacture; table of propeller stress calculation.

AIRPLANES

Protective Coatings. Protecting and Finishing Aircraft Structures, T. B. Colby. Aviation, vol. 25, no. 1, July 2, 1928, pp. 26 and 61-62, 4 figs. Commercial finishing practices for aircraft structures; finish for steel tubing for fuselage before assembling and welding; protection of exterior of welded unit; finish for duralumin tubing; treating metal flying boats and pontoons; finishes for all-metal planes; method of finishing all-metal wing construction.

Wing Flutter. An Introduction to the Problem of Wing Flutter, C. F. Greene. Am. Soc. Mech. Engrs.—Aeronautic Division—advance paper for meeting, June 28, 29, 1928, 6 pp., 5 figs.

Wings, Slotted. Slotted Wings, F. Handley Page. Am. Soc. Mech. Engrs.—Aeronautic Division—advance paper for meeting, June 28, 29, 1928, 11 pp.

AIRSHIPS

United States. The Status of the Airship in America, G. Betancourt. Am. Soc. Mech. Engrs.—Aeronautic Division—advance paper for meeting, June 28, 29, 1928, 7 pp.

AIRWAYS

Weather Forecasting Stations. Meteorological Service for Commercial Airways, C. G. Rossby. Am. Soc. Mech. Engrs.—Aeronautic Division—advance paper for meeting, June 28, 29, 1928, 7 pp., 1 fig.

ALLOY STEEL

Manufacture. The Manufacture of Alloy Steel, E. C. Smith. Am. Metal Market, vol. 35, no. 111, June 12, 1928, pp. 20-22, 43 and 47. Discusses important phases of those steels whose tonnage has established them as production materials; type of pig iron most suitable; alloy steels are dependent upon special elements for their peculiar properties; special elements involved; probable future combinations. Paper read before Am. Iron & Steel Inst.

Electric Furnace Widely Employed for Making Alloy Steel, W. H. Priestley. Iron Trade Rev., vol. 82, no. 23, June 7, 1928, pp. 1472-1474, 2 figs. Discussion of paper on "The Manufacture of Alloy Steels" by E. C. Smith, presented before Am. Iron and Steel Inst.; good practice to melt with heavier slags, rich in lime and low in iron oxide; much cracking and tearing of ingots in rolling might be eliminated if steel were poured through small nozzles at as low temperature as consistent with good practice; changes taking place in methods of melting alloy-steel tonnage.

ALLOYS

Aluminum. *See Aluminum Alloys.*
Chromium. *See Chromium Steel.*
Copper. *See Copper Alloys.*
Iron. *See Iron Alloys.*

ALUMINUM ALLOYS

Electroplating. Electroplating on Aluminum and Its Alloys, H. K. Work. Eng. and Min. Jl., vol. 125, no. 23, June 9, 1928, p. 931. Successful method developed by author; chemical etching in acid metal or acid dip; surface of aluminum is pitted by action of dip; immersion layer surface is formed which greatly facilitates plating; roughened metal is then immersed for first coat in nickel-plating bath, to which electric current is applied.

ANTIMONY ORE TREATMENT

New Brunswick. The Lake George Antimony Ores and Their Concentration, C. S. Parsons. Can. Min. Jl. (Gardenvale, Que.), vol. 49, no. 20, May 18, 1928, pp. 405-408, 3 figs. Antimony deposit at Lake George, York Co., New Brunswick; historical and geological notes; samples of ore submitted to laboratories of Mines Branch for tests; gravity concentration; flotation; hand sorting; jigging; table concentration; large-scale pilot tests; flow sheet recommended as simplest and most feasible method of concentrating ore; outline mineral map of province.

ARCHES, WOODEN

Design. Progress in the Design and Construction of Modern Timber Structures (Fortschritte in der Ausfuehrung neuzeitlicher Holzkonstruktionen), T. Gesteschi. Bautechnik (Berlin), vol. 6, no. 25, June 12, 1928, pp. 327-344, 67 figs. Typical structural details of wooden roof trusses and frames, latticed wooden arches, vaults and domes and their application in construction of shops, churches, athletic halls, auditoriums; number of notable examples from recent German practice.

ARTESIAN WELLS

Tube Wells. H. B. Saxby and A. S. Knox. Indian Eng. (Calcutta), vol. 83, no. 19, May 12, 1928, pp. 263-265. Term tube well has originated in India, and in other parts of world term artesian or borehole is usually applied; there is, as far as writers are aware, no material difference; in authors' opinion great future of tube wells lies in agriculture, for irrigating such land that is not periodically flooded and for growing crops in cold-weather season.

ASBESTOS

Milling. Milling Practice. Asbestos, vol. 9, no. 12, June 1928, pp. 25, 27-28, 30-32. Effect on distribution of asbestos; two typical flow sheets for asbestos milling in Canada; milling method employed in Cyprus; milling methods in use at Amianthus Mine.

AUTOMOBILE PLANTS

Layout. Line-Production Layout, C. R. F. Engelbach. Soc. Automotive Engrs. —Jl., vol. 22, no. 6, June 1928, p. 692. Principles adopted in layout of plant for continuous production; even gear-cutting and grinding machines are placed in their correct positions in spite of difficulties of supervision; enameling ovens usually installed in enameling department are placed in line of operation wherever required. Abstract of paper presented before Instn. Automobile Engrs., Lond.

AUTOMOBILES

Brakes. Vacuum Brake for Motor Vehicles. Engineering (Lond.), vol. 125, no. 3255, June 1, 1928, pp. 667-668, 4 figs. Developed by Westinghouse Brake and Saxby Signal Co.; most important requirements of servo system are that comparatively light pressure on control pedal shall provide any braking effort required, that braking effort shall be in proportion to pressure.

Multiple Reactive Gears. Multiple Reactive Gears, E. K. Sandeman. Lond., Edinburgh and Dublin Philosophical Mag. and Jl. of Science (Lond.), vol. 5, no. 31, May 1928 (Supp. no.), pp. 946-958, 6 figs. This gear follows as logical outcome of theory of torque converter; plans of two mechanical networks with equivalent electric circuits are shown.

Standardization. Many Changes are Recommended in S.A.E. Standards. Automotive Industries, vol. 58, no. 26, June 30, 1928, pp. 1007-1009, 4 figs. Discussion of reports of Standards Committee of Soc. of Automotive Engrs., submitted at Quebec meeting which were ratified with few exceptions; revisions made in small aircraft parts in accordance with latest Army-Navy practice.

Transmission Gears, Progress. Internal Gear Outstanding Transmission Development, S. O. White. Automotive Industries, vol. 58, no. 25, June 23, 1928, pp. 938-941.

B

BAKELITE

MOULDING. Bakelite Moulding Methods, R. A. Lowe. Machy. (Lond.), vol. 32, no. 816, May 31, 1928, pp. 259-263, 8 figs. Description of processes and appliances used in bakelite moulding; presses used for moulding in most cases are hydraulic; flash, positive, and positive flash moulds; thread moulding; undercuts and projections; recessing and coring; question of flow; trapped air; bakelite tests; table of mechanical and electrical properties of bakelite.

BEAMS

THEORY. Load Carried By Two Beams Crossing, H. Adams. Structural Engr. (Lond.), vol. 6, no. 6, June 1928, pp. 183-185. In investigating this case, simpler formulas are recapitulated first; presents formulas for case in which rolled steel joists be required instead of fir beams.

BEARING METALS

RESEARCH. Bearing Metals, E. C. Wadlow. Automobile Engr. (Lond.), vol. 18, no. 242, June 1928, pp. 221-225, 16 figs. Practical investigation of load-carrying properties of bearing metals; research dealing with materials and lubricants as they are obtained commercially; tests to obtain information regarding suitability of cold-drawn and extruded tubes for plain journal bearings; microstructure and general performance; correlation of bearing factors with chemical and physical properties.

BRONZE, TESTING. Wear and Mechanical Tests of Some Railroad Bearing Bronzes, H. J. French. Am. Soc. Testing Matls.—Preprint, no. 34, for mtg. June 25, 1928, 28 pp., 18 figs.

BEARINGS

ANTI-FRICTION. Anti-Friction Bearings for Auxiliaries in the Iron and Steel Industry, E. S. Jefferies. Iron and Steel Engr., vol. 5, no. 6, June 1928, pp. 242-243. Reviews most prominent applications; adoption of anti-friction bearings in transportation equipment; ideal application for anti-friction bearings is on pinion and gear shafts of large mill gear reducing units.

BRONZE. Bronze Bearings for Heavy Duty, N. K. B. Patch. Iron Age, vol. 121, no. 23, June 7, 1928, pp. 1599-1600.

JOURNAL. The Effect of Running In on Journal-Bearing Performance, S. A. McKee. Mech. Eng., vol. 50, no. 7, July 1928, pp. 528-533, 4 figs. Discussion of paper published in Mech. Eng., Dec. 1927, p. 1335, describing investigation at Bureau of Standards, object of which was to evaluate effect of running in upon performance of babbitted, full-journal bearings.

Modern Methods for Testing of Bearings (Die neuzeitliche Lagerpruefung), E. v. Ende. Zeit. fuer technische Physik (Leipzig), vol. 9, no. 4, 1928, pp. 121-126, 7 figs. Reviews theory of journal friction; principles of apparatus for testing of journal friction with special reference to Kammerer and Vieweg designs.

BOILER CODE

ITALY. The Boiler Code of Italy (Italienische Dampfkesselvorschriften). Archiv für Wärmewirtschaft (Berlin), vol. 9, no. 5, May 1928, pp. 159-160. Extract from text of official code on construction and testing of boilers and steam vessels; notes differences between Italian and German codes.

BOILER FURNACES

FIRING SYSTEMS, STEEL PLANTS. Four Fuels Burned Under Boilers, J. R. Miller. Blast Furnace and Steel Plant, vol. 16, no. 6, June 1928, pp. 787-789 and 793, 2 figs. Equipment and operation of steam-generating equipment at blast-furnace power house of Otis Steel Co.'s Riverside Works; blast-furnace gas, powdered coal, coke gas or oil may be used; high pressure steam plant.

Practice and Progress in Combustion of Coal as Applied to Steam Generation, F. H. Rosencrants. Fuel (Lond.), vol. 7, no. 6, June 1928, pp. 272-281, 2 figs. Position of pulverized-fuel firing in relation to stoker firing; discusses two systems of pulverized-coal firing, bin-and-feeder and unit system; traveling-grate stokers and stoker furnaces; ash problem. Abstract of paper read before Instn. Elec. Engrs.

FUEL ECONOMY. Low Grade Heat Proclamation, W. D. Wylde. Eng. and Boiler House Rev. (Lond.), vol. 41, no. 12, June 1928, pp. 577-579, 3 figs.

PULVERIZED COAL. Practice and Progress in Combustion of Coal as Applied to Steam Generation, F. H. Rosencrants. Eng. and Boiler House Rev. (Lond.), vol. 41, no. 12, June 1928, pp. 594-597, 3 figs. Extracts from paper read before Instn. Elec. Engrs. previously annotated. Present abstract deals only with section of paper dealing with pulverized-coal firing. See also Editorial comments, pp. 575-576, 1 fig.

REFRACTORY MATERIALS, TESTING. Fire Brick for Boiler Furnaces, W. A. Carter. Blast Furnace and Steel Plant, vol. 16, no. 6, June 1928, p. 816. Tests and investigations advisable in selecting proper refractory for boiler-furnace walls are outlined; methods for making up specifications described. Abstract of paper from Am. Refractories Inst.—Tech. Bul. 22.

Testing Refractories for the Furnace, W. B. Mitchell. Blast Furnace and Steel Plant, vol. 16, no. 6, June 1928, p. 815. Responsibility of manufacturer of firebrick and of purchaser in selecting appropriate brand is defined and suggestions offered.

BOILER PLATES

NICKEL STEEL. Alloy Steel for Boiler Construction, C. McKnight. Int. Nickel Co.—Bul., no. 12, 11 pp., 17 figs. Paper presented before Am. Soc. Steel Treating, previously annotated.

TEMPERATURE EFFECT. The Properties of Materials for Use at High Temperatures With Special Reference to Boilers for Superheated Steam, R. G. C. Batson. Engineering (Lond.), vol. 125, no. 3256, June 8, 1928, pp. 723 and (discussion) 702-703.

DESIGN. The Present Trend in Boiler Practice, W. H. Patchell. Engineering (Lond.), vol. 125, no. 3256, June 8, 1928, pp. 723-724 and (discussion) 703-704. Modern tendency appears to be development of still larger steam-generating units, which will utilize to better advantage space they occupy, and of still higher steam pressures to meet more exacting demands of steam cycles that are now becoming fashionable. Abstract of paper read before Instn. Civil Engrs. See also Engineer (Lond.), vol. 145, no. 3779, June 15, 1928, pp. 653-654.

HIGH PRESSURE. High-Pressure Boiler. Times Trade and Eng. Supp. (Lond.), vol. 22, no. 517, June 2, 1928, p. 296, 1 fig. In design of new type of boiler for generation of high-pressure steam developed by Brown Boveri, leading points aimed at are reliability, low cost, possibility of considerable overload, insensibility to fluctuation of load, and low consumption at small load; to avoid heavy drums perforated by many holes for tubes and thick parts exposed to fire and to heat stresses, heat is transferred to steam in indirect way by means of superheated steam in tube coils of small diameter and thickness.

LOCOMOTIVE. *See Locomotive Boilers.*

WASTE HEAT. Waste-Heat Boilers in the Steel Mill, R. H. Stevens. Iron Age, vol. 121, no. 23, June 7, 1918, pp. 1605, and (discussion) 1605-1606.

BRAZING

HYDROGEN. Brazing by the Hydrogen Process. Machy. (N.Y.), vol. 34, no. 11, July 1928, p. 813. Methods of hydrogen brazing involves welding together of parts to be joined by means of copper flux and is result of considerable development work by General Electric Co.; by use of atmospheres of protective gas in electric furnaces, steel parts used in manufacture of complicated assemblies can be united by strong alloy weld. See also Automotive Industries, vol. 58, no. 24, June 16, 1928, p. 917, 1 fig.; and Brass World, vol. 24, no. 6, June 1928, p. 188, 1 fig.

BREAKWATERS

DESIGN. Harbour Breakwaters, H. H. G. Mitchell. Engineering (Lond.), vol. 125, no. 3257, June 15, 1928, pp. 749-750, and (discussion) 725-726. Breakwaters are here divided into three types, namely, mound breakwaters, mounds with solid superstructure, and solid breakwaters. Abstract of paper presented before Instn. Civil Engrs. See also Engineer (Lond.), vol. 145, no. 3779, June 15, 1928, p. 655.

BRIDGES

ARCH, DESIGN. Algebraic Determination and Comparison of Stress in an Arch of Two Joints and in a Fixed Arch of Certain Type (Determination algebrique et comparison des efforts dans un arc à deux articulations et dans un arc encastre, de type particulier), Wahl. Génie Civil (Paris), vol. 92, no. 23, June 9, 1928, pp. 562-564, 1 fig. Application of theory to determine sections of two bridges on Marne at Issy and at Lagny; formulas for fixed and jointed arches.

CANTILEVER. Bridge Across Upper Columbia. Eng. World, vol. 32, no. 6, June 1928, pp. 279-280, 1 fig. Design and construction; five steel spans of combined length of 1112 fet., with 475 ft. of timber-panel approaches; pier construction; steel spans.

CONCRETE. Rigid Frame Construction for Westchester County Park Commission, A. G. Hayden. Pub. Works, vol. 59, no. 6, June 1928, pp. 217-221, 9 figs. Principle of continuity was deliberately applied in invention of new structural form calculated to best meet conditions imposed by restricted headroom at highway crossings; new type of structure showed substantial economy; reason for inherent economy; careful comparison of cost of reinforced-concrete frame bridge, reinforced-concrete arch, and steel girder bridge with concrete abutments.

CONCRETE, ARCH. Reinforced Concrete Bridge over the Elorn, Brest, L. Turner. Concrete and Constr. Eng. (Lond.), vol. 23, no. 6, June 1928, pp. 419-422, 3 figs. Construction of three arch spans each of approximately 600-ft. span on centres or formwork spanning gaps between piers, without intervening support from river bed; centre was built on timber bents erected on shore of estuary few hundred yards upstream from bridge; two barges with arch connecting them were floated out into stream.

CONCRETE CONSTRUCTION. Erect 92-Ton Slabs with Derricks. Ry. Eng. and Maintenance, vol. 24, no. 6, June 1928, pp. 244-245, 2 figs. Heavy members for Pennsylvania bridge were delivered on cars and set in place between trains; concrete structure consists of six spans ranging from 22 ft. 3 in. to 35 ft. long end-to-end of slabs with four slabs per span; slab cast two miles from bridge.

DESIGN. Bridges and Structures (Bruecken und Baukonstruktionen), K. Bernhard. V.D.I. Zeit (Berlin), vol. 72, no. 23, June 9, 1928, p. 798, 1 fig. Annual review of engineering progress in bridge construction; steel and concrete construction in Germany; new structural steels and high-grade cements.

MOVABLE. Movable Bridges. Demag News (Duisburg), vol. 2, no. 3, 1928, pp. 75-76, 6 figs. Bridges with movable sections allowing shipping to pass through when open; swing and bascule bridges; different method of constructing Skandsen Bridge crossing Trondhjem Canal in Norway; roller bridges.

RAILROAD, ARC WELDING. Railway Bridge Electrically Welded (Puente ferroviario soldado electricamente). Ingenieria Internacional, vol. 16, no. 6, June 1928, p. 291, 1 fig. Brief description of arc welding of railway bridge at Chicopee Falls, Mass.; cost of erection was less than half of riveting similar structure; several other advantages of method enumerated.

Members Welded Into "One-Piece" Bridge. Constr. Methods, vol. 10, no. 7, July 1928, pp. 16-17, 7 figs. Single-track bridge, 180 ft. long, which carries Boston and Maine Railroad over power canal at Chicopee Falls, Mass.; steel tonnage saving 33 per cent; outstanding advantage secured by use of arc welding; bridge was designed exclusively for arc welding; welding details.

SUSPENSION, HUDSON RIVER. Notes on Recent Developments in Bridge Engineering, J. Husband. Structural Engr. (Lond.), vol. 6, no. 6, June 1928, pp. 179-182. Hudson River bridge of 3,500 ft. span; feasible limit of span; quotes from First Progress Report on Hudson River Bridge recently issued; table exhibits leading dimensions of Hudson River, Delaware River and Brooklyn bridges; quantities involved in construction of bridge are listed. (Continuation of serial.)

WOODEN, CREOSOTED. Creosoted Timber Bridge Spans Sweetwater River Along Old Oregon Trail. Wood Preserving News, vol. 6, no. 6, June 1928, pp. 77-79, 2 figs. Bridge is 437 ft. long; nineteen 23-ft. spans on 4-pile bents; all lumber used in structure is pressure creosoted with exception of guard rails; built at cost of $16,000.

C

CADMIUM PLATING

QUANTITY PRODUCTION. Cadmium Plating in Quantity Production, C. H. Loven. Metal Industry (N.Y.), vol. 26, no. 6, June 1928, pp. 252-255, 2 figs. Its value as protection against rust; description of methods of plating; means of control; analysis of cadmium-plating solutions.

CALORIMETERS

GAS. Gas Calorimeters, C. H. Lander. Times Trade and Eng. Supp. (Lond.), vol. 22, no. 518, June 9, 1928, p. 319. Report of investigation carried out with assistance of laboratory staff of Fuel Research Station of Thomas recording gas calorimeter; instrument is of American origin but in essential respects has been redesigned by Cambridge Instrument Co. Abstract from special report no. 20, Department Sci. and Indus. Research.

CANALS

LOCKS, CONCRETE CONSTRUCTION, GERMANY. Experience with Concrete in the Construction of the Fuerstenberg Twin Shaft Locks on the Oder (Erfahrungen im Gussbetonbau bei der Herstellung der Zwillingschachtschleuse bei Fuerstenberg Oder), Moeller and F. Albrecht. Bauingenieur (Berlin), vol. 9, nos. 20 and 21, May 18 and 25, 1928, pp. 364-370 and 386-392, 19 figs. Brief description of works and detailed report on composition making and pouring of 120,000 cu. m. of concrete; analyses of aggregates, water ratio; tests of strength and imperviousness; construction plant and methods of laying reinforcement, pouring of concrete, construction of forms and timber falsework. (To be concluded.)

WELLAND, CANADA. $13,750,000 for Welland Ship Canal This Year. Contract Rec. (Toronto), vol. 42, no. 22, May 30, 1928, pp. 572-574, 8 figs. Details of work to be carried out during present season; permanent operating buildings.

CAR COUPLINGS

Automatic. The Development of the Automatic Coupler in America, A. G. Williams. Baldwin Locomotives, vol. 7, no. 1, July 1928, pp. 25-31, 14 figs.

CAST IRON

Electric Conductivity. The Electrical Conductivity of Cast Iron, H. Pinsl. Iron and Steel Industry (Lond.), vol. 1, no. 7, Apr. 1928, p. 224. Study of electrical conductivity of cast iron; factors which govern specific resistance; influence of phosphorus, manganese and sulphur. Abstract translated from Giesserei—Zeitung, no. 3, 1928.

Graphitization. The Graphitization of Cast Iron, R. Stumper. Iron and Steel Industry (Lond.), vol. 1, no. 8, May 1928, pp. 247-249. Discussion of article entitled "Die Spongiose des Gusseisens," appearing in Korrosion und Metallschutz; graphitization of cast iron is one of most typical examples of selective corrosion; chemical constitution; earlier investigations; graphitic disintegration in grey cast-iron pipes.

Graphite in Gray Cast Iron and Its Influence on Strength (Beiträge zur Kenntnis des Graphits im Grauen Gusseisen und seines Einflusses auf die Festigkeit), P. Bardenheuer and K. L. Zeyen. Mitteilungen aus dem Kaiser-Wilhelm-Institut fuer Eisenforschung (Düsseldorf), vol. 10, no. 3, 1928, pp. 23-53, 176 figs. partly on supp. plates. Full report of investigations carried out at Technical Academy of Aachen, previously annotated.

Machinability. Data on Wear and Machinability of Cast Iron, T. H. Wickenden. Am. Metal Market, vol. 35, no. 111, June 12, 1928, pp. 13-17 and 42, 9 figs.

Nickel. The Future of Alloy Cast Iron. Foundry Trade Jl. (Lond.), vol. 38, no. 617, June 14, 1928, p. 430. It is clear that to produce very best results from alloy addition conditions under which it should be used must be well understood; basis of development must lie in control of cast iron itself before it leaves melting furnace; general effect of nickel on cast iron.

Oxyacetylene Welding. Strength of Cast Iron Welds, R. H. Hobrock and J. P. Walsted. Welding Engr., vol. 13, no. 6, June 1928, pp. 31-34. Study of some of the effects of thermal treatment on cast iron welded by oxyacetylene process; physical effects of heating welded sections; effects of heating and fusion on chemical composition of welded section and on welding rod; research carried on by Engineering Experiment Station at Purdue University.

Properties. The Static and Fatigue Properties of Some Cast Irons, J. B. Kommers. Am. Soc. Testing Matls.—Preprint, no. 40, for mtg. June 25, 1928, 24 pp., 15 figs. Tests include tension tests on two different sizes of specimens, compression, impact transverse, Rockwell and Brinell hardness, and fatigue tests; several properties of irons are compared, and it is shown that while fatigue endurance limit of cast irons may be roughly estimated from properties such as tensile strength, hardness, and modulus of rupture, knowledge of effect of available factors in influencing properties of cast iron is meagre.

CEMENT KILNS

Fuel Economy. Portland Cement Industry, J. Watson. Inst. Fuel—Jl. (Lond.), vol. 1, no. 3, Apr. 1928, pp. 309-312. Claims need for totally new form of kiln; progress in fuel economy in manufacture of portland cement is very slight and will be until new process is evolved; at present there is no cheaper or better method of producing cement clinker than by means of rotary kiln.

Portland, Setting. Digest of Literature on Nature of Setting and Hardening Process in Portland Cement, R. H. Bogue. Rock Products, vol. 31, no. 12, June 9, 1928, pp. 62-63. Theory of crystallization from supersaturated solution; application to portland cement; sums up generalizations of LeChatelier on setting and hardening of cements. (Continuation of serial.)

CHEMICAL ENGINEERING

Fuel Industry. Fuel Industries and Work of Chemical Engineer, A. Duckham. Chem. and Met. Eng., vol. 35, no. 6, June 1928, pp. 347. Discusses relation of chemical engineer to fuel-using industries. Abstract of paper read before Soc. of Chem. Industry Conference.

CHROMIUM PLATING

Influence of Cathode. Influence of the Cathode on the Electrodeposition of Chromium. H. S. Lukens. Metal Industry (Lond.), vol. 32, no. 23, June 8, 1928, pp. 567-568. Abstract of paper read before Am. Electrochem. Soc., previously annotated.

Polishing and Buffing. Polishing and Buffing for Chromium Plating, C. H. Eldridge. Metal Industry (N.Y.), vol. 26, no. 6, June 1928, pp. 258-259. Methods used and recommended by General Chromium Corp.

CHROMIUM STEEL

Heat Resisting. Heat-Resisting Steels—Mechanical Properties, W. H. Hatfield. Iron and Coal Trades Rev. (Lond.), vol. 116, no. 3142, May 18, 1928, pp. 739-742. Abstract of paper read before Iron and Steel Inst.

Refining. Refine Chrome Steel at Low Heat, N. N. Menshih. Iron Age, vol. 121, no. 26, June 28, 1928, pp. 1817-1818. Low temperature essential in basic open-hearth furnace if chromium-bearing scrap is used and if high ballistic tests must be met; deleterious effect of chromium when present from beginning of heat mitigated considerably if certain properties of element and its slag-forming oxides are known and provided for; residual chromium depends upon furnace practice.

COAL

Carbonization. Liquid Fuel From Coal, D. Brownlie. Diesel Engine Users Assn. (Lond.)—Paper, no. 584, read at mtg. Mar. 30, 1928, 40 pp., including discussion. Outstanding national problem in Great Britain; four general methods that may be used for production of liquid fuel from bituminous coal and similar material; high-temperature and low-temperature carbonization; hydrogenation; synthetic liquid fuels.

Research. Studies in Carbonization. Gas Jl. (Lond.), vol. 182, no. 3396, June 20, 1928, pp. 883-888 and (discussion) 888, 5 figs. Temperature, size of coal, blending with coke and inorganic compounds; experimental plant includes horizontal retort closed at one end, condensers, ammonia scrubbers, purifiers, gas meters, and gas sample holders; experimental results; size of coal; temperature of retort; mixtures of coal and coke; mixtures of coal with inorganic compounds; physical structure and reactivity of coke. Abstract of report to Instn. Gas Engrs. See also Gas World (Lond.), vol. 88, no. 2289, June 16, 1928, pp. 633-635.

Liquefaction, Bergius Process. The Conversion of Coal Into Oil by the Bergius Method, J. I. Graham and D. G. Skinner. Inst. Fuel—Jl. (Lond.), vol. 1, no. 3, Apr. 1928, pp. 246-255 and (discussion) 255-261, 3 figs. Full text of paper previously annotated from Instn. Petroleum Technologists—Jl., Feb. 1928.

Coking Heat. The Coking Heat of Gas and Coke Coals (Ueber die Verkokungwaermen von Gas- une Kokskohlen), E. Terres and M. Meier. Gas- und Wasserfach (Munich), vol. 71, nos. 20 and 21, May 19 and 26, 1928, pp. 457-461 and 490-495, 10 figs. Second report from department of chemical engineering of Brunswick Institute of Technology, continuing previously published investigation by Terres and Wolter; verifies previous determinations; calibration of apparatus; determination of coking heat of several German and English coals. (To be concluded.)

Cutters. A New German Coal Cutter. Colliery Guardian (Lond.), vol. 136, no. 13516, May 18, 1928, pp. 1938-1939, 5 figs. "SKS" coal cutter is being introduced into German coal mines; coal is holed by set of three twist drills placed side by side and running simultaneously; two outer ones in same direction and middle one in opposite direction; machine weighs 326 lb.; on comparative trials carried out in conjunction with percussion type, coal cutter exhibited advantages, such as speed of cutting, reduced power consumption, etc. Abstract from Glueckauf.

Industry. Collieries, K. N. Moss. Inst. Fuel—Jl. (Lond.), vol. 1, no. 3, Apr. 1928, pp. 303-307. Statistical data and tables; cost of coal and power purchased at coal mines, July-Sept. 1927; level of wholesale prices of coal and other commodities, Jan. 1928; comparative levels of wages in coal industry, 1921 and 1927; railway rates on coal in Great Britain, 1913 and 1927.

COAL MINES AND MINING

Explosives. A Step Forward in Explosives, E. E. Jones. Explosives Engr., vol. 6, no. 6, June 1928, pp. 213-215 and 226, 3 figs. Selection of explosive for blasting coal; comparison is difficult; shot firers not cure-all; air spacing within cartridge; important factors in producing lump coal; conclusions relative to shooting coal. Presented at convention of Practical Operating Men, Cincinnati.

Mechanization. Developments in Coal Mine Mechanization in 1927. Min. Congress Jl., vol. 14, no. 6, June 1928, pp. 417-422 and 446. States showing developments in mechanical production during 1927; many states show increase in adoption of mechanical production methods; others still in experimental stage; review indicates live interest and steady advancement in use of mechanical loaders, scrapers and conveyors.

Steel Supports. Five Years' Experience with Steel Arches as Roadway Supports, R. Bennett and M. B. Gardner. Instn. Min. Engrs.—Trans. (Lond.), vol. 75, part 2, May 1928, pp. 93-115 and (discussion) 126-135, 33 figs. Paper previously annotated from Iron and Coal Trades Rev. and Colliery Guardian.

COKE INDUSTRY

Improvements. The British Coking Industry and Some of Its Products, R. Ray. Inst. Fuel—Jl. (London.), vol. 1, no. 3, Apr. 1928, pp. 220-225 and (discussion) 226-233. Deals with points which affect necessity for modernization of coking industry and shows how, by adoption of such enlightened policy, great benefit would result to user and to producer of coke; considers how further economies could be made by production of more suitable coke for both blast-furnace and domestic purposes, and by utilization to better advantage of certain by-products of coking process; concludes that coking and iron and steel industries must stand or fall together.

CONCRETE AGGREGATES

Sizes. Separate Sizes of Coarse Aggregate for Concrete, R. T. Giles. Cement, Mill and Quarry, vol. 32, no. 3. Feb. 5, 1928, pp. 26-28. Separating coarse aggregate into several sizes for manufacture of concrete is subject of extreme importance rapidly attracting more and more attention; how segration occurs; rejection; using local material; satisfactory specification. Paper presented before Nat. Crushed Stone Assn.

Testing. Comparative Tests of Crushed Stone and Gravel Concrete in New Jersey. Concrete, vol. 32, no. 6, June 1928, pp. 23-24. Summary of results of tests of crushed stone and gravel concrete as reported by U. S. Bureau of Public Roads; discussions by S. Walker and A. T. Goldbeck.

CONCRETE CONSTRUCTION

Belt Conveyors. Belt Conveyors Place Concrete. Concrete, vol. 32, no. 6, June 1928, pp. 21-22. 4 figs. Concrete placed in 2700-ft. Seventh Street viaduct at Decatur, Ill., and in California flood control job taken from mixer to forms on portable belt conveyors: two jobs presenting varying conditions are described.

CONCRETE

Deterioration by Oil. Effect of Oil on Concrete, O. Colberg. Rock Products, vol. 52, no. 34, Apr. 25, 1928, p. 88. Observations made on arched concrete slab, which deteriorated after 20 years' exposure to effect of lubricating oils; it was concluded that detrimental effect of oil was mainly due to adulteration of lubricating oils during war by fatty oils of animal and vegetable origin; protective measures suggested are density of concrete, cement of low lime content and possibly admixture of trass. Abstract translated from Beton u. Eisen, Apr. 20, 1928.

Mixing. Designing a Concrete, J. G. Bragg. Bldg. Age, vol. 50, no. 6, June 1928, pp. 92-93. Method of design is simply method of selecting proper proportions of cement, fine and coarse aggregates to produce concrete having necessary compressive or tensile strength: covers four basic principles in production of good concrete; ratio of fine to coarse aggregate, quantity of mixing water, thorough mixing and curing.

Proportioning. Water-Cement Ratio Concrete, R. P. V. Marquardsen. Eng. and Contracting, vol. 67, no. 6. June 1928, pp. 313-318, 1 fig. Formulas and forms based on field-condition aggregates; water-cement ratio; grading of aggregates; proportioning for economy; basic theory.

Reinforced, Testing. Experimental Tests of Concrete-Steel Bond, L. N. Edwards and H. L. Greenleaf. Am. Soc. for Testing Matls.—Preprint, no. 65, for mtg. June 25, 1928, 14 pp., 11 figs. Results obtained show; (1) wide range of bond strength, probably indicating effect of "mother rock" origin of sands and of their granulometric composition; (2) general effect of use of excessive water content in concrete mix; (3) desirability of more complete investigation of factors affecting concrete-steel bond and its reliability under conditions involving variations in application of loads and impact.

COPPER

Fatigue. A Metallographic Study of the Path of Fatigue Failure in Copper, H. F. Moore and F. C. Howard. Metal Industry (Lond.), vol. 22, no. 24, June 15, 1928, pp. 589-592. 9 figs. Reprint of paper published in Univ. of Ill.—Bul., no. 37, 1928, previously annotated.

COPPER ALLOYS

Review of Progress. Metals and Alloys (Metalle und Legierungen), Masing. V.D.I. Zeit. (Berlin), vol. 72, no. 23, June 9, 1928, p. 787. Brief annual review of progress in production of aluminum and copper alloys; scientific research in alloys.

COPPER MINES AND MINING

Dust Collection. Dust Control in Southwestern Ore-Milling Plants, G. E. Lynch. Eng. and Min. Jl., vol. 125, no. 22, June 1928, pp. 887-889. First plant to use it was Moctezuma Copper Co. of Phelps Dodge Corp., cost about $6,000; copper queen mill at Warren, Ariz., dust-collection plant cost about $12,500; daily operating cost about $4; Ray plant of Nevada Consolidated Copper Co. cost about $6,000 complete; New Cornelia plant at Ajo, Ariz.; Allenby Copper plant in British Columbia; dust control is good business.

CRANES

Bridges. Loading Bridges With Belt Conveyors and Screeners. Demag News (Duisburg), vol. 2, no. 3, 1928, pp. 76-78, 7 figs. Subdividing work of loading-bridge crane devoted to pure hoisting and only traveling quite short distances horizontally while subsequent transportation of goods to storage-yard is performed by some other conveying appliance working quite independently of crane.

Floating. Large Floating Cranes and Their Work. Demag News (Duisburg), vol. 2, no. 3, 1928, pp. 69-74, 16 figs. Details of two floating cranes of 250-ton capacity employed for salvage repairs to ships and work in which they have been engaged.

CUPOLAS

CONTROL. Cupola Control by Auxiliary Tuyeres. Engineering (Lond.), vol. 125, no. 3257, June 15, 1928, p. 744, 3 figs. Improved efficiency of cupolas resulting from Poumay system of auxiliary tuyeres for control of combustion in them; system aims at producing carbon monoxide under fusion zone and in completing combustion of this gas inside charge itself so that discharged gases consist almost wholly of carbon dioxide.

DESIGN. Melting Plant and Appliances in Modern Iron Foundries, J. McLachlan and C. A. Otto. Iron and Steel Industry (Lond.), vol. 1, no. 9, June 1928, pp. 275-279, 3 figs. Supremacy of cupola for remelting pig iron in foundry never seriously threatened; comparison with air furnace and electric furnace; Dutch bell founders; various types of cupolas in use in British iron foundries; solid-bottom cupola; tilting spout; receiver type of cupola; continuous casting during length of blow; connection between pressure and volume of blast and quality of castings. (To be continued.)

D

DAMS

ARCH, THEORY. Arch Dams With Rings of Variable Thickness, F. W. Hanna and T. L. E. Haug. West Constr. News, vol. 3, no. 10, May 25, 1928, pp. 336-339, 3 figs. In method of archanalysis described, theory of elastic displacements have been used; extended to apply to arches under water pressure and to include effects of both rib shortening and shear.

MASONRY, CALCULATION. Calculation of Masonry Dams (Le calcul des barrages en maçonnerie), G. Pigeaud. Génie Civil (Paris), vol. 92, no. 13, Mar. 1928, pp. 314-317. Observations of some recent notes of Baticle concerning gravity dams with triangular sections; general conditions; application to dams with vertical upstream face.

SPILLWAY GATES. Relative Merits of various Types of Spillway Gates on or Adjacent to Dams. Elec. West, vol. 60, no. 6, May 15, 1928, pp. 362-376, 17 figs. Consideration of experiences of design, manufacture and operation of spillway gates on dams of operating companies of Pacific Coast States; formulas and coefficients; flashboards, needles and stop logs; collapsible gates; sector or drum gates; butterfly gates; roller gates; automatic gates. Bibliography. Committee report to Pac. Coast Elec. Assn.

DIESEL ENGINES

PENN. STATE CONFERENCE. Diesel Engineers Gather for Penn. State Conference. Power, vol. 67, no. 26, 1928, pp. 1162-1163. Review of papers and discussions at Oil Power Conference June 14 to 16 by Oil & Gas Power Division of Am. Soc. of Mech. Engrs.; manufacturing and sales problems studied; mechanical injection used for 11,000-hp. unit; trend toward lightness and higher speeds; demand for standardized Diesel-fuel specifications; standardization of certain engine parts proposed.

AUTOMOTIVE, RESEARCH IN. The Diesel As a Vehicle Engine, K. Neumann. Nat. Advisory Committee for Aeronautics—Tech. Mem., no. 467, June 1928, 43 pp., 21 figs. Operation of Diesel as vehicle engine investigated for development possibilities; working process of Diesel vehicle engine considered on basis of theoretical indicator diagram; experiments with 4-cylinder four-stroke-cycle Dorner oil engine. Translated from V.D.I. Zeit., May 28, 1927.

COMPRESSORLESS. The Governing of Compressorless Diesel Engines (Methoden der Regulierung von kompressorlosen Dieselmotoren), O. Holm. Werft—Reederei—Hafen (Berlin), vol. 9, no. 9, May 7, 1928, pp. 173-177, 8 figs. See translated abstract in Mar. Engr. and Motorship Bldr. (Lond.), vol. 51, no. 610, June 1928, p. 231.

POWER PLANTS. Industrial Use of Oil Engines, E. J. Kates. Oil Engine Power, vol. 6, no. 4, Apr. 1928, pp. 241-249, 8 figs.

TWO-CYCLE. An Answer to the Question Is the High-Speed Two-Cycle Diesel Possible? P. H. Schweitzer. Power, vol. 67, no. 25, June 19, 1928, pp. 1102-1104, 5 figs. Conclusions reached by O. Holm based on his study of mechanics of scavenging; he found that in 2-stroke-cycle engine neither r.p.m. nor piston speed is determining factor, as it is for 4-stroke-cycle engine; information regarding most favorable port dimensions and charging pressures for various engine speeds.

ELECTRIC LOCOMOTIVES. The Diesel-Electric Locomotive of the Compagnie Fermière Des Chemins De Fer Tunisiens, O. Schlapfer. Brown Boveri Rev. (Baden, Switzerland), vol. 15, no. 6, June 1928, pp. 188-191, 4 figs. Particulars regarding section of railway in Tunis and Diesel locomotive used; gauge 1,000 mm.; maximum gradient 2 per cent; engine rated at 250 hp. at 550 r.p.m.; economy of Diesel-electric locomotive as compared with steam shown in few figures.

The Diesel Locomotive in North Africa. Oil Engine Power, vol. 6, no. 4, Apr. 1928, pp. 255-258 and 268, 7 figs. Details of Diesel motive power on Tunisian railroad and searching tests made; fuel-consumption trials; speed trials on various gradients.

AUTOMOTIVE. German Automotive Developments, A. Nagel. Oil Engine Power, vol. 6, no. 4, Apr. 1928, pp. 263-267, 14 figs. Development of vertical stationary Junkers engine; Junkers car engine is two-cylinder opposed-piston engine with rated output of 45 hp. at 1,000 r.p.m.; exhaustive tests on test bed of Dessau Works. Abstract translated from V.D.I. Zeit.

DIRECTION FINDING

RADIO BEACONS. Direction Finding at Sea, R. L. Smith-Rose and S. R. Chapman. Times Trade and Eng. Supp. (Lond.), vol. 22, no. 518, June 9, 1928, p. 319. Method of direction-finding at sea has been under examination both by Air Ministry and by Committee on Directional Wireless; which involves erection of rotating beacons at shore stations; results of investigations of such beacon carried out in ships under seagoing conditions. Abstract of Special report, no. 6, Department Sci. and Indus. Research.

DIRECTION FINDING APPARATUS

RADIO. Directional Wireless Marine Navigation, R. L. Smith-Rose. Elec. Rev. (Lond.), vol. 102, no. 2637, June 8, 1928, pp. 994-995. Relative merits of directional transmission and reception are discussed and apparent technical superiority of rotating beacon over mean direction finder is pointed out.

DIE CASTING

DESIGN. Die-Casting Dies, F. W. Curtis. Am. Mach., vol. 68, nos. 23 and 24, June 7 and 14, 1928, pp. 911-913 and 959-961, 10 figs. June 7: Design and construction of dies and metal used; accuracy depends upon dimensions, taper or draft necessary for extraction and kind of metal being cast; double-impression die for casting external spur gears; casting external threads; use of vents at matching faces. June 14: Group of dies for intricately shaped parts and characteristics of various alloys; casting made with inserts; forming internal threads; die made with radial core; casting dovetail. (To be continued.)

DILATOMETERS

APPLICATION. The Dilatometer and Its Application. Am. Mach., vol. 68, no. 25, June 21, 1928, p. 1019, 3 figs. Operation details of dilatometer by means of which correct quenching temperature is mechanically indicated regardless of type of steel; by arrangement of recording chart to show amount of expansion during heating period, rate of heating is also definitely recorded; by comparison with known rates for steels, proper heating rate for given steel can be controlled.

DRILLING MACHINES

JIGS AND FIXTURES. Pneumatically controlled Continuous Drilling Machine. Machy. (Lond.), vol. 32, no. 817, June 7, 1928, pp. 289-293, 6 figs. Pneumatically controlled jigs and fixtures used on continuous drilling machine for drilling two holes for feather pins; machine is of rotating type having six heads which carry drill spindles; jigs are primarily air-operated compound cross-slides on which locating pins and drill bushing are mounted.

E

EARTH PRESSURE

THEORY. Earth Pressure, J. M. Moncrieff. Engineering (Lond.), vol. 125, no. 3255, June 1, 1928, pp. 674-675. Reviews various mathematical theories that have been formulated for computation of earth pressures, and points out that, in certain cases, notably that of Rankine, conditions postulated as basis of mathematical development are not, in general, satisfied in case of retaining walls. Abstract of address before Instn. Structural Engrs.

ELECTRIC APPARATUS

MARINE. Special Marine Electric Apparatus, K. Yamada. Inst. Elec. Engrs. of Japan—Jl. (Tokyo), no. 478, May 1928, pp. 512-522, 6 figs. Gyro Compass, Gyro stabilizer and fathometer which are only used on board ship and are not familiar to general public are popularly explained in order to give general idea about their mode of utilization and action. (In Japanese.)

ELECTRIC CABLES

ARC PROOFING. Arc Proofing Cables, C. H. Shaw. Elec. World, vol. 91, no. 25, June 23, 1928, pp. 1338-1339. Extensive series of experiments was undertaken by New York Edison Co. to determine relative protective values of different combinations of refractory materials through exposure of specially prepared test; samples to controlled electric arcs in which energy at arc and distance of test material from arc were maintained uniform, thereby providing test data that permit direct comparisons.

HIGH TENSION. High-Tension Cable for Power Transmission (Hochspannungskabel fuer elektrische Kraftuebertragungen), R. Apt. V.D.I. Zeit. (Berlin), vol. 72, no. 24, June 16, 1928, pp. 844-850, 23 figs. Discusses problems of manufacture, laying and testing of high-tension cables; Krupp and Passburg methods of manufacture; use of single-core cables for high voltages; cable couplings; standard specifications and tests of German Society of Electrical Engineers.

Electrical Fields of Some High Tension Cables (Elektrische Felder einiger Hochspannungskabel), V. Fock, W. Malyschew and A. Walther. Archiv fuer Elektrotechnik (Berlin), vol. 19, no. 4, Mar. 15, 1928, pp. 463-471, 12 figs. Report from Leningrad Physico-Technical laboratory on experimental determinations of electric fields in cables, of practical interest to cable manufacturers, by means of capacity sounding apparatus suggested by N. Semenoff; comparison of empirical with theoretically deduced results.

UNDERGROUND, FAULT LOCATING. Locating Underground Network Cable Faults. Elec. World, vol. 91, no. 25, June 23, 1928, pp. 1344-1345, 2 figs. Testing equipment consists of 15-kw. transformer reactor and necessary control and measuring equipment which is mounted on truck.

UNGERGROUND, LAYING. An Automatic Underground Cable Layer. Telegraph and Telephone Jl. (Lond.), vol. 14, no. 159, June 1928, pp. 196-197, 3 figs. Machine can actually lay up to 300 ft. of cable per hour, performing three other operations at same time; excavator is driven by four-cylinder Diesel engine of 40/45 hp., running on crude oil.

ELECTRIC CIRCUIT BREAKERS

OIL. Oil Circuit Breaker Developments. Elec. West, vol. 60, no. 6, May 15, 1928, pp. 343-349, 13 figs. Trend of design and manufacture; manufacturing companies submit descriptions of high-voltage circuit breakers and their operation; reports from various electric companies regarding their practice. Committee report to Pac. Coast Elec. Assn.

ELECTRIC CONDUITS

THREADING. Threading Conduit, R. L. Dodd. Elec. World, vol. 91, no. 25, 1928, p. 1334, 1 fig. Method now in use on system of Milwaukee Elec. Ry. and Light Co., of threading line from one manhole or pull box to another through conduit so that cable may be pulled through it; air compressors, mounted on truck, furnish power.

ELECTRIC CONVERTERS

ROTARY, SHORT CIRCUITS. Short-Circuit Phenomena in Rotary Converters (Kurzschlussvortechnik) (Berlin), vol. 19, no. 4, Mar. 15, 1928, pp. 437-443, 13 figs. Report from Government Electrotechnical Experiment Institute, of Moscow, continuing analysis and discussion of phenomena accompanying short circuiting of rotary converters.

ELECTRIC FURNACES

ANNEALING. Electric Annealing of Non-Ferrous Metals, R. M. Keeney. Heat Treating and Forging, vol. 14, no. 6, June 1928, pp. 630-632. Problem of economies in heating covering heat treatments of brass, copper and nickel-silver products; rolling-mill operations a possibility. Abstract of paper presented before Am. Electro-Chem. Soc.

APPLICATIONS. Some New Applications of Electric Furnaces, A. N. Otis. Am. Metal Market, vol. 35, no. 111, June 12, 1928, pp. 6-8 and 23, 9 figs. Work now being done with newer types of equipment; developments in use of electric furnaces, with atmospheres of protective gas, for copper-brazing steel parts together; furnace of elevator type used for annealing sheet steel and punchings for motors and generators; use in nitriding process for case-hardening; use of electric heating for processes considered unusual.

HIGH FREQUENCY. High-Frequency Heating. Elec. Rev. (Lond.), vol. 102, no. 2636, June 1, 1928, pp. 943-945, 3 figs. Comparative review of methods of generating currents necessary for supplying high-frequency furnaces; salient advantages of high-frequency heating; Tesla type of generator; tube-type generator; shows diagrammatically lay-out for h.f. furnace installation with thermionic-tube generator.

ELECTRIC LINES

CONTROL CIRCUITS. Protection of Control Circuits, J. H. Nelzen. Elec. World. vol. 91, no. 24, June 16, 1928, p. 1293, 1 fig. Control circuits used by Wisconsin Public Service Co. tried out and found to be quite successful; so devised that all operations are performed through functioning of single master relay connected across control pair.

DESIGN. Electric Transmission of Power as Applied to Large Areas, A. Page. Engineering (Lond.), vol. 125, no. 3256, June 8, 1928, pp. 724 and (discussion) 704; also Elec. Rev. (Lond.), vol. 102, no. 2638, June 15, 1928, pp. 1069-1071, including discussion. For main systems there is no alternative to overhead lines; voltage and carrying capacity of grid lines are fixed at 132 kv. and 50,000 kw. respectively; stability of grid system is intimately connected with problem of voltage control; in secondary transmission, pressures range from 11,000 to 66,000 volts; underground cables will continue to be extensively used. Abstract of paper read before Instn. Civil Engrs.

FLASHOVER. Flashover Investigation on 220-kv. Lines, L. L. Conrad. Elec. West, vol. 60, no. 6, May 15, 1928, pp. 458-460, 3 figs. Two standard 3-element oscillographs, regular test department equipment, were at hand for immediate use, which, with some modifications, could be put into service with least delay. Committee report to Pacific Coast Elec. Assn.

Lightning Protection. A Theory of Lightning, G. LeG. Fortescue. Elec. Jl., vol. 26, no. 6, June 1928, pp. 291-294, 4 figs. Protection of lines against lightning; influence of topography of line construction; ground wires for protection; other remedial measures; flashover and its relation to transformer insulation.

Maintenance. Operation and Maintenance of Rocky Mountain Transmission Line, V. M. McDonald. Elec. West, vol. 60, no. 7, June 1, 1928, pp. 595-599, 8 figs. Discussion of difficulties incident to maintaining service over 110-kv. Shoshone-Denver transmission line in Colorado; conductors and hardware; ground wires; telephone and transportation; line maintenance in Rocky Mountains.

Overhead. Pole-Line Structures, Devices and Maintenance. Elec. West, vol. 60, no. 6, May 15, 1928, pp. 471-477, 3 figs. Methods used to prevent grass fires from burning poles; use of solderless connectors; maintenance of distribution transformers and devices; bakelite tubes vs. porcelain tubes for 11 and 16-kv. fuses; painted vs. unpainted cross-arms; methods of stubbing poles; tree-trimming methods and procedure; wooden vs. steel poles for distribution work. Committee report to Pacific Coast Elec. Assn.

Power-Arcs. Transmission Line Power-Arcs, P. Ackerman. Elec. Rev. (Lond.), vol. 102, no. 2637, June 8, 1928, pp. 1019-1020. Practical results of series of power-arc tests carried out by Shawinigan Water Co.; general characteristics of power-arc; tests show clearly that duration of arc is more serious and more damaging than current magnitude; explosive expansion of arc; chimney effect; wind effect on arc; persistency of power arcs.

Voltage Drop Calculation. Rough Check for Voltage-Drop Components, R. C. R. Schulze. Elec. World, vol. 91, no. 22, June 2, 1928, pp. 1136-1137, 1 fig. Presents chart which provides quick way to determine roughly in phase and quadrature components of voltage drop along transmission line.

ELECTRIC LOCOMOTIVES

Sweden. The 1-C-1 Class D Locomotives for the Stockholm-Gottenborg Railroad (Die 1-C-1 Lokomotiven Klasse D fuer Stockholm-Gothenburg), P. Friebel. Elektrische Bahnen (Charlottenburg), vol. 4, no. 3, Mar. 15, 1928, pp. 45-58, 38 figs. Construction and details of motors, transformers and other electric equipment of 80-ton, 1,660-hp. locomotives, 13 m. long, able to develop maximum tractive power of 16 tons and speed of 90 km. per hr., manufactured by Almanna Svenska Elektriska Aktiebolaget.

ELECTRIC MEASURING INSTRUMENTS

Automatic. The Hall High-Speed Recorder, C. I. Hall. Gen. Elec. Rev., vol. 31, no. 6, June 1928, pp. 328-331, 9 figs. Automatic device which gives complete record of characteristics developed in electrical circuit; such as transmission or distribution line, during and immediately following occurrence of accidental fault.

ELECTRIC MOTORS

Control. Some Recent Developments in Motor Control, B. W. Jones. Gen. Elec. Rev., vol. 31, no. 6, June 1928, pp. 315-318, 8 figs. Primary purpose of control to make motor work; trend from current-limit to time control; non-reversing and plugging operations; a.c. and d.c. equipment.

Control Apparatus. Motor Control Gear, G. W. Stubbings. Electricity (Lond.), vol. 42, no. 1963, June 21, 1928, p. 21, 1 fig. Brief description of three types of protective gear which have been evolved to protect 3-phase motors against effects of single phasing, each of which devices depends on different principle; conclusion points out that phase-balance relays give protection against faults other than single phasing.

Induction. Circle Diagram of Induction Motor (Die Entnahme der Leistung und des Drehmomentes aus dem Kreisdiagramm des Lnduktions-motors), E. Siegel and J. Labus. Elektrotechnik u. Maschinenbau (Vienna), vol. 46, no. 9, Feb. 26, 1928, pp. 189-193, 3 figs. Gives simplified construction, whereby load and torque can be sealed directly from circle diagram.

Intermediate Rotor. Electric Motors with Intermediary Rotors, H. dePistoye. Mech. Eng., vol. 50, no. 7, July 1928, pp. 545-546. Such motor permits increasing speed but at cost of considerable mechanical complication; describes several types of these motors, one of which can be run at speed triple that of synchronism while another can be run at speed either greater or less than that of synchronism. Abstract translated from Technique Moderne, no. 8, p. 286.

Synchronous. Definition of An Ideal Synchronous Machine and Formula for the Armature Flux-Linkage, R. H. Park. Gen. Elec. Rev., vol. 31, no. 6, June 1928, pp. 332-334, 1 fig. Flux in every circuit of synchronous machine depends in complicated way on currents in every circuit of machine and on relative position of armature phases and rotor.

ELECTRIC REGULATORS

Feeder. 2,400-Volt Regulators Used for 11-Kv. Line, E. F. Pearson. Elec. World, vol. 91, no. 26, June 30, 1928, p. 1390, 1 fig. Advantages of using standard stock 2,400-volt feeder regulator equipment and saving cost of over 11,000-volt regulator led Northwestern Electric Co. to develop an ingenious scheme for regulating voltage on 11-kv. feeder.

ELECTRICITY SUPPLY

Rural. The Distribution of Electricity in Rural Districts, H. F. G. Woods. Elec. Rev., vol. 102, no. 2639, June 22, 1928, pp. 1108-1110, 3 figs. Employment of overhead lines for distribution and transmission is of necessity imposed by financial considerations; it is unnecessary that main supply pressure exceed 3,300 volts; village community is supplied by installing supply transformer, of outdoor type, upon suitably constructed platform, mounted upon H-pole at terminus of high-tension line. Abstract of paper read before Incorporated Mun. Elec. Engrs.

ELECTRIC TRANSFORMERS

Design. Notes on Transformers, C. W. Olliver. Colliery Eng. (Lond.), vol. 5, no. 52, June 1928, pp. 245-248, 6 figs. Brief exposition of important factors affecting transformer installation and design; methods of connection; interconnected-star connection; earthed neutrals; insulation tests between low and high-tension windings; oil conservators.

Loading. Transformer Loading—Ratio of Connected Load to Demand, K. B. Ayres. Elec. West. vol. 60, no. 6, May 15, 1928, pp. 465-469, 12 figs. Tabulates data received from members to give ready reference which will show within reasonable limits ratio between connected load and demand for light and for power for many different classes of business; distribution-transformer capacity for cooking and heating loads; outline of methods used by San Joaquin Light & Power Corp. to determine transformer capacity that is necessary to serve range and water-heater loads. Committee report to Pacific Coast Elec. Assn.

Short Circuits. Determining Short-Circuits in Current-Transformer While in Service. Elec. News (Toronto), vol. 37, no. 12, June 15, 1928, pp. 89-90, 5 figs. Adaptable to circuits preferably above 6,600 volts; faults are immediately indicated by ammeter reading of secondary load with and without resistor. Report by Meter Committee of Nat. Elec. Light Assn.

Testing. Analysis of Current Transformer Tests, E. C. Goodale. Elec. West, vol. 60, no. 7, June 1, 1928, pp. 612-613, 1 fig. Transformation laws, autotransformers; transformer having two primary windings; case of three primary windings feeding from common source; expressions may be derived for division of load among any number of primaries. (Continuation of serial.)

ELECTRIC TRANSMISSION AND DISTRIBUTION

Planning. Simplified Distribution Planning, W. R. Bullard. Elec. World, vol. 91, no. 25, June 23, 1928, pp. 1341-1344, 5 figs. Methods of calculating economic characteristics of electric distribution systems, particularly transformer spacing and sizes of line conductor.

ELECTRIC WELDING, RESISTANCE

Miter. Improving the Miter Weld. Welding Engr., vol. 13, no. 6, June 1928, pp. 39-40, 6 figs. New types of resistance welders are designed to produce miter welds meeting exacting requirements of manufacturing plants.

Electric Welding. Electric Welding, H. E. Grove. Commonwealth Engr. (Melbourne), vol. 15, no. 9, Apr. 2, 1928, pp. 329-336, 17 figs. Describes various types of welded joints and tests made on them to determine strength of joint; consideration of butt welds, especially those in tension; test relating to investigations on tubular jib for Scotch derrick crane. (Continuation of serial.)

ELECTRIC WELDING, ARC

Electronic Tornado. Electronic-Welded Materials Stand Severe Test. Heat. and Vent. Mag., vol. 25, no. 6, June 1928, p. 99, 4 figs. Applications of electronic-arc welding process in field of boiler maker and heating contractor have produced results that apparently justify extravagant claims.

ELECTRICITY ON FARMS

Motors. Electricity in Agriculture, R. B. Matthews. Rugby Eng. Soc.—Proc. (Rugby), vol. 22, 1927-1928, pp. 1-9 and (discussion) 9-10. Electric motors in farm buildings; plowing; tractor or rope-haulage plows; advantages with electric plowing; increasing egg supply; electric incubators; good for cow milking machines; efficiency in dairy; ultra-violet-ray treatment of farm stock.

ENGINEERING RESEARCH

Organization. Organizing the Industry's Engineering Research, A. D. Bailey. Nat. Elec. Light Assn.—Advance Paper for mtg. June 4-8, 1928, 6 pp. Operating companies interested in certain lines of engineering research are encouraging and supporting such work at universities or in private laboratories; research projects typical of work being done by Am. Soc. Mech. Engrs.; Am. Soc. Civ. Engrs. has research committees; Am. Ry. Assn., with its organized research and programme for year involving expenditure of two million dollars; recommended that research committee be set up in Engineering National Section.

ETHYL CHLORIDE COMPRESSORS

Rotary. Ethyl Chloride Rotary Compressors, W. W. O'Mahony. Ice and Cold Storage (Lond.), vol. 31, no. 362, May 1928, pp. 123-124, 3 figs. Details of French machine and its use in aviation; direct-coupled driving and special system of automatic lubrication, with complete recovery of oil, are outstanding features; superiority is claimed from standpoint of mechanical efficiency; remarkable applications of this rotary compressor in Bourget Aerodrome Laboratory of medical studies.

F

FEEDWATER

Degasification. The Degasification of Feedwater (Entgasung des Speisewassers), Schlicke. Wärme (Berlin). vol. 51, no. 20, May 19, 1928, pp. 373-374, 1 fig. Description of process for removal of injurious gases at 100 to 120 deg. cent.; its use in industrial power plants.

Treatment. Boiler Scale Prevention. A. T. Ridout. Machy. Market (Lond.), no. 2439, June 1, 1928, pp. 495-496. Physical system of treating water for boilers; by its use seawater may be used for make up feed; system utilizes colloids; coagulation and absorption of colloids fairly important; treatment of linseed oil; elimination of oil in feedwater. Paper read before Inst. Marine Engrs.

Treatment of Evaporator Feed Water, T. A. Solberg. Power, vol. 67, no. 26, June 26, 1928, pp. 1154-1155.

FEEDWATER HEATERS

Control. Automatic Control of Stage Feedwater Heaters, J. M. Drabelle. Power Plant Eng., vol. 32, no. 12. June 15, 1928. pp. 662-663, 4 figs. Method of controlling temperature of feedwater when extraction turbines are added to old plant using open heaters.

FIRE PROTECTION SURVEYS

Results. What a Fire Protection Survey Revealed, A. C. Carruthers. Safety Eng., vol. 60, no. 6, June 1928, pp. 219-221, 1 fig. Results of survey to determine extent of fire-fighting facilities in 20,703 buildings of various types in 157 villages, towns and cities in 28 states; 90 per cent were found without fire protection.

FLOW OF FLUIDS

Significance of Static Pressure. Dynamic Significance of Static Pressure, G. De Bothezat. Heat. and Vent. Mag., vol. 25, nos. 5 and 6, May and June 1928, pp. 65-67 and 75 and 79-83, 3 figs. Defines terms and explains phenomena fundamental in ventilation; qualitative relation between pressure and flow velocity in steady stream; quantitative relation between fluid velocity and fluid pressure; flow of air in ducts; air flow through fan; air flow through wind-mill.

FLOW OF STEAM

Measurement. Measurement of Steam Flow in Works Practice, H. C. Armstrong and T. Nordenson. Inst. Fuel—Jl. (Lond.), vol. 1, no. 2, Jan. 1928, pp. 161-177 and (discussion) 177-186, 32 figs. partly on supp. plate. Full text of paper previously annotated from Eng. and Boiler House Rev., Dec. 1927.

FLOW OF WATER

Measurement. Applying the Theory of Similitude to Discharge Measurements (Anwendung der Aehnlichkeitstheorie auf Durchflussmessungen), A. Grunwald and F. Engel. V.D.I. Zeit. (Berlin), vol. 72, no. 21, May 26, 1928, pp. 699-702, 9 figs. Review of Reynold's theory of similitude and its application to problems of discharge from orifices, nozzles, Poncelet apertures, etc.; transition from laminary to turbulent flow in case of Venturi meters.

Pipe. Formulæ For Estimating the Flow of Water in Pipes. New Reclamation Era, vol. 19, no. 6, June 1928, p. 93. Formulas used by Bureau of Reclamation engineers for estimating flow of water in pipe lines of various materials; wood-stave pipe; cast-iron pipe; precast concrete pipe; monolithic-concrete pipe; riveted-steel pipe; drain tile.

FLUE DUST

Electric Precipitation. Flue Dust Recovery, H. W. C. Henderson. World Power, vol. 9, no. 54. June 1928, pp. 340-347, 7 figs. Application of electric precipitation; describes installations for cleaning blast-furnace gas, coke-oven and producer gas sulphur-dioxide gases in acid industry, and plants working in conjunction with smelting processes, alumina calcining and cement kilns. (Concluded.)

FLUMES

DESIGN. Flumes. Elec. West, vol. 60, no. 6, May 15, 1928, pp. 376-396, 22 figs. Present-day methods of design, erection and maintenance; flow in flumes; inlets to flumes; outlets; short and long flumes; typical hydraulic computations for replacement of old flumes on existing canals; mechanics; metal; maintenance of wood flumes, lining and belting. Committee report to Pac. Elec. Assn.

FOUNDRIES

MATERIALS HANDLING. Handling Plant in the Foundry. Iron and Steel Industry (Lond.), vol. 1, no. 8, May 1928, pp. 253-255, 3 figs. Materials-handling equipment shown at international Foundry Trades Congress and Exhibition in Paris last autumn; diagrams of Bonvillain & Ronceray modern foundry continuous-flow system, continuous-working Rosieres roller moulding press, and sand-jet moulding machine. Based on account published in V.D.I. Zeit.

Materials-Handling Engineers Consider Foundry Work. Foundry, vol. 56, no. 12, June 15, 1928, p. 493. Review of meeting of materials-handling division of Am. Soc. of Mech. Engrs.; system developed for handling small castings speeds up work; unit containers suggested for less than carload lots of freight.

FREQUENCY CHANGERS

VARIABLE-RATIO. Variable-Ratio Frequency-Changer Sets, C. W. Kineaid. Elec. Jl., vol. 26, no. 6, June 1928, pp. 279-284, 7 figs. Variable-ratio frequency changer was developed to suit cases where certain features are desired; description of various types of variable-ratio sets.

FUEL ECONOMY

PROGRESS. Fuel Economy in 1927 (Zur Bilanz der Wärmewirtschaft im Jahre 1927), D. Przygode. Wärme (Berlin), vol. 51, nos. 20 and 21, May 19 and 26, pp. 368-372 and 384-388, 13 figs. Review of progress in high-pressure steam for peak loads in power plants; interconnection of power and heating plants; long-distance heat installations; refinement of fuel; long-distance gas supply; gas works; coal liquefaction; high-speed compressorless Diesel engines; mercury-vapor steam plants; pulverized coal firing, etc.

FUEL UTILIZATION

SOLID AND LIQUID. Utilization of Solid and Liquid Fuels, C. H. Lander. Engineering (Lond.), vol. 125, no. 3256, June 8, 1928, pp. 722 and (discussion) 701-702. Abstract of paper read before Instn. Civil Engrs. See also Engineer (Lond.), vol. 145, no. 3778, June 8, 1928, p. 628.

FURNACES, ANNEALING

STOKERS. Stokers Applied to Annealing Furnaces, J. B. Whitlock. Blast Furnace and Steel Plant, vol. 16, no. 6, June 1928, pp. 776-778, 5 figs. Annealing-furnace stokers with boiler-type grates effect important improvements in annealing practice; fuel saving considerable; temperature control easily maintained; 12 new box-annealing furnaces arranged in six batteries at plant of American Rolling Mill Co.; furnace construction.

FURNACES, METALLURGICAL

OIL FIRING. Oil Fuel as Applied to Metallurgical Works. Metal Industry (Lond.), vol. 32, no. 23, June 8, 1928, pp. 572-573. Advantages of oil over solid fuels in industrial furnaces may be summed up as follows: increase of output, economy of fuel, less material wastage, much higher temperatures obtained in shorter periods, temperature under instant control, saving in furnace attendance and less floor space.

G

GAUGES

INTERFEROMETER (ZEISS). Measuring Gaugeblocks by Light Waves, F. Konig. Machy. (N.Y.), vol. 34, no. 11, July 1928, pp. 809-813, 8 figs. Details of new interferometer developed by Carl Zeiss, Jena, Germany, for making absolute measurements; device can also be converted into comparator; measurements to millionths of an inch made; conditions involved in use of polychromic light; swiveling prism for effecting spectral dispersion; adjustable virtual plane of reference about midway between two surfaces of gauge block; slide rule used in conjunction with interferometer.

GARBAGE

DISPOSAL. Garbage Collection and Disposal—Methods and Costs. Am. City, vol. 38, no. 6, June 1928, pp. 167-169. Prepared from report presented at annual conference of International Association of Street Sanitation Officials; generally agreed that collection and disposal of garbage is necessary function of municipal government.

GAS INDUSTRY

PRODUCTION PROBLEMS. American Gas Association Studies Production Problems. Chem. and Met. Eng., vol. 35, no. 6, June 1928, pp. 345-347, 4 figs. Editorial staff report of joint Production and Chemical Conference of American Gas Association held May 22 to 24 in Rochester; this meeting dealt with engineering and chemical problems; manufacture of water gas; operating results on Sterling, Ill., plant of Koppers continuous vertical ovens; coking-plant tests; plant-control equipment.

GAS PRODUCERS

ARC WELDING. Fabricating Special Equipment by Arc Welding Proves Economical, R. R. Smith. Iron Trade Rev., vol. 82, no. 25, June 21, 1928, p. 1601, 2 figs. Details of gas-producer feed mechanism and its fabrication by arc welding. Paper submitted in Lincoln arc welding prize competition.

GAS UTILIZATION

INDUSTRIAL PLANTS. Town's Gas and Industry, H. R. Hems. Gas World (Lond.), vol. 88, no. 2286, May 26, 1928, pp. 525-528, 2 figs. Fuel costs; method of charging; use of gas for industrial purposes; special service; design of furnaces; "Revergen" furnace; improved refractories and insulation; installations at Redditch; drying stoves; hardening and tempering of springs; manufacture of needles and fish hooks; gas-sealed furnace. Extracts from paper read before Brit. Commercial Gas Assn.

GEARS AND GEARING

FRICTION. Friction Gearing. Can. Machy. (Toronto), vol. 39, nos. 10 and 11, May 17 and 31, 1928, pp. 31 and 68, and 35 and 75-76, 3 figs. May 17: Friction gearing employed where positive and definite velocity ratio is not necessary and in cases where small powers are being transmitted; composition wheels; Goss' conclusions; spur-friction gearing; conditions to be observed. May 31: Plain spur-friction gears used as part of mechanism of power drop hammers used on forging work; Billing and Spencer friction board drop hammer.

STANDARDIZATION. Tentative American Standard. Machy. (N.Y.), vol. 34, no. 11, July 1928, supp. sheets nos. 133 and 134, 2 figs. Standard spur-gear tooth form, approved by Am. Eng. Standards Committee, Am. Gear Manufacturers' Assn. and Am. Soc. of Mech. Engrs., covering 14½-deg. composite system (full-depth tooth) and 20-deg. stub involute system; diagrams of basic racks for both systems.

THRUST. Direction of Rotation and Thrust in Worm and Spiral Gearing. Machy. (Lond.), vol. 32, no. 817, June 7, 1928, supp. sheet no. 66, 8 figs. Diagrams show direction of rotation and thrust for both driver and driven wheels, and cover all cases of these two forms of power transmission.

GEOPHYSICAL EXPLORATION

PROSPECTING. Electrical Prospecting, J. J. Jakosky. Engrs. Bul., vol. 12, no. 6, June 1928, pp. 10 and 26, 1 fig. Reliable method of locating conductive ores; effectiveness of any electric process depends almost solely on electric conductivities of ore-body; extensive research is being carried on to obtain more fundamental data regarding wave propagation and effects of various mineralized zones and surrounding earth.

GOLD DEPOSITS

MANITOBA. Province of Manitoba. Can. Min. Jl. (Gardenvale, Que.), vol. 49, no. 6, Feb. 10, 1928, p. 137, 1 fig. Map of Eastern Manitoba gold areas, scale 25 miles to inch, accompanies development news items; for geology, refers to Geological Survey, Ottawa, reports, 1922, part C, and 1923, part B.

ONTARIO. Province of Ontario. Can. Min. Jl. (Gardenvale, Que.), vol. 49, no. 6, Feb. 10, 1928, pp. 138-139, 1 fig. Map of Red Lake Gold area, Ontario, scale 25 miles to inch, accompanies development news items; for geology, refers to Ontario Dept. of Mines Report, vol. 33, part 4, 1924; also Geol. Survey, Canada, report no. 578, 1896.

QUEBEC. Gold Deposits of Cadillac, Fourniere and Malartic Townships, Quebec, W. F. James and J. B. Mawdsley. Can. Min. Jl. (Gardenvale, Que.), vol. 49, no. 6, Feb. 10, 1928, pp. 132-134. General account of geology of area; field work done in 1925; operations have been undertaken by some companies; best known properties are O'Brien, Malartic and Thompson. Extracts from report published by Geological Survey of Quebec.

GRAIN ELEVATORS

BRITISH COLUMBIA. Four New Grain Elevators of Large Capacity of British Columbia Ports, W. F. Findlay. Contract Rec. (Toronto), vol. 42, no. 23, June 6, 1928, pp. 627-630, 3 figs. Additional facilities for handling of grain are now in course of construction at Vancouver, Victoria and New Westminster; $5,000,000 expenditure involved; North Shore elevator; Fraser River elevator; advantages of fresh water; storage section.

GRINDING

SURFACE. Finish Grinding Flat-Surface Work. Am. Mach., vol. 68, no. 24, June 14, 1928, pp. 967-970, 8 figs. Groups of efficient disk or flat surface grinding operations of automatic and semi-automatic type; Gardner grinder equipped with rotary drum that has eight fixtures attached to it; Besly double-ended machine; Badger double-spindle grinder.

H

HARBORS

TORONTO. Further Improvements to be Undertaken by Toronto Harbor Commissioners, J. G. Langton. Contract Rec. (Toronto), vol. 42, no. 22, May 30, 1928, pp. 580-581, 3 figs. Principal industries locating on harbor properties; tables set forth work accomplished to date.

HARDNESS TESTING MACHINE

NEW TYPE. A New Hardness Testing Machine. Engineer (Lond.), vol. 145, no. 3780, June 22, 1928, pp. 696-697, 3 figs. Details of simple form of machine for carrying out tests on number of articles simultaneously; it is patented invention of E. G. Herbert; principle of operation of "Cloudburst" machine is to "rain down" vast number of small hard steel balls from height adjustable to hardness requirements of particular ease upon whole surface under test.

HEAT CONDUCTIVITY

THERMAL. Thermal Conductivity Standards. Franklin Inst.—Jl., vol. 206, no. 5, May 1928, pp. 709-710. As part of co-operative programme with Celotex Co., attempt is being made to determine accuracy which can be expected from various devices in use for measuring thermal conductivity; number of test specimens have been prepared which may be termed thermal-conductivity standards and are being furnished to various institutions possessing hot-plate conductivity apparatus.

HIGH BUILDINGS

WIND STRESSES. Wind Stresses in Many-Storied Buildings, R. Fleming. Engineering (Lond.), vol. 125, no. 3254, May 25, 1928, pp. 625-628, 9 figs. Subject of wind resistance in tier buildings of many stories may be divided into three parts; wind pressure to be assumed, determination of stresses in structure due to assumed pressure, working or unit stresses to be used in proportioning members of structure.

HIGH-SPEED STEEL

MAGNETIC ANALYSIS. The Incremental Permeability Method for the Magnetic Analysis of High-Speed Steel, W. B. Kouwenhoven and J. D. Tebo. Am. Soc. Testing Matls.—Preprint, no. 31. for mtg. June 25, 1928, 19 pp. 11 figs.

HYDRO-ELECTRIC POWER DEVELOPMENTS

PROGRESS. Progress in Hydro-Electric Installations, Including Intakes, Leads, Tunnels, Dams, Headraces, Pipe-Lines and Tailraces, J. McLellan. Engineering (Lond.), vol. 125, no. 3258, June 22, 1928, pp. 786-787 and (discussion) 759. In 1920 total water power developed and in course of development throughout world was approximately 23,000,000 hp.; it is now approximately 35,000,000 and is increasing at rate of 1,500,000 hp. a year; size of installations has grown immensely. Abstract of paper read before Instn. Civil Engrs. See also Engineer (Lond.), vol. 145, no. 3780, June 22, 1928, pp. 680-681.

Progress and Trend in Hydraulic Power Development, H. A. Hageman. Universal Engr., vol. 47, no. 6, June 1928, pp. 33-36. Progress in hydroelectric development in past 25 years; more knowledge is available on characteristics of pipe lines, surge tanks, and transmission systems; examples of developed water powers operating in parallel with other prime movers; benefit of storage development; automatic hydroelectric stations.

CANADA. Hydro-electric Construction in Canada, Active and Prospective. Contract Rec. (Toronto), vol. 42, no. 22, May 30, 1928, pp. 557-560, 5 figs. $200,000,000 will be required for works under way or contemplated; large developments at present under construction reviewed by provinces.

BRITISH COLUMBIA. A Great Hydro-Electric Scheme for British Columbia, R. E. Turnbull. Water and Water Eng. (Lond.), vol. 30, no. 353, May 21, 1928, pp. 219-221, 1 fig. History of British Columbia Electric Railway Co.; existing power plants; need of Bridge River scheme; details of scheme; progress of work.

I

ICE PLANTS

MAINTENANCE AND REPAIR. Operation and Maintenance of Ice Manufacturing Plants, J. A. Hawkins. Ice and Refrig., vol. 74, no. 6, June 1928, pp. 543-544. First considers "Water"; must understand ammonia; condensing pressure; rate of harvesting an individual problem. Paper read before S. Calif. Assn. of Ice Industries.

INDUSTRIAL PLANTS

MAINTENANCE AND REPAIR. Maintenance of Shop Equipment, G. H. Ashman. Indus. Mgmt. (Lond.), vol. 15, no. 6, June 1928, pp. 206-208. Organization of maintenance department with discussion of various functions and responsibilities such as care of buildings, continuous inspection, building foundations, repairs, power, heat and light upkeep, storage of dies, patterns and jigs, safety devices. Abstract of paper presented before Am. Soc. Mech. Engrs.

INTERNAL-COMBUSTION ENGINES

HIGH-SPEED. The Internal Combustion Engine, H. R. Ricardo and G. Porter. Modern Transport (Lond.), vol. 19, no. 482, June 9, 1928, pp. 15 and 17. Brief review of papers dealing with light high-speed and heavy types presented before Instn. Civil Engrs.

Light High-Speed Internal-Combustion Engines, H. R. Ricardo. Engineering (Lond.), vol. 125, no. 3257, June 15, 1928, pp. 751-752 and (discussion) 727. Speed of engines is limited by (1) breathing capacity, (2) dissipation of heat from connecting-rod big-end bearings, and (3) mechanical operation of valves. Abstract of paper read before Instn. Civil Engrs.

OIL CORROSION. Oil and Corrosion, H. J. Young. Mar. Engr. and Motorship Bldr. (Lond.), vol. 51, no. 610, June 1928, pp. 206-207.

PISTONS, ALUMINUM ALLOY. Light Piston Alloys, H. Reimger. Automotive Abstracts, vol. 6, no. 6, June 20, 1928, p. 178. Attempts have been made to manufacture pistons from organic compounds probably similar to bakelite, etc., but have led to no results; aluminum and magnesium are still only basic materials; discusses different metals used for alloying with aluminum. Brief abstract translated from Motorwagen, Apr. 10, 1928, p. 217.

IRON

PHOTOELECTRIC PROPERTIES. The Photoelectric and Thermionic Properties of Iron, A. B. Cardwell. Nat. Acad. of Sciences—Proc., vol. 14, no. 6, June 15, 1928, pp. 439-445, 3 figs. Preliminary report of investigations on variation of photoelectric sensitivity of iron as it undergoes extended process of outgassing by heat treatment; effect of crystallographic changes on photoelectric sensitivity of thoroughly out-gassed iron; effect of crystallographic change on thermionic emission from outgassed iron and variation of long-wave-length limit through outgassing process.

IRON ALLOYS

NICKEL. The Influence of Nickel and Silicon on an Iron-Carbon Alloy, A. B. Everest, T. H. Turner and D. Hanson. Iron and Steel Industry (Lond.), vol. 1, no. 6, Mar. 1928, p. 194. Account of preliminary work on effect of nickel on simple iron-carbon-silicon alloys, over ranges of nickel between 0 and 40 per cent, and of silicon between 0 and 3.6 per cent. Abstract of paper read before Iron and Steel Inst.

IRON CASTING

GRAY. Ways to Improve Gray Iron Castings, R. Moldenke. Iron Age, vol. 121, no. 25, June 21, 1928, pp. 1747-1749. High strength of superheat or high-test irons points to recapture of lost markets; high malleability attainable also; superheating destroys graphite nuclei; hold superheated metal before pouring; composition of high-test irons; results of alloy additions; advances summarized.

IRON AND STEEL INDUSTRY

CANADA. Iron Smelting and Steel Making in Canada, F. W. Gray. Can. Min. Jl. (Gardenvale, Que.), vol. 49, no. 6, Feb. 10, 1928, pp. 125-128, 3 figs. In 1913 there were in Canada 22 blast furnaces, of which five had for some years been idle; in autumn of 1927 only four in blast; number and operating condition of Canadian blast furnaces in 1913, as given by Director of Mines Branch at Ottawa, and present conditions, as nearly as can be ascertained.

CONTROL INSTRUMENTS. Recording and Controlling Instruments in the Iron and Steel Industry, C. C. Eage and R. M. Walker. Iron and Steel Engr., vol. 5, no. 6, June 1928, pp. 263-277, 16 figs. Applications bearing upon metallurgical phase of industry; iron and coal mines and limestone-quarry applications; coke ovens and by-products department; blast-furnace department recording instruments employed are given in list; steel mill; producer-gas machines.

CHANGES IN. Iron Industry Facing Great Changes, E. C. Eckel. Iron Age, vol. 121, no. 24, June 14, 1928, pp. 1669-1671, 1 fig.

IRON AND STEEL PLANTS

OXYACETYLENE WELDING REPAIRS. Oxywelding Heavy Mill Engines. Iron Age, vol. 121, no. 25, June 21, 1928, p. 1751, 5 figs. Five halftones illustrating oxyacetylene welding and cutting repairs in steel mills, each accompanied by brief description.

ELECTRIC MOTORS. Service Records of Auxiliary Motors in the Steel Mills, A. C. Cummins. Gen. Elec. Rev., vol. 31, no. 6, June 1928, pp. 303-308, 9 figs. Detailed and accurate maintenance data essential to economical production; pre-mill-type, early-mill-type, and modern-mill-type motors; average service of bearings, armature coils, commutators, and shaft.

ENGLAND. Famous British Works. Iron and Steel Industry (Lond.), vol. 1, no. 9, June 1928, pp. 281-286, 6 figs. Description of Redcar Works of Dorman, Long & Co.; one of largest and most perfectly equipped rolling-mill installations in Great Britain; blast furnaces; coke ovens; steel works; soaking pits; cogging mill; 9-ft. 6-in. plate mill; handling plates; universal plate mill; sound edges and dead straightness.

TURBO-BLOWERS. Performance Data Should Include All Facts. Power Plant Eng., vol. 32, no. 12, June 15, 1928, pp. 668-669. In order to analyze properly performance of turbo-blower with its governing mechanism not only records of air pressure and air volume, but also records of steam pressure, steam temperature, vacuum, atmospheric temperature and atmospheric pressure should be available; faulty action of instruments affects readings.

J

JAPANNING OVENS

EXPLOSION PREVENTION. Oven Fires and Explosions, A. E. Maehler. Brass World, vol. 24, no. 16, June 1928, pp. 177-178, 2 figs. Steps taken to eliminate definitely cause of japan-oven fires and explosions.

JIGS

DESIGN. Boring, Facing and Tapping Fixture, B. J. Stern. Machy. (N.Y.), vol. 34, no. 11, July 1928, pp. 835-836, 1 fig. Fixture for use in finishing face and tapping pipe thread in hole of cast-iron pipe flange.

L

LIGHT AND LIGHTING

PSYCHOLOGICAL EFFECT. The Psychological Foundations of Light Perception and the Importance of a Psychological Theory of Lighting for Illumination Engineering (Die psychologischen Grundlagen der Beleuchtungswahrnehmung und die Bedeutung der psychologischen Beleuchtungslehre fuer die Lichttechnik), S. Krauss. Licht u. Lampe (Berlin), vol. 17, no. 11, May 31, 1928, pp. 385-390, 4 figs. Common ground of vision psychology and illumination engineering; laboratory experiments on light perception and tentative psychological theory of vision and lighting; German bibliography on subject.

LOCOMOTIVE BOILERS

NICKEL STEEL. Nickel Steel for Locomotive Boilers, C. McKnight. Boiler Maker, vol. 28, no. 6, June 1928, pp. 152-157, 7 figs. Possesses high strength and ductility; Canadian Pacific Railway locomotives; comparison of nickel and carbon steel plates; high-temperature characteristics of nickel steel; embrittlement in service; uniformity of nickel steel; corrosion and firebox cracks; boiler tubes and staybolts.

DESIGN. The Design and Proportion of Locomotive Boilers and Superheaters, C. A. Brandt. Ry. and Locomotive Eng., vol. 41, no. 4, Apr. 1928, pp. 101-105, 7 figs. Boiler design for increased locomotive capacity; efforts must be directed towards production of locomotive which will develop highest possible power per unit of total weight; discusses problems of boiler and superheater or steam-producing part of locomotive; boiler design; high steam pressures; water-tube firebox; superheater; results obtained with type E superheater. Abstract of paper presented to Can. Ry. Club.

LOCOMOTIVES

DEVELOPMENT. Latest Types of Steam and Internal-Combustion Locomotives, H. Fowler and H. N. Gresley. Engineering (Lond.), vol. 125, no. 3257, June 15, 1928, pp. 751 and (discussion) 726-727. Tabular data giving recent practice as regards express passenger and powerful freight locomotives; Schmidt-Henschel and Winterthur high-pressure locomotives; steam-turbine, Diesel, and Kitson-Still locomotives. Abstract of paper read before Instn. Civil Engrs. See also Ry. Gaz. (Lond.), vol. 48, no. 23, June 8, pp. 773-774 and 788, and Engineer (Lond.), vol. 145, no. 3779, June 15, pp. 656-657, and Motor Transport (Lond.), vol. 19, no. 482, June 9, pp. 11 and 20.

FEEDWATER HEATERS. Effect of the Feed-Water Heater on Overall Engine Efficiency, Railroad Herald, vol. 32, no. 7, June 1928, pp. 31-32, 2 figs. Effect of feedwater heater on boiler; effect of heater on overall engine performance.

FRAMES. A Novel Method of Frame Construction, L. L. Neebe. Baldwin Locomotives, vol. 7, no. 1, July 1928, p. 55, 2 figs. New method of locomotive frame construction, that eliminates splices between upper and lower front rails and main frames; shows old design of frame with bolted joints, and new design; both front rails are cast integral with main frame; after bolting to cylinder, rail is welded to main frame.

OIL BURNING, FIREBOXES. T. & P. Tests Special Firebox for Oil-Burning Locomotives. Ry. Age, vol. 84, no. 23, June 8, 1928, pp. 1324-1326, 4 figs. Comparative test runs with locomotive equipped with standard firebox shows nine per cent fuel saving; results of tests comparing Martin water-tables with firebox of conventional construction; installation provides additional features; table and firebox construction; circulation of water.

STEAM TURBINE. Report on Steam Turbine Locomotives. Ry. Mech. Engr., vol. 102, no. 6, June 1928, pp. 331-335, 5 figs. Proposed turbine-locomotive design; transmission; steam boiler; pulverized-coal burners; turbine and generator; condensers; feedwater heater, pump and injector. Abstract of report presented to Int. Ry. Fuel Assn.

VALVE GEARS (CAPROTTI). A Locomotive With Poppet Valves, A. Caprotti. Baldwin Locomotives, vol. 6, no. 3, Jan. 1928, pp. 67-68, 2 figs. Points out principal details of its construction; largest engines require no power reverse and cab lever is entirely free from all kicking.

LOOMS

BEARINGS. Comparative Performance of Looms with Plain and Roller Bearings, G. H. Perkins. Am. Soc. Mech. Engrs.—Textile Div. Paper, for mtg. May 22, 1928, 5 pp., 2 figs. Full text of paper, previously annotated from Textile World, May 26, 1928.

LUBRICATING OILS

PROPERTIES. The Viscosity-Gravity Constant of Petroleum Lubricating Oils, J. B. Hill and H. B. Coats. Indus. and Eng. Chem., vol. 20, no. 6, June 1928, pp. 641-644, 5 figs. Viscosity-gravity constant is low for paraffinic crudes and high for naphthenic crudes; its value for any oil is direct index of degree of paraffinic or naphthenic character which it possesses.

LUMBER UTILIZATION

POSSIBILITIES. Possibilities of More Complete Forest Utilization in the Lake States by Integration of Industries, R. D. Garver. Am. Lumberman, no. 2770, June 16, 1928, pp. 43 and 53. Integration schemes; improved methods of manufacture; suitability of waste as raw material; supply of raw material; business-organization side; closer correlation of lumber and pulp interests.

M

MACHINE TOOLS

FOR CENTRIFUGAL PUMPS. Machining Covers for Centrifugal Pumps, J. E. Fenno. Machy. (N.Y.), vol. 34, no. 11, July 1928, pp. 816-818, 4 figs. Tools designed for machining cast-iron volute covers; special tool holder and cam constructed to guide tool according to eccentricity and depth of groove; drill jigs.

IMPROVEMENTS. Machine Tools and Tools (Werkzeugmaschinen und Werkzeuge), Buxbaum. V.D.I. Zeit. (Berlin), vol. 72, no. 23, June 9, 1928, p. 790. Annual review of progress in design and construction of drilling, milling, grinding, shearing, punching, planing machines and tools, lathes, etc.

OBSOLESCENCE. Data on Machine Tool Obsolescence to be Sought in Survey, K. W. Stillman. Automotive Industries, vol. 58, no. 24, June 16, 1928, pp. 903-904, 1 fig. Machine-tool obsolescence considered of vital importance in enabling factories to take proper account of operating costs; ordinary depreciation write-off doesn't meet situation; individual investigations; difficult problem is development of method for using data for future protection and is one in accounting.

STANDARDIZATION. Reports of Divisions to Standards Committee—Production Division. Soc. Automotive Engrs.—Jl., vol. 22, no. 6, June 1928, pp. 719-725, 7 figs. Report submitted for approval after having been considered carefully by Division; tool-holder shanks and tool-post openings; terminology; taps, cut and ground threads; cylindrical plug and thread gauges; ring thread-gauges; line drawings and tables of dimensions given.

STEEL CASTINGS. Substitution of Steel Castings for Cast Iron in Machine Tool Construction, H. J. Hart. Am. Mach., vol. 68, no. 15, Apr. 12, 1928, p. 626. Electric steel castings run from 70,000 to 240,000 lb. per sq. in. in tensile strength, with toughness of elongation many times that of cast iron, generally showing ductility of 20 to 40 times that of cast iron; with steel castings it is quite possible to obtain annealed casting that can readily be worked and machined cheaply. See discussion by J. B. Armitage, E. Stubbs and B. P. Graves in June 28 issue of same journal.

MANGANESE STEEL

MACHINING. Progress in Machining Manganese Steel, A. S. Martin. Machy. (N.Y.), vol. 34, no. 11, July 1928, pp. 862-863, 3 figs. Examples of what is now being accomplished in way of machining cast and rolled manganese steel; proper tool angles, feeds, and speeds determined by experiments; shape of drill points for manganese steel; cutting keyways; shaping, planing and boring operations. (Continuation of serial.)

MATERIALS HANDLING

Cost Reduction. Effective Materials Handling Reduces Production Costs, H. V. Coes. Wire. vol. 3, no. 6, June 1928, pp. 201 and 204-205. Chicago wire manufacturer analyzes fundamental principles of material; handling for A.S.M.E.; sets down known facts, such as will guide to correct solution of materials-handling problem. and right use of materials-handling devices; quotes rules. Paper presented before Am. Soc. Mech. Engrs.

METAL WORKING INDUSTRY

Research. Research in Metal Working Industries. Am. Mach., vol. 68, no. 26, June 28, 1928, pp. 1041-1042. Summary of research policies of 187 "millionaire" manufacturing companies in metal-working industries; average expenditure for research is $68,300 per year; benefits of at least one-third of industrial research passed on to consumer in form of improved products; development of new fields for standard products is of major interest to 25 per cent of metal-working companies; profits of research.

METALS

Corrosion. Some Factors Involved in Corrosion and Corrosion-Fatigue of Metals, D. J. McAdam, Jr. Am. Soc. Testing Matls.—Preprint, no. 41, for mtg. June 25, 1928, 42 pp., 15 figs. Résumé of previous work; interaction of cyclic stress-range, number of cycles, and time, in causing penetration of steel under corrosion; effect of varying cyclic stress range, with constant time and number of cycles; effect of time and number of cycles on penetration of metal under corrosion; effect of diameter or thickness of specimen on corrosion-fatigue limit; torsional corrosion fatigue.

MINE TIMBER

Preservation. Preservation of Mine Timber, J. Foster. Colliery Eng. (Lond.), vol. 5, no. 52, June 1928, pp. 236-237, 4 figs. Brief account of Wolman system of timber impregnation.

MINES AND MINING

Aerial Exploration, Canada. Exploring the North Country. Can. Min. Jl. (Gardenvale, Que.), vol. 49, no. 21, May 25, 1928, pp. 425-426, 2 figs. North Country experiments in prospecting portend active season; most ambitious known as Northern Aerial Minerals Exploration, Ltd.; average wage prospector $150 a month with ten per cent interest; 40 to 50 prospectors by airplane to each base, with collapsible canoes and provisions; in event of important discovery other prospectors rushed by canoe to stake surrounding ground for organization.

What Canada's Mining Development Means to the Construction Industry, C. E. L'Ami. Contract Rec. (Toronto), vol. 42, no. 22, May 30, 1928, pp. 565-567, 5 figs. Huge building programme in North Country as result of present boom in mines; new towns are springing up that demand modern facilities; railways are rushing extensions into mining areas; millions of dollars are being spent.

Diesel Engines. The Use of Diesel Engines in Mining Operations, R. C. Rowe. Can. Min. Jl. (Gardenvale, Que.), vol. 49, no. 20, May 18, 1928, pp. 402-403, 3 figs. Source of mine power through medium of compressed air; driving milling plants either through medium of electricity or direct driven; Diesels and direct Diesel-driven compressors have now been brought down to reasonable weights; mines, using electrical energy for mining power, must have auxiliary plant to maintain main service of mine in case of current failure; for this purpose, Diesel plant is admirable.

MINING INDUSTRY

Quebec. Mining Development in Western Quebec in 1927, W. F. James. Can. Min. Jl. (Gardenvale, Que.), vol. 49 no. 6, Feb. 10, 1928, pp. 121-123, 4 figs. Important feature is increased prospecting; settlement is concentrated chiefly in vicinity of Osisko Lake; Rouyn and Noranda are estimated to have combined population of more than 5,000; large developed copper orebodies are Noranda Mines, Waite-Montgomery, Aldermac and Amulet; spectacular gold-bearing quartz veins in Cadillac township; discovery of chalcopyrite in Dufay township; most encouraging feature has been increase of public interest.

MOTOR BUSES

Specifications. Uniform Motor Bus Specifications Code. Can. Ry. and Marine World (Toronto). no. 364, June 1928, p. 367. Committee has formulated code of uniform motor-bus specifications, which has been submitted to 18 national organizations in United States for endorsement; code is divided into four parts; chief recommendations; part 4, really code proper, defines various types of motor buses.

MOTOR CARS (RAILROAD)

Gasoline-Electric. Gas-Electric Motor Cars as Applied to Steam Railroads, P. M. Gillilan. Ry. Age, vol. 84, no. 22, June 2, 1928, pp. 1273-1275, 1 fig.

Oil-Electric. Oil-Electric Motive Power on the Canadian National, C. E. Brooks. Ry. Age, vol. 84, no. 23, June 9, 1928, pp. 1319-1323, 3 figs. Influence of three years' operating experience on development of cars and locomotives driven by internal-combustion engines; cars equipped with 4-6- and 8-cylinder engines; 14 oil-electric car equipments in service on Canadian National system; effect of experience on design; details of problems encountered with engines, and how solved.

N

NATURAL GASOLINE INDUSTRY

Progress in. Progress of the Natural-Gasoline Industry for 1926-1927, H. B. Bernard. Petroleum (A.S.M.E. Trans.), vol. 50, no. 12, Jan.-Apr. 1928, pp. 3-5, 5 figs. In Seminole Field, air or gas lift used for producing oil and for producing oil and extracting gasoline with same equipment; use of superheated steam for power and process requirements; gas injection on two-cycle engines.

NITROGEN INDUSTRY

International Conference. The Nitrogen Conference on Adriatic. Chem. and Industry (Lond.), vol. 47, no. 22, June 1, 1928, pp. 575-577. Second International Nitrogen Conference took place from Apr. 30 to May 8, on board S.S. Lutzow; review of papers read covering subject of nitrogen economies and problems, nitrogen fertilizers, etc.

Heavy. Heavy Internal-Combustion Engines, G. Porter. Engineering (Lond.), vol. 125, no. 3257, June 15, 1928, pp. 752 and (discussion) 727. Abstract of paper read before Instn. Civil Engrs.

Standby Service. Oil Engines Serve Well for Standby Loads. Power Plant Eng., vol. 32, no. 12, June 15, 1928, pp. 670-672, 3 figs. Low standby loss, high efficiency of operation and rapid starting ability make oil engine well suited as auxiliary in large stations.

O

OIL ENGINE CASTINGS

Oxyacetylene Welding. Oxy-Acetylene Welding of Oil Engine Castings. Can. Machy. (Toronto), vol. 39, no. 10, May 17, 1928, pp. 38 and 40. 1 fig. Problems involved in welding large complicated gray-iron castings such as are used in oil engines consist mainly in controlling heat of welding operations so that there will be no warping out of true nor cracking due to internal stresses; casting generally preheated over its entire mass; internal stresses; welding equipment; important preparation; weld must penetrate; welding with bronze.

OIL FUEL

Synthetic. Liquid Fuels Other Than Petroleum, A. E. Dunstan and H. G. Shatwell. Inst. Fuel—Jl. (Lond.), vol. 1, no. 3, Apr. 1928, pp. 262-268 and (discussion) 268-271. Full text of paper previously annotated from Instn. Petroleum Technologists—Jl., Feb. 1928.

OIL TANKS

Design. Design of Pressure Vessels for Oil, T. Mc. Jasper. Oil and Gas Jl., vol. 27, no. 4, June 14, 1928, pp. 128-129, 6 figs. Strength of steel; resistance of corrosion; resistant lining; conditions for testing; effect of temperature; effect of shape of heads and lack of reinforcement; vessel design; test results; correct shape of head; ductile leak proof joint. Paper presented before Western Petroleum Refiners' Assn.

OPEN HEARTH FURNACES

Refractory Materials. Refractories and the Open-Hearth, J. R. Miller. Blast Furnace and Steel Plant, vol. 16, no. 6, June 1928, pp. 807-808. Severe conditions of service at vital points make refractory problem one involving not only material quality but utmost care on part of user; run of furnace is determined by life of roof; front-wall failure; high-temperature currents; joints and air filtration; furnace life and production.

Silica Brick. Silica Brick in the Open-Hearth Furnace, B. M. Larsen. Blast Furnace and Steel Plant, vol. 16, no. 6, June 1928, pp. 803-807, 6 figs. Investigation of changes that take place in silica brick under conditions that are met with in service, particularly in open-hearth roof; forms of silica; recrystallization in silica brick; immiscibility in silicate systems; kinds of wear or deterioration of roof brick; causes of spalling in roof blocks; seasoning of roof brick by flux saturation and recrystallization.

ORE TREATMENT

Flotation. The Trend of Flotation, A. J. Weinig and I. A. Palmer. Colo. School of Mines Quarterly, vol. 23, no. 2, Apr. 1928, 90 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.

Flotation Reagents. Flotation Reagents, A. F. Taggart. Min. and Met., vol. 9, no. 258, June 1928, pp. 257-261, 4 figs. Historical notes; frothing agents; collection of froth differs from Elmore process; dynamic force of bubbles; chemical collecting agents; surface tension; water-avid and water-repellent properties; solubility and structural formulas as guides to selection of organic reagents; control of slime movement; behavior of some reagents resembles chemical affinity.

OXYACETYLENE WELDING

Application. Welding and the Engineer, C. A. Daley. Welding Engr., vol. 13, no. 6, June 1928, pp. 41-43. Survey of oxyacetylene welding and cutting processes which are of particular interest to civil engineers; oxyacetylene welding and cutting as applied to railroad maintenance; frog welding; switch point welding; structural steel cutting; cutting under air pressure; contractor equipment easily repaired; bridge repair; pipe welding. Paper read at joint meeting of Am. Soc. of Civil Engrs. and Am. Welding Soc.

P

PAINT SPRAYING

Hazards. Spraying Troubles. Labor and Industry, vol. 15, no. 5, May 1928, pp. 3-10, 2 figs. Discussion of some factors in spray finishing which involve danger of explosion and fire, and means of preventing accidents.

PAPER RESEARCH LABORATORIES

Iowa. An Outstanding Paper Research Laboratory, L. K. Arnold. Paper Industry, vol. 10, no. 3, June 1928, pp. 446d-446f, 4 figs. Iowa State College, Ames, Iowa, laboratory equipped not only with small-scale research equipment, but with large semi-commercial unit for production of wallboard; research equipment; semi-commercial unit; laboratories of department are also equipped with much small-scale equipment such as is used in paper mills.

PAVEMENTS, CONCRETE

Construction. California Job Shows Modern Methods of Concrete Pavement Construction. Concrete, vol. 32, no. 6, June 1928, pp. 13-16, 8 figs. Proportioning aggregates by weight or volume; design mix using three sizes of coarse aggregate; graded aggregates taken from commercial central batching plant; "weakened plane" joints; joint-construction details; longitudinal float finishing.

Specifications. Strength Specification Concrete for Street Paving, F. A. Hess. Eng. News-Rec., vol. 100, no. 25, June 21, 1928, pp. 968-969, 1 fig. Unusual water-cement ratio requirements caused little additional work and no additional cost; at Mundelein, Ill., minimum compressive strength was specified; ratio of coarse to fine aggregate specified.

PETROLEUM

Production Methods. Progress in the Production of Oil, H. R. Pierce. Petroleum (A.S.M.E. Trans.), vol. 50, no. 12, Jan.-Apr. 1928, pp. 1-2.

Refining. Progress in Refining, W. Samans. Petroleum (A.S.M.E. Trans.), vol. 50, no. 12, Jan.-Apr. 1928, pp. 6-9. Governing factor in progress is supply and demand; savings possible in manufacture; construction and engineering problems; various processes in vogue; developments in manufacture and use of steam and power; research work under way.

Transportation. Development of Transportation of Crude Oil in 1927, B. P. Sibole. Petroleum (A.S.M.E. Trans.), vol. 50, no. 12, Jan.-Apr. 1928, pp. 5-6. Conservation has been keynote in transportation of crude oil, especially by pipe line; gathered from wells by pipe lines; while small portion is carried to delivery or tidewater by tank cars, most of it goes on to such delivery by pipe line; conservation of oil; conservation of equipment; economy in movement.

PIPE, STEEL

Arc Welding. Electric Welding of Pipe Lines, J. D. Wright. Am. Inst. Elec. Engrs.—Jl., vol. 47, no. 6, June 1928, pp. 407-410, 10 figs. Outlines process of manufacture of steel pipe from flat rolled steel plates by automatic metallic arc welding; data are given showing physical and chemical analysis of plate, weld, and welding wire, as well as speed of welding and electrode and power consumption.

PLASTICS

Properties. The Effect of Mechanical Working on the Plastic Properties of Materials. O. Manfred and J. Obrist. Plastics, vol. 4, nos. 3, 4 and 5, Mar., Apr. and May 1928, pp. 131-135, 189-190 and 209-210, and 252-253 and 270. 7 figs. Mar.: Optical structure of plastic materials; commercial plasticizing methods; extrusion; use of cones; loose spheres. Apr.: Differences in structure of various products is explained, using modern casein solids as examples. May: Similarity in effects of drawing and cold working of metals and plastification of raw materials employed in plastics.

PLATE MILLS

ELECTRIC DRIVE. The New 84-in. Tandem Plate Mill of the Lukens Steel Company, J. H. McElhinney and W. H. Burr. Gen. Elec. Rev., vol. 31, no. 6, June 1928, pp. 297-302, 14 figs. General description of plant and products; electric equipment; roughing and finishing mills; heat-treating and charging operations; finishing processes in plate production.

PLOWS

BOLTS, STANDARDS. Plow Bolts. Mech. Eng., vol. 50, no. 7, July 1928, pp. 565, 1 fig. Tentative American Standards for Plow Bolts was approved in Apr. 1928, by American Eng. Standards Committee; this standard was developed by Sectional Committee on Standardization of Bolt, Nut, and Rivet Proportions; reproduces typical page of standard plow bolts.

ELECTRIC. Some Observations Regarding the Use of the "Electric Plow," T. A. Wood. Elec. West, vol. 60, no. 7, June 1, 1928, p. 607. Charging plowed soil with 500,000-cycle, 104-kv. energy apparently kills insect life and weeds; during summer of 1927 plow was used on test fields of buckwheat and potatoes; electric discharges in soil and air create considerable ozone; possibilities of this method of soil treatment.

PORT TERMINALS

OPERATION. Marine Terminal Operation, W. C. Brinton. Pac. Mar. Rev., vol. 25, no. 6, June 1928, pp. 250-251. Suggestions for reduction of costs at that point in steamship operation where waste is most apparent and economy is least stressed; relatively few men in terminal operations of shipping companies with mechanical training, not to mention engineering education; few trenchant remarks on sorting evil; packages. Excerpts from paper presented before Matls. Handling Division of Am. Soc. Mech. Engrs.

PORTS

MONTREAL. The Port of Montreal, L. Chalmers Tombs. Dock and Harbour Authority (Lond.), vol. 8, nos. 89 and 91, Mar. and May, 1928, pp. 138-142 and 204-207, 2 figs. Apr.: History and facilities of great inland harbor; railways; trade; flour; packing-house products; butter; cheese; livestock; pulp and paper; automobiles; specimen export cargoes. May: Freight rates and charges; port charges; exceedingly reasonable, in fact lower than at many other ports; north Atlantic steamship conference; advantages of system. (To be continued.)

PRINCE RUPERT, B.C. Prince Rupert Harbour. Dock and Harbour Authority (Lond.), vol. 8, no. 91, May 1928, pp. 201-203, 8 figs. Growing British Columbian fishing port; natural harbour; there are eight wharves; natural outlet; fisheries; cold-storage plant; lumbering and logging; pulp possibilities; transportation.

POWER PLANTS

ELECTRIC, SUBSTATIONS. Non-Supervised Substations, S. J. Spurgeon. Elec. World, vol. 91, no. 22, June 2, 1928, pp. 1145-1149, 9 figs. Economic and public relations considerations; steel structures for 22-kv.. and 44-kv., used by Alabama Power Co. are simple in design and operation.

ENGINEERING. How the Power Engineer Serves the Industrial Plant, T. R. C. Flint. Elec. News (Toronto), vol. 37, no. 11, June 1, 1928, pp. 41-43. Object of central-station power engineer is to eliminate waste, improve efficiency and power factor, and generally decrease operating costs for consumer; power-factor difficulty; reduced load gives poor power factor; increasing heating load; real industrial-heating service.

HEAT BALANCE. A Method for Calculating Central Station Heat Balance, E. B. Hyde, Jr., and M. A. Guigou. Power, vol. 68, no. 1, July 3, 1928, pp. 12-17, 16 figs. Article presents simplified method of calculating heat balance for proposed power station, indicates data required, and tells how to obtain it; finding amount of steam taken by turbines; heat-balance calculations.

HOTELS. New York's Largest Hotel to Generate Power and Burn Pulverized Fuel. Power, vol. 67, no. 25, June 19, 1928, p. 1122, 1 fig. Forty-four storey "New Yorker" now under construction will install four boilers with unit pulverizers and 2,200-kw. of generating capacity; boilers will be horizontally fired.

HYDROELECTRIC. Possible Improvements in Design to Reduce Cost of Hydro-Electric Projects, L. F. Harza. Power, vol. 67, no. 22, May 29, 1928, pp. 991-992, 1 fig. Generators built by welding structural shapes are being used as economy in construction; hydroelectric station is best suited for operation on peak load.

HYDROELECTRIC, AUTOMATIC. Automatic and Semi-Automatic Hydro Plants of Pacific Gas and Electric Company, E. F. Maryatt. Elec. West, vol. 60, no. 6, May 15, 1928, pp. 428-435, 6 figs. Hydraulic features; plant equipment; hydraulic turbine controller and shutdown device; butterfly-valve control; emergency overspeed shutdown; automatic operation of plant; operation sequence; protective features; preceding developments. Committee report to Pacific Coast Elec. Assn.

HYDRO-ELECTRIC, KENTUCKY. Hydro-Electric Plant Built on High Piers, L. F. Harza. Power, vol. 67, no. 26, June 26, 1928, pp. 1132-1133, 2 figs. Four miles distant and operating in water synchronism with Dix River station, new 2,000-kw. hydro station at Dam No. 7 on Kentucky River, makes available additional 15-ft. head; three generating units and auxiliaries housed in low buildings mounted on high piers; automatic float control of propeller-type turbines provides for operation at gate opening, giving best efficiency.

HYDROELECTRIC, QUEBEC. The Upper Saguenay a Big Power and Industrial Centre. Elec. News (Toronto), vol. 37, no. 12. June 15, 1928, pp. 58-65, 32 figs. Hydro plant of 540,000 hp. operating; second plant of more than million hp. under construction; modern pulp and paper mills; aluminum production on tremendous scale; Chute-a-Caron; Arvida and Aluminum.

STEAM, COAL TESTING. Selecting Coal by Actual Test. Eng. Times (Toronto), vol. 1, no. 20, May 16, 1928, p. 1, 1 fig. Cost per thousand pounds of steam and capacity developed are two determining factors in selecting coal; average fuel cost per thousand pounds of steam for entire year was approximately 26 cents; table of economy test of coal.

POWER PLANTS, HYDROELECTRIC

EQUIPMENT. Hydraulic Power Plants and Machinery (Wasserkraftmaschinen und-Anlagen), Oesterlen. V.D.I. Zeit. (Berlin), vol. 72, no. 23, June 9, 1928, pp. 776-777, 1 fig. Annual review of progress in design and construction of propeller and Kaplan turbines, Francis turbines, waterwheels; pumped storage plants.

MARYLAND. Construction Problems, W. L. Locke. Stone and Webster Jl., vol. 42, no. 6, June 1928, pp. 827-838, 5 figs. General scheme of constructing Conowingo developments; master progress chart was prepared; transportation is keynote to all operations such as Conowingo; water diversion was major problem; traveling derrick which erected structural steel in power station.

POWER PLANTS, STEAM

DESIGN. Prospective Development in the Generation of Electricity and its Influence on the Design of Station-Plant, S. L. Pearce. Engineering (Lond.), vol. 125, no. 3257, June 15, 1928, pp. 753-754 and (discussion) 728-729, 2 figs. Abstract of paper read before Instn. Civil Engrs.

The Trend of Power Plant Design, F. H. Daniels. Blast Furnace and Steel Plant, vol. 16, no. 6, June 1928, pp. 790-793, 5 figs. Increased boiler pressures and higher degrees of superheat in modern installations have brought about improvements in design of boiler settings and in methods of burning fuel; types of stokers for various fuels; controlling air for combustion; progress in burning of pulverized coal.

HIGH PRESSURE. Operating Experiences with 1300-Pound Steam Pressure, J. Anderson. Inst. Fuel- Jl. (Lond.), vol. 1, no. 2, Jan. 1928, pp. 131-149 and (discussion) 149-160, 18 figs. Full text of paper previously annotated from Engineering, Jan. 6 and 13, 1928.

POWER PLANTS, STEAM ELECTRIC

EQUIPMENT, PURCHASING. Competitive Purchasing and Evaluation of Proposals for Power-Plant Equipment, L. B. Bonnett. Mech. Eng., vol. 50, no. 7, July 1928, pp. 521-522. Describes procedure employed by Brooklyn Edison Co., which it is believed encourages manufacturers to propose best equipment they know how to build; it is believed to result in fairest judgment of merits of different proposals and therefore in purchase of most satisfactory equipment for physical conditions which have to be met.

PULVERIZED COAL

DEVELOPMENTS. Pulverized-Fuel Developments in the United States, L. M. Jockel. Elec. Rev. (Lond.), vol. 102, no. 2637, June 8, 1928, pp. 1013-1014. Notes from serial report of Prime Movers Committee of N.E.L.A.; facts relating to successes and to failures; details as to furnace walls, preheaters, burners, etc., are stated in tables; valuable information relating to operation and maintenance of various plants; report contains useful proximate analyses of various coals used, which are generally high grade bituminous varieties.

PUMPING STATIONS

AUTOMATIC CONTROL. Automatic Control for Water Pumping, H. A. Tolburg. Elec. World, vol. 91, no. 22, June 2, 1928, pp. 1152-1153, 5 figs. Pumping plant of new municipal water plant for city of Monmouth, Ill.; includes two deep-well turbine pumps, two 3-in. horizontal centrifugal service pumps, one 6-in. horizontal centrifugal fire pump, all pumps being driven by 2300-volt, slip-ring induction motors; automatic features are controlled by pressure regulators and float switches placed in reservoir and on distribution system.

MILWAUKEE, WIS. New Pumping Equipment for Milwaukee Water-Works, H. H. Brown. Eng. News-Rec., vol. 100, no. 22, May 31, 1928, pp. 843-845, 3 figs. Deals with three new 400-hp. 2-pass boilers and new 40-m.g.d. steam-turbine-driven centrifugal pump; shows progress that is being made in Milwaukee water-works.

PUMPS

AIR LIFT, AUTOMATIC. Applications of the Hydrautomat. Power Engr. (Lond.), vol. 23, no. 267, June 1928, pp. 241-242. Basic principles of hydrautomat as air compressor and air extractor; compressed air is produced when water falls down vertical pipe from upper reach into closed tank, drawing air with it through small pipes; by combining compressor and aspirator, equipment is made practically independent of variations in level of head and tail races; overall efficiency is from 50 to 60 per cent; hydrautomat has no wearing parts and needs no attention. Abstract translated from Génie Civil, Apr. 7, 1928, p. 335.

PYREX

DIELECTRIC PROPERTIES. Dielectric Data on "Pyrex," C. L. Dawes and P. H. Humphries. Elec. World, vol. 91, no. 25, June 23, 1928, pp. 1331-1332, 8 figs. Tests of material over wide range of frequency and temperature establish standard of comparison for dielectrics exhibiting ionization and hysteresis lag.

R

RADIO

ATMOSPHERIC CONDITIONS. Some Correlations of Radio Reception with Atmospheric Temperature and Pressure, G. W. Pickard. Inst. Radio Engrs.—Proc., vol. 16, no. 6, June 1928, pp. 765-772, 9 figs. Correlation between night reception and pressure was found; signal strength increasing as areas of low pressure passed over receiver and decreasing with passages of high pressures; meteorological relations, particularly those with temperature and pressure; two series of reception measurements were available for comparison.

RADIO TRANSMISSION

SHORT WAVE. Beam Transmission of Ultra Short Waves, H. Yagi. Inst. of Radio Engrs.—Proc., vol. 16, no. 6, June 1928, pp. 715-741, 38 figs. Description of various experiments performed at wavelengths below 200 cm.; effect of earth and various types of inductively excited antennas; discussion of beam and horizontally polarized radiation; magnetron tubes used for production of very short wavelengths as low as 12 cm.; circuit arrangements employed; effect of variation of plate voltage, magnetic field strength and other factors on high-frequency output.

RAILROADS

CURVES, CHANGING. Determining the Throw for a Curve, C. H. Bartlett. Ry. Engr. and Maintenance, vol. 24, no. 6, June 1928, pp. 258-261, 2 figs. Explanation of steps entering into selection of ordinates for revision of alignment; methods of compounding curve; spirals for operation at fixed speed; discussion of spiral; relation of spirals to grade lines and to direction of traffic.

REPAIR SHOPS, HEAT TREATING. Heat Treating Methods and Equipment for Railroad Shops. Ry. and Locomotive Eng., vol. 41, no. 4, Apr. 1928, pp. 113-114. Suggestions on preheating; manufacture and repairs to high-speed machine tools; chisels, caulking and similar tools; and reamers, taps, rivet sets, etc. Committee report to Am. Ry. Tool Foremen's Assn.

SIGNALS AND SIGNALING. Automatic Signals Reduce Operating Costs on Double Track. Ry. Age, vol. 84, no. 22, June 2, 1928, pp. 1291-1292, 2 figs. Big Four eliminates five of nine manual block stations with cross-over interlockings on 60-mile double-track section; explains why change was benefit.

SIGNALS AND SIGNALING, INTERLOCKING. Rock Island Completes 33-Lever Electric Interlocker, J. H. Molloy. Ry. Signaling, vol. 21, no. 6, June 1928, pp. 220-223, 6 figs. Plant in Chicago terminal relieves five switchtenders; storage battery used for track circuits; special circuits for dwarf signals; facilitates handling of traffic in busy Rock Island-New York Central joint terminal zone in Chicago; type of machine and control; switch operation and indication; interlocking tower is 15 by 34 ft. in size and two storeys high, with English basement; two types of wire distribution used.

TRACKS, CONCRETE BASE. Is Concrete Better Than Cross-Ties? F. D. McHugh. Sci. Am., vol. 139, no. 1, July 1928, pp. 54-55, 6 figs. Test section of rigid concrete slab roadbed on quarter-mile stretch of Pere Marquette, used for year, indicates certain advantages over ballasted track.

RAILS

CHROMIUM STEEL. Chromium Steel Rails, T. Swiden and P. H. Johnson. Iron and Steel Can. (Gardenvale, Que.), vol. 11, no. 6, June 1928, pp. 174-176. Influence of reheating and cooling in air; influence of simple heat treatment; typical carbon-steel rails; service reports on chromium-steel rails; chromium-steel fishplates. Abstract of paper read before Iron and Steel Inst.

RAILS, STEEL

RESEARCH. Fatigue Resistance of Rail Steel, J. R. Freeman, Jr. Iron Age, vol. 121, no. 25. June 21, 1928, pp. 1743-1745, 3 figs. Discussion of test data secured from Bureau of Standards investigations of comparative properties of rails made from rising steel in standard big-end-down ingot moulds and rails from fully piping (killed), steel made in big-end-up sinkhead ingot endurance ranges from 46,000 to 59,000 lb. per sq. in.; rail steel killed with aluminum can be poured free from pipe and excessive segregation in sinkhead moulds of Gathmann type.

REFRACTORY MATERIALS

PROBLEMS. The Problem of the Refractory. Eng. and Boiler House Rev. (Lond.), vol. 41, no. 12, June 1928, pp. 590 and 593. Author attempts to state point of view of progressive manufacturer of refractories; conditions which tend to destroy refractories in actual service fall mainly under two headings; erosion by fuel slag, clinker, dust-carrying gases or other fluxes and problem of spalling and cracking in service.

REFRIGERATING PLANTS

CORROSION. Corrosion in Refrigerating Plants. Refrig. World, vol. 62, no. 6, June 1928, p. 23. For calcium-chloride brine; open brine systems; condenser systems. Technical staff of Mass. Inst. Tech. submitted recommendations to Am. Soc. Refrig. Engrs.

REFRIGERATION

PROGRESS. Refrigerating Engineering (Kaeltetechnik), R. Plank. V.D.I. Zeit. (Berlin), vol. 72, no. 23, June 9, 1928, pp. 780-781. Brief annual review of progress in design and construction of refrigerating plants; applications of refrigeration.

REFUSE AS FUEL

UTILIZATION. The Utilization of Town's Refuse and Refuse Fuels, A. B. Scorer. Inst. Fuel—Jl. (Lond.), vol. 1, no. 3. Apr. 1928, pp. 288-296 and (discussion) 296-300. Full text of paper previously annotated from Surveyor (Lond.), Jan. 20, 1928.

RIVERS

ST. LAWRENCE. The St. Lawrence Waterway, W. Kelly, E. A. Forward and J. P. Hogan. Mech. Eng., vol. 50, no. 7, July 1928, pp. 509-512, 3 figs. Symposium dealing with waterway itself and with its power and navigation potentialities; first paper gives particulars of waterway and its five sections of improvements recommended by Joint Board of Engineers of United States and Canada and of ice conditions which will have to be overcome; second paper deals with transportation problems, character of traffic, improvements necessary; in third paper estimates are made of cost of generating power at most favorable site, and questions involved in problem of marketing power are discussed.

IMPROVEMENT, ST. LAWRENCE. St. Lawrence River Dredging, Water Levels, Etc. Can. Ry. and Marine World (Toronto), no. 364. June 1928, p. 370. Department has designed, and proposes to construct, 7 submerged weirs in St. Lawrence River between Montreal and Sorel to provide greater depth of water in Montreal harbor; proposed location of weirs.

ROAD MATERIALS

TESTING. Report of Committee D-4 on Road and Paving Materials. Am. Soc. Testing Matls.—Preprint, no. 73, for mtg. June 25, 1928, 34 pp., 1 fig. Proposed revisions of existing tentative specifications; proposed tentative methods of abrasion testing of gravel; proposed specifications for concrete pavements and bases; proposed tentative recommended practice for bituminous paving-plant inspection.

ROADS

NEW BRUNSWICK. New Brunswick Spending More than $3,000,000 for Further Improvement of Highways System, J. D. Black. Contract Rec. (Toronto), vol. 42, no. 22, May 30, 1928, pp. 585-588, 1 fig. New high figures for expenditure in any one year from provincial funds for roads and bridges; nine contracts for rebuilding 65 mi. of trunk highways in seven counties already awarded and many bridges being replaced by modern structures to take care of rapidly increasing automobile traffic.

ONTARIO. $7,000,000 for Ontario Provincial Highways, G. S. Henry. Contract Rec. (Toronto), vol. 42, no. 22, May 30, 1928, pp. 582-583. This year's programme of Ontario department of Public Highways contemplates extensive grading and paving work; one large bridge and several smaller ones.

Important Road Projects in Northern Ontario, J. Sinton. Contract Rec. (Toronto), vol. 42. no. 22, May 30. 1928, pp. 583-584. Ontario Department of Northern Developments has several major schemes in hand as well as general improvement and maintenance of 12,500 mi. of roads in north.

SURVEYING. Accuracy in Highway Surveys Should be Consistent with Purpose, W. H. Spindler. Highway Mag., vol. 19, no. 6, June 1928, pp. 152-153, 1 fig. Rules indicating requirements of one district state highway office in Illinois for preliminary surveys for paving and grading; distances; centre-line distances; other distances; preliminary levels; check levels; curves; intersection angle; degree of curve; deflections; important measurements in preliminary surveys.

RUBBER

RESEARCH. Effects of Temperature and Humidity During the Preparation and Testing of Rubber Compounds. Franklin Inst.—Jl., vol. 206, no. 5, May 1928, pp. 719-720. Abstract of report by physical testing committee of rubber division of American Chemical Society; report presents complete data and final conclusions based on investigation conducted at Bureau of Standards in accordance with programme drawn up by physical testing committee.

RUBBER FACTORIES

MATERIALS-HANDLING. Cutting the "Hidden Cost" of Handling Materials. Can. Machy. (Toronto), vol. 39, no. 11, May 31, 1928, pp. 44 and 46 and 48 and 50, 6 figs. Few ideas taken from plant of Gutta Percha and Rubber Ltd., in Toronto; trucking accomplished by several gas and electric lift trucks, and yard auto truck; all trucking is done by service department; hoist and monorail system; escalator; delivering material to each worker at rate at which he can use it.

S

SEWAGE DISPOSAL

ACTIVATED SLUDGE METHOD. Bulking of Activated Sludge, W. Scott. Pub. Works, vol. 59, no. 6, June 1928, p. 228. English investigation indicates it is due to constituents of sewage and not to under or over-aeration; describes result of investigation into cause of bulking of activated sludge. Abstract of paper read at Assn. of Mgrs. of Sewage Disposal Works of England.

SEWAGE DISPOSAL PLANTS

OPERATION. Schenectady Sewage Plant Operation. Pub. Works, vol. 59, no. 6, June 1928, pp. 223-225. Details of 1927 experiences; hosing gas-vent scum reduced; spring operation of Imhoff tanks; chlorinating sewage; sludge as fertilizer; animal life in trickling filters.

SEWAGE TREATMENT

METHODS. Novel Sewage Treatment Methods in Small Plant. Pub. Works, vol. 59, no. 6, June 1928, pp. 246-248, 5 figs. Modified Imhoff tank with sprinkling filter and cylindrical sludge-digestion tank, with capacity of 250,000 gal.; sprinkling filter without side walls; plant serves Gaithersburg and Washington Grove, Md.

SEWERAGE

RUN-OFF. Sewerage, With Special Relation to Run-Off, J. B. L. Meek. Engineering (Lond.), vol. 125, no. 3258, June 22, 1928, pp. 789-790 and (discussion) 760-761, 6 figs. Several areas differing in character and population were selected for experiment; all inlets to sewers in each area were traced, in order to be certain that only drainage from selected area was entering sewer; rainfall was gauged by means of automatic recorder, and quantity falling was compared directly with run-off. Abstract of paper read before Instn. Civil Engrs. See also Surveyor (Lond.), vol. 73, no. 1899, June 15, 1928, pp. 647-648, 6 figs.

SHIP PROPULSION

SUPERHEATED STEAM. The Generation and Utilization of High-Pressure Superheated Steam for Marine Propulsion, Weir and H. E. Yarrow. Engineering (Lond.), vol. 125, no. 3256, June 8, 1928, pp. 721 and (discussion) 701. From thermodynamic aspect, there is no maximum limit to temperature which might be used, but there is practical limit fixed by nature of materials available; corrosive and erosive effects of working fluid are tensified by high temperature, but definite limitations are imposed in main by weakening influence of temperature on constructional materials in use. Abstract of paper read before Instn. Civil Engrs. See also Engineer (Lond.), vol. 145, no. 3778, June 8, 1928, p. 627.

SHIPS

REFRIGERATION. Nine New Modern Steamships Refrigerated, J. D. Blanke. Ice and Refrig., vol. 74, no. 6, June 1928, pp. 537-542, 20 figs. Net insulated space capacity of 510,000 cu. ft.; refrigeration of all space is effected by brine circulation; insulation in these ships consists of wood linings and granulated cork on panel system; refrigerating machinery in duplicate; capacity of carbon-dioxide machinery system; control of brine system.

New Experiments on the Refrigerating Plants of Merchant Vessels, E. Goos. Information on Refrigeration (Institut Int. du Froid)—Monthly Bul., vol. 8, no. 12, Dec. 1927, p. 1141. On board ships, in majority of carbon-dioxide machines, leather linings of stuffing boxes have been replaced by cast-iron segments or metallic linings; double pipe liquefiers are used, internal tube of which, in contact with seawater, is lined with 1.5 to 2 mm. of copper; recently Raschig rings have been utilized for damp refrigerators. Abstract translated from Werft-Reederei-Hafen, 1926, no. 4, p. 7.

SILT DEPOSITS

PREVENTION. Prevention of Silt Deposits in Conduits. Elec. West, vol. 60, no. 6, May 15, 1928, pp. 396-406, 12 figs. Transportation of debris by flowing water; suspension; theoretical settler design; types of settlers in use; tests on Kern River no. 3 settling basin; method of analyzing samples. Committee report to Pac. Coast Elec. Assn.

SMOKE ABATEMENT

PUBLIC HEALTH. Relation of Some Combustion Problems to Public Health, S. W. Parr. Iron and Steel of Can. (Gardenvale, Que.), vol. 11, no. 6, June 1928, pp. 178-180. Smoke evil; brief analysis of situation; sanitation of air.

STAINLESS STEEL PROPERTIES

CORROSION RESISTING. The A-B-C of Corrosion Resisting Steels, F. R. Palmer. Chem. and Met. Eng., vol. 35, no. 6, June 1928, pp. 364-365. Critical comment by W. Mitchell on article in March issue of same journal; includes reply by Palmer.

STEAM ACCUMULATORS (RUTHS)

HAMBURG, GERMANY. An Electric Railway Stores Steam, W. Mattersdorff. Power, vol. 68, no. 1, July 3, 1928, pp. 8-9, 4 figs. Modern steam accumulator displaces storage batteries and banked boilers at Hamburg Elevated Railway Plant; boiler equipment; two Ruths accumulators installed; method of governing turbine is illustrated; instances illustrate how functioning of accumulator offsets service troubles.

STEAM CONDENSERS

SCALE PREVENTION. Scale Prevention in Surface Condensers (Kühlwasser-im pfung), Eschmann. Wärme (Berlin), vol. 51, no. 14, Apr. 7, 1928, pp. 269-272, 7 figs.

STEAM ENGINES

BLEEDING. New Design for Bleeding Steam Reduce Industrial Power Costs. Power, vol. 67, no. 22, May 29, 1928, pp. 972-975, 5 figs. Bleeder-type engines in general comprise control mechanism to furnish automatically desired amount of heating steam as function of its pressure; problem of incorporating bleeding mechanism in uniflow engines.

STEAM, HIGH PRESSURE

EFFICIENCY. Higher Steam Pressures and Temperatures. Nat. Elec. Light Assn.—Serial Report of Prime Movers Committee, June 1928, 38 pp., 36 figs. Economy; station thermal efficiency; turbine efficiency ratio; auxiliary power requirements; economy considerations; design and operating features; actual operating experiences; design considerations; manufacturers' statements; study of reheat economies; some effects of reheating on station economy.

UTILIZATION. Use of High Pressures and Superheat (Emploi des hautes pressions et surchauffes), Duberstret. Société des Ingénieurs Civils de France (Paris)—Memoirs, vol. 81, nos. 1 and 2, Jan. and Feb. 1928. pp. 219-265, 39 figs. partly on supp. plates. Review of principal theories and applications; superheating; projects and plants and description of turbines; conclusions.

STEAM PIPE

HIGH PRESSURE, FITTINGS. Valves and Fittings for High Pressure Steam Piping, F. H. Morehead. South. Power Jl., vol. 46, no. 6, June 1928, pp. 65-72, 19 figs.

STEAM PIPE LINES

JOINTS. Pipe Joints that Will Hold at High Pressures and Temperatures, I. W. Whittle. Power, vol. 67, no. 24, June 12, 1928, pp. 1051-1052, 3 figs. Weld-sealed pipe joints for high steam pressures and temperatures insure both tightness and strength; these joints may take many forms, each having its advantages.

STEAM TURBINES

MULTIPLE-CYLINDER. Multi-Cylinder Steam Proc. (Rugby), vol. 22, 1927-1928, pp. 75-104, 14 figs. Description of various types of multi-cylinder turbines; impulse reaction type; reaction type; example of pure reaction multi-cylinder turbine; two impulse-type turbines discussed in detail; influence of details of design on turbine efficiency; features of many of impulse turbines in multi-cylinder designs.

PRACTICE. The General Trend of Modern Development in Steam-Turbine Practice, H. L. Guy. Engineering (Lond.), vol. 125, no. 3257, June 15, 1928, pp. 752-753 and (discussion) 727-728. Of tendencies affecting thermal efficiency of steam plant perhaps most evident is pronounced movement toward higher steam pressures; regenerative feed heating; introduction of feed heaters, evaporator and ejectors. Abstract of paper read before Instn. Civil Engrs.

STEEL

TEMPERATURE EFFECT. Fatigue-Resisting Properties of 0.17 per cent. Carbon Steel at Different Temperatures and at Different Mean Tensile Stresses, H. J. Tapsell. Iron and Coal Trades Rev. (Lond.), vol. 1.6, no. 3140, May 4, 1928, pp. 650-651, 4 figs., and discussion in no. 3142, May 18, p. 759. Little published information relating to fatigue-resisting properties of steel at high temperatures; description of tensile, creep, and fatigue tests undertaken to estimate practical fatigue limits for different temperatures; discussion of results. Abridgment of paper read at Iron and Steel Inst.

STEEL HEAT TREATMENT

TEMPERING. The Tempering of Steel. Iron and Steel Industry (Lond.), vol. 1, no. 8, pp. 261-262, 3 figs. Process of tempering over which complete control achieved by scientific methods is necessary in order to secure uniformity of results, economy and efficiency; difficulties encountered in practice; Homo electric tempering furnace.

STEEL INGOTS

HETEROGENEITY. Second Report on the Heterogeneity of Steel Ingots. Foundry Trade Jl. (Lond.), vol. 38, nos. 613, 614 and 615, May 17, 24 and 31, 1928, pp. 354-356, 369-372 and 383-389, 19 figs. Account of alloy-steel ingots produced from fully killed steel containing nickel, nickel and chromium, and nickel, chromium, and molybdenum; ingots studied indicate that high technical standard has been attained in production of such material. See also Iron and Coal Trades Rev. (Lond.), vol. 116, no. 3140, May 4, 1928, pp. 635-646, 26 figs., and discussion in no. 3140, May 11, pp. 714-715.

STEEL, LOW CARBON

TESTING. Flow in a Low-Carbon Steel at Various Temperatures, French and Tucker. Can. Machy. (Toronto), vol. 39, no. 11, May 31, 1928, p. 31. Discussion of Bureau of Standards paper giving account of investigation of flow of low-carbon steel at various temperatures; relation between load and life; one of principal effects of increase of temperature is reduction of strain-hardening ability of steel.

STEEL MANUFACTURE

CRUCIBLE PROCESS. The Use of High-Class Swedish Iron in the Manufacture of Crucible Steel. Iron and Steel Industry (Lond.), vol. 1, no. 8, May 1928, p. 249. Ever since crucible process was started in Sheffield, Swedish bar iron has constituted main raw material; two main methods used in crucible process; charging crucibles; nature of slag.

STEEL RESEARCH

SAFE LOADS. Safe Loads for Steel Working at High Temperatures. Iron Age, vol. 121, no. 25, June 21, 1928, pp. 1749-1750, 4 figs. U. S. Bureau of Standards publication gives data whereby superheated steam or chemical equipment may be designed; discussion of tests reported by H. J. French, H. C. Cross, and A. A. Peterson; five steels studied; at 800 deg. fahr. boiler steel must be stressed considerably below 10,900 lb. per sq. in. if it is to remain in service indefinitely.

STOKERS

LOCOMOTIVE. Mechanical Stokers for Locomotives, W. G. Clark. Baldwin Locomotives, vol. 6, no. 3, Jan. 1928, pp. 29-41, 25 figs. First stokers; several of underfeed type; limit in stoker firing of large locomotives is about reached, and present trend is backward toward firing of smaller locomotives with mechanical stokers; present stokers grouped into two general classes, steam jet type, and shovel type.

UNDERFEED. Burning Coal on Underfeed Stokers, J. G. Worker. Blast Furnace and Steel Plant, vol. 16, no. 6, June 1928, pp. 784-786. 2 figs. Includes excerpts from paper presented by Am. Eng. Co. before Mech. Division of Stone and Webster, Inc.

STREAM POLLUTION

OXYGEN-DEMAND DETERMINATION. Running Water not Always Pure. Can. Engr. (Toronto), vol. 54, no. 23, June 5, 1928, p. 584. Results of extensive series of experiments conducted in stream pollution laboratories of U. S. Public Health Service; reference given to publication entitled "The Oxygen Demand of Polluted Waters" recently issued by U. S. Public Health Service, No. 173; self-purification of water; water contaminated with organic matters found in sewage and in various industrial wastes does gradually rid itself of such pollution, if allowed free access to air; deoxygenation of polluted water.

STREET CLEANING

TOLEDO, OHIO. Street Cleaning in Toledo. Pub. Works, vol. 59, no. 6, June 1928, pp. 229-231, 1 fig. Survey of city's methods and practices, with recommendations for improving organization, equipment and financing; records.

STREET LIGHTING

SERIAL REPORT. Street and Highway Lighting. Elec. West, vol. 60, no. 6, May 15, 1928, pp. 571-576. Second installment of 3-year serial report; how much cities are spending; cost of auto accidents; recommended practice for overhead street-lighting system; street light for every intersection; highway lighting. Committee report to Pacific Coast Elec. Assn.

STREET TRAFFIC CONTROL

INCREASING CAPACITY. Increasing the Capacity of a Secret System, H. S. Simpson. Elec. Ry. Jl., vol. 71, no. 25, June 23, 1928, pp. 1039-1041. How passenger-carrying capacity of street system may be increased; immediately available method of relief is using to maximum capacity that which now possessed; unnecessary street obstructions; curb parking; street storage in any business district should never be permitted; signals often hinder traffic movement. Discussion of paper presented before N. Y. Elec. Ry. Assn.

STRUCTURAL ENGINEERING

PROBLEMS. Problems for the Structural Engineer, R. Fleming. Can. Engr. (Toronto), vol. 54, no. 23, June 5. 1928, pp. 579-582, 6 figs. Problems discussed in series of pertinent questions which might conceivably be asked structural engineer; riveting vertical flanges; width of cover plates; glazed steel sash; framing in floors; load on wooden bridge floor.

STRUCTURAL STEEL

BRIDGES. High-Strength Steel for Modern Bridges, L. S. Moisseiff. Am. Soc. Steel Treating—Trans., vol. 13, no. 6, June 1928, pp. 941-949. Indications of trend in bridge building and brief history of use of alloy steels; use of nickel steel for bridges; heat treated steel in bridge building.

SWIMMING POOLS

WATER CHLORINATION. Swimming Bath Purification by Chlorine. Contract Rec. (Toronto), vol. 42, no. 23, June 6 1928, pp. 6 5-616, 3 figs. Description of sterilization installation in large English pool to indicate trend of British practice in this respect; advantages of liquid chlorine; circulation equivalent to complete replacement of contents of bath every 3½ hours.

T

TELEPHONE SWITCHBOARDS

TERMINAL STRIPS. Terminal Strips, E. S. Savage. Bell Laboratories Rec., vol. 6, no. 4, June 1928, pp. 333-336, 5 figs. Type of strip, used for terminating subscribers' lines on main distributing frames; great majority of terminal strips are of general type shown.

TEXTILE MILLS

WATER UTILIZATION. The Value of Water in Textile Mills for Purposes Other Than Water Power, C. T. Main. Am. Soc. Mech. Engrs.—Textile Div. Paper for mtg. May 22, 1928, 5 pp. Full text of paper previously annotated from Textile World, May 26, 1928. See also Textile World, vol. 73, no. 21, May 26, 1928, pp. 121-122, 145 and 147.

THERMOMETERS, TESTING

SPECIFICATIONS. Report of Committee D-15 on Thermometers. Am. Soc. for Testing Matls.—Preprint for mtg. June 25, 1928, 5 pp. Proposed specifications for thermometers for heating test of raw tung oil for specific gravity determination, and for Engler viscosimeters.

TIDAL POWER

UTILIZATION. Tidal Power, and Turbines Suitable for Its Utilization, A. H. Gibson. Engineering (Lond.), vol. 125, no. 3258, June 22, 1928, pp. 785-786 and (discussion) 759. One of most important problems is that of storage; enumerates various systems; another problem is that of best size and type of turbine and turbine setting for use in tidal scheme; question of d.c. versus a.c. generation. Abstract of paper read before Instn. Civil Engrs. See also Engineer (Lond.), vol. 145, no. 3780, June 22, 1928, p. 680.

TOOLMAKING

COST CONTROL. Control of Costs of Building Tools, G. A. Pennock. Mech. Eng., vol. 50, no. 7, July 1928, pp. 534-536. Outline of plan employed by Hawthorne Works of Western Electric Company in accelerating output of work involved in manufacture and repair of tools; estimating plan; application of time standards; examples illustrating economies effected.

TOOLS

MAINTENANCE AND REPAIR. Make Tool Repair Costs Part of Production, A. Stuber. Factory and Indus. Mgmt., vol. 76, no. 1, July 1928, pp. 70-73, 4 figs. Account of system by which Eastman Kodak Co. not only estimates costs but controls in advance repairs of large variety of dies and other tools.

TRAIN CONTROL

TEST SWITCHBOARDS. Train Control Test Board. Ry. Elec. Engr., vol. 19, no. 6, June 1928, pp. 195-196, 1 fig. Arrangement of switches and valves makes it possible to compare any piece of equipment with another already tested; complete switchboard for testing General Railway Signal, auto-manual train stop apparatus has been developed in Springfield, Mass., shop of Boston & Albany; moving-track element; power supply; switches; other electrical apparatus.

TUBES, SEAMLESS

MANUFACTURE. Compare Economic Features of Seamless Tube Manufacture, R. C. Stiefel and G. A. Pugh. Iron Trade Rev., vol. 82, no. 25, June 21, 1928, pp. 1602-1605, 6 figs. Pilger and automatic-mill processes of manufacturing seamless tube compared; pilger process in use chiefly in Europe and automatic or plug-mill process in United States; expanding method will permit production of large-size tubes up to about 24-in. diam. at little additional power requirement and with initial plant cost equal to cost of plant for direct production of tubes. From paper presented before Am. Soc. Mech. Engrs.

TUNNELS, PRESSURE

SUMMARY OF INFORMATION. Pressure Tunnels. Elec. West, vol. 60, no. 6, May 15, 1928, pp. 406-417, 7 figs. Summary of information concerning all pressure tunnels reported by member companies of Pacific Coast Electrical Assn.; lined and unlined tunnel; shapes; reinforced lining; leakage tests in Pacific Coast practice; flow coefficients; failures and partial failures. Committee report to Pac. Coast Elec. Assn.

TURBO-GENERATORS

IMPROVEMENTS. Recent Improvements in Turbine Generators, S. L. Henderson and C. R. Soderberg. Am. Inst. Elec. Engrs.—Jl., vol. 47, no. 6, June 1928, pp. 411-415, 6 figs. During last few years there has been very rapid increase in rating of turbo-generators; summary of problems which have been encountered, and solved, by engineers of Westinghouse Elec. & Mfg. Co.; present status of design of turbo-generators and probable directions of future developments.

BROWN-BOVERI. Turbo-Generator at Rotterdam. Engineer (Lond.), vol. 145, no. 3775, May 18, 1928, pp. 549-551, 10 figs. Further details of Brown-Boveri set installed at Rotterdam; rotor of high-pressure cylinder consists of two single-phase impulse wheels with mean diameter of 1,000 mm., followed by ten rows of reaction blading with mean diameter of 823 mm.; all blading in this cylinder is of stainless steel; alternator has maximum continuous capacity of 25,000 kva. or 20,000 kw. at power factor of 80 per cent; tests of machine by Professor Dresden. (Concluded.)

V

VACUUM TUBES

FOUR ELEMENT. Four-Element Tube Characteristics As Affecting Efficiency, D. C. Prince. Inst. Radio Engrs.—Proc., vol. 16, no. 6, June 1928, pp. 805-821, 14 figs. Work undertaken because of apparent lack of any logical proved explanation for amount of current collected by grid of three-element tube of standard design when grid and plate are at nearly same potential; report covers making of tests and calculations in search for requirements of low-loss tube; work performed.

TRIODE. Influence of Secondary Discharges from Metals on the Operation of Three-Electrode Lamps (L'Influence des émissions secondaires des métaux sur le fonctionnement des lampes à trois électrodes), H. Le Boiteux. Revue Générale de l' Electricité (Paris), vol. 23, no. 22, June 2, 1928, pp. 939-946, 11 figs. June 2: Treats of secondary currents in grid of three-electrodes tubes; characteristics of plate currents in function of plate tension; curves and data which fix relative importance of currents. June 9: Phenomenon of secondary discharge; form of secondary current during oscillation; application to certain types of tubes.

VENTILATION

STATIC PRESSURE. Dynamic Significance of Static Pressure, G. De Bothezat. Heat. and Vent. Mag., vol. 25, nos. 5 and 6, May and June 1928, pp. 65-67 and 75 and 79-83, 3 figs. Defines terms and explains phenomena fundamental in ventilation; qualitative relation between pressure and flow velocity in steady stream; quantitative relation between fluid velocity and fluid pressure; flow of air in ducts; air flow through fan; air flow through wind-mill.

VOLTAGE REGULATORS

COMPUTATIONS. Computing Compensator Settings for Voltage Regulators, V. W. Palen. Elec. World, vol. 91, no. 25, June 23, 1928, p. 1334, 1 fig. Computations for double loop circuits. (Continuation of serial.)

W

WALLS, TILE

STRENGTH. Stronger Walls With a New Form of Tile, A. B. McDaniel. Mfrs. Rec., vol. 93, no. 25, June 21, 1928, pp. 73-74, 2 figs. Describes investigation of strength of walls built with interlocking-rib clay building tile which has recently been devised by L. S. Munson for purpose of giving walls greater transverse and compression tests.

WATER CHLORINATION

PROGRESS. Water Purified by Chlorination, W. J. Orchard. Can. Engr. (Toronto), vol. 54, no. 22, May 29, 1928, p. 562. Progress in chlorination of water supplies; sanitation of swimming pools; treatment of sewage and wastes; duplicate installations advisable. Paper presented before Southwest Water Works Assn.

EMERGENCY. Emergency Water Disinfection During Recent Floods in California, C. G. Gillespie. West. Constr. News, vol. 3, no. 11, June 10, 1928, pp. 376-377, 2 figs. Author installed barrel for emergency chlorination; ordinary kitchen chlorox, containing about 0.5 lb. of active chlorine, was diluted into this barrel; spigot regulated to feed about one pint of original solution into 20,000 gal. of water.

WATER FILTRATION

DEVELOPMENTS. Developments in Water Filtration, J. R. Baylis. Can. Engr. (Toronto), vol. 54, no. 23, June 5, 1928, p. 588-590. Recent developments which have been made in treatment and filtration of water; recent practice in treatment of hard waters; outline of progress in water purification, giving few developments that stand out most prominently.

SAND. The Sand Filter and Filter Sand, A. L. Collins. West. Constr. News, vol. 3, no. 11, June 10, 1928, pp. 370-373, 3 figs. Filter plants for various classes of service; principles involved in operation of sand-filter unit; part which filter sand plays in process; defines filter; art of modern filtration for domestic purposes; chief purpose of sand filter in connection with water for domestic supply; controls; sand problem; test sample defined.

WATER FILTRATION PLANTS

DESIGN. The Design and Construction of Small Filtration Plants, H. K. Bell. Am. Water Works Assn.—Jl., vol. 19, no. 6, June 1928, pp. 653-664. Capacity of filtration works covered are those ranging from 100 to 1,400 gal. per minute and serving communities of from 1,000 to 10,000 population; explains these problems and shows how they have been worked out.

Filter Plant Operation Trials, W. H. Johnson. Can. Engr. (Toronto), vol. 54, no. 22, May 29, 1928, p. 575. Troubles met with small plants discussed; superintendent must be versatile; operating troubles. Paper presented before Kentucky-Tennessee Section, Am. Water Works Assn.

EXPERIMENTAL. Experimental Water-Filtration Plant for Chicago, L. D. Gayton. Eng. News-Rec., vol. 100, no. 22, May 31, 1928, pp. 861-863, 5 figs. City builds $150,000 plant to determine most efficient and economical plan of coagulation, sedimentation, filtration, carbonation and chlorination of billion gallons daily; range of experiments; dispensing filtered water to public.

HARTFORD, CONN. Innovations Increase Output of Filters, C. M. Saville. Water Works Eng., vol. 81, no. 12, June 6, 1928, pp. 779-780 and 857, 2 figs. Several important innovations introduced into filtration system of Hartford, Conn., which are expected to increase efficiency of operation; two new filter beds under construction; rate of filtration and color; no chemicals used; several innovations in operation procedure; cost of operation of plant; use of copper sulphate.

WATER PIPE LINES

COPPER. Service Pipe Practices in Washington Suburban Districts, R. B. Morse. Water Works Eng., vol. 81, no. 13, June 20, 1928, pp. 943-944. Flexibility of soft copper tubing; no perceptible distortion results from bending; earth augur used under approved paving; early connections of galvanized steel; all services metered; water and sewer connections in same trench; decide to standardize on copper service pipe; soft copper tubing saves expense; how tubing is fitted.

WATER SUPPLY

OTTAWA, ONT. Report on Water Supply for Ottawa, A. F. Macallum. Can. Engr. (Toronto), vol. 54, no. 23, June 5, 1928, pp. 591-592. Works Commissioner reports in favor of rapid-sand filtration plant at Lemieux Island to cost $1,275,000; plant would have capacity of 32,000,000 gal.; commissioner also suggests metering every service in city; experimental plant proposed in addition.

WATER TANKS, CONCRETE

DESIGN. Some Points Concerning the Design of Concrete Tanks, E. C. Snelgrove. Surveyor (Lond.), vol. 73, no. 1896, May 25, 1928, p. 566. Under drainage; type of design; tanks or reservoirs may be covered or uncovered; elevated tanks. Abstract of paper presented before Instn. Structural Engrs.

Some Points Concerning the Design of Concrete Tanks, E. C. Snelgrove. Structural Engr. (Lond.), vol. 6, no. 6, June 1928, pp. 165-176 and (discussion) 176-178, 23 figs. Observations upon certain details of tank design; two examples, of recent date; points to be considered in first general survey are location, foundations, type of design shuttering, cleaning facilities, provision against expansion and contraction, concrete test, protection against frost, etc.

WATER WELLS, DEEP

QUALITIES. Qualities of Waters from Deep Wells, H. F. Blomquist. Can. Engr. (Toronto), vol. 54, no. 23, June 5, 1928, pp. 583-584. Supplies from water-bearing formations more than 200 ft. deep discussed; desirable qualities of water; sampling water at varying depths in wells; groundwaters vary widely. Paper presented at Water Works Conference.

WELDS

HEAT TREATMENT. The Heat Treatment of Welds, G. R. Brophy. Welding Engr., vol. 13, no. 6, June 1928, pp. 35-36. Although heat treatment does improve results, necessity for it can usually be avoided by adopting correct welding procedure; heat treatment of weld holds great promise of improvement to physical properties; normalizing treatment, consisting of heating to from 950 to 1,000 deg. cent., for from two to three hours (in case of ½-in. plates) followed by rapid air cooling; role of manganese and carbon.

WOOD PRESERVATIVES

TESTING. Report of Committee D-7 on Timber. Am. Soc. Testing Matls.—Preprint, no. 75, for mtg. June 25, 1928, 8 pp. Tables prepared by U. S. Bureau of Standards for correcting density and volume of creosote oil from observed to standard temperatures.

WOODWORKING PLANTS

ELECTRIC DRIVE. Some Actual Savings Through Motor Drive, W. A. Marshall. Wood-Worker, vol. 47, no. 4, June 1928, pp. 39-40, 1 fig. As result of change to motor drive, feature that appeals most to owners of establishment referred to is fact that plant is much more flexible; one machine or one department can be operated if desired without having to run entire equipment; careful tests were made before motor installations, to see if motors of correct ratings were used; ball-bearing motors were specified throughout.

Z

ZINC-NICKEL ALLOYS

ELECTRODEPOSITION. The Effect of Superposed Alternating Current on the Deposition of Zinc-Nickel Alloys, H. C. Cocks. Faraday Soc.—Trans.—(Lond.), vol. 24, part 6, June 1928, pp. 348-358, 6 figs. Outline of phenomena attending cathodic deposition of zinc and nickel separately and together; investigation of deposition of alloy, zinc-nickel from acid sulphate electrolyte using d.c. and superposed a.c.; explanation of effect of superposed a.c.

Engineering Index

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A

ABRASIVES

Specifications. Coated Abrasive Data Prepared. Abrasive Industry, vol. 9, no. 8, Aug. 1928, pp. 210-212. United States government issues proposed master specifications for materials purchased for various Federal departments; comments and criticism invited; proposed United States government master specifications for waterproof garnet paper, artificial waterproof abrasive paper, and revision of master specifications for emery cloth.

AERIAL PHOTOGRAPHY

Canada. A Challenge to the Canadian Pilot, A. M. Narraway. Can. Aviation (Toronto), vol. 1, no. 2, July 1928, pp. 18-19 and 45-46, 3 figs. Experiences of last six years in photographing Canada's unexplored and inaccessible regions; part which airman is expected to play in development of this work; Dominion leads in aerial photography; greatest development in aerial surveys during past year has been investigation and development of Canada's vast waterpower resources.

AERONAUTICAL EDUCATION

University of Toronto. Canadian Aviation and the University of Toronto, J. H. Parkin. Can. Aviation (Toronto), vol. 1, no. 2, July 1928, pp. 14-15 and 44, 5 figs. Aerodynamic laboratory established at University of Toronto ten years ago has been invaluable; courses started for undergraduates; researches conducted at University; test work of laboratory; instruction in aeronautical engineering; course, while sacrificing little in general training in mechanical engineering subjects, increases instruction in mathematics and provides sufficient specialized instruction in aeronautical subjects to enable student to enter industry.

AERONAUTICAL ENGINEERING EDUCATION

Training. Training Aeronautical Engineers, E. W. Stedman. Can. Aviation (Toronto), vol. 1, no. 1, June 1928, pp. 26 and 28. Chief branches of aeronautical engineering outlined with main essentials for training engineers for aircraft industry; experimental aeronautics; aircraft and aircraft-engine construction; aircraft operation allied with engineering; post-graduate courses recommended for each branch; aeronautical engineer needs all training of mechanical or civil engineer without omission of any part; when teaching ordinary engineering principles examples should be taken from aeronautical engineering practice.

AERONAUTICAL INSTRUMENTS

Naval. Aircraft Instruments, T. C. Lonnquest. Aviation, vol. 25, no. 2, July 9, 1928, pp. 107 and 129-134, 4 figs.

AERONAUTICS

Canada. Air Services in Canada, J. S. Scott. Can. Aviation (Toronto), vol. 1, no. 1, June 1928, pp. 38-40. Work of Directorate of Civil Government Air Operations, Controller of Civil Aviation, Aeronautical Engineering Division and Royal Canadian Air Force which comprise Air Services of Canada, and are part of Department of National Defence; aerial photography; aerial protection of forests; aerial dusting; examination of personnel and inspection of aircraft; formation of light airplane clubs; inspection of aircraft during construction. (To be continued.)

Air Services in Canada, J. S. Scott. Can. Aviation (Ottawa), vol. 1, no. 2, July 1928, p. 38, 2 figs. Policy and service of Royal Canadian Air Force which administers and controls all military air operations; almost endless training of personnel necessary; students of applied science and engineering trained at Camp Borden in summer; training of N. C. O. pilots; advanced, service, and refresher flying training; winter training important; technical training for boys; civilian flying training. (Concluded.)

Aviation in Canada During 1927, C. P. C. Downman. Aero Digest, vol. 13, no. 2, Aug. 1928, p. 338, 1 fig. Developments in Canada during 1927 are taken up; air mail services; sudden demand for light aircraft; statistics of flights made and passengers carried; flying clubs established.

Canadian Aviation League. Popular Aviation, vol. 3, no. 1, July 1928. p. 33. Aims of Aviation League of Canada.

AERONAUTICS, COMMERCIAL

Canada. Commercial Aviation of Today, J. H. MacBrien. Can. Aviation (Toronto), vol. 1, no. 1, June 1928, pp. 14-15, 2 figs. Comparison of progress in other countries reveals Canada as lagging far behind; rapid development in United States; it is abundantly clear that Canada must develop her airways rapidly so that manufacturers and business men may not have to work under a handicap with their competitors in other countries; great regularity necessary; maps show tremendous growth of European air service in six years; advantages of aerial transportation.

Progress of Civil Aviation in Canada, J. A. Wilson. Can. Aviation (Toronto), vol. 1, no. 2, July 1928, pp. 12 and 46. In no country is there greater scope for useful and profitable employment of aircraft; no civil aviation in Canada not now self-supporting; aviation is playing important part in development of Dominion; Canada had demand for flying; air services are recognized; by end of 1929 no district in continental Canada will be beyond flying distance of one of commercial company's bases.

AIR BRAKES

Report. Report of Committee on Brakes and Brake Equipment. Ry. Age (Daily Edition), vol. 84, no. 25C, June 26, 1928, pp. D114-D118, 9 figs. Analysis is made of paper on braking power presented at 1927 convention of Air Brake Assn.; braking power on refrigerator cars; loaded weights have wide variation; coefficient of friction for cast-iron and steel wheels; standardization of brake levers now impracticable; braking ratio recommendations.

AIR COMPRESSORS

Centrifugal. Centrifugal Compressors with Cooled Casings (AEG-Electro Kreiselkompressoren mit Gehaeuskuehlung). V.D.I. Zeit. (Berlin), vol. 72, no. 17, Apr. 28, 1928, p. 57, 3 figs. Use of electrically driven centrifugal compressors is steadily extending in coal mines; A.E.G. of Germany has developed range of machines in capacities from 180,000 to 1,050,000 cu. ft. of free air per hour, with delivery pressures up to 120 lb. per sq. in.; cooled casings are employed; construction has only been made possible by refinements in foundry practice. See brief translated abstract in Colliery Eng. (Lond.), vol. 5, no. 52, June 1928, p. 252.

AIR CONDITIONING

Evaporation Charts. Solution of Evaporation Problems in Light of Modern Research (Die Berechnung der Verdungstungsvorgaenge auf Grund neuerer Forschungen), F. Merkel. Sparwirtschaft (Vienna), no. 6, June 1928, pp. 312-317, 18 figs. Use of charts for solving problems in evaporation; diagrams and formulas for various cases of evaporation encountered in air conditioning; humidification and dehumidification; heating and ventilation; drying process studied graphically.

AIR MAIL SERVICE

Canada. Air Mail Service in Canada. Can. Aviation (Toronto), vol. 1, no. 1, June 1928, pp. 34 and 36. Description of mail services inaugurated in Canada; work of Canadian Transcontinental Airways, and Western Canada Airways in transporting mail; great saving of time in reaching remote parts of Canada and unusual conditions encountered.

AIRCRAFT ENGINES

Compression-Ignition Research. High-Speed Compression-Ignition Engine Research, H. B. Taylor. Royal Aeronautical Soc.—Jl. (Lond.), vol. 32, no. 211, July 1928, pp. 555-570 and (discussion) 571-595, 18 figs. Tests of high-speed compression-ignition engines at Royal Aircraft Establishment described and prospects of such engines for aeronautical use shown; main problem in development was that of fuel-injection system; tests of various sprayers; as torque is reduced so is specific fuel consumption; utilization of cheap fuels having high flash point. Paper presented at joint meeting of Instn. of Automobile Engrs. and Royal Aeronautical Soc.

Exhaust Silencers. Engine Exhaust Silencers. U. S. Naval Inst.—Proc., vol. 54, no. 8, Aug. 1928, pp. 701-706, 9 figs.

Manufacturers' Specifications. Manufacturers' Specifications on Engines Available for Commercial Use As Compiled by Aviation. Aviation, vol. 25, no. 2, July 9, 1928, p. 122. One-page table of manufacturers' specifications for aircraft engines.

Supercharging. Aircraft Engine Superchargers, A. L. Berger. Aero Digest, vol. 13, no. 1, July 1928, pp. 98 and 100, 7 figs.

AIRCRAFT EXHIBITION

Montreal. Montreal Aircraft Show Proves Big Success. Can. Aviation (Toronto), vol. 1, no. 2, July 1928, p. 17, 4 figs. Opening of Exhibition, June 7, is described with brief abstracts of addresses presented by Major-General MacBrien and J. A. Wilson.

AIRCRAFT PROPELLERS

Design of Airfoil Sections. Section Properties of a Series of Airfoils Suitable for Propeller Design, F. W. Caldwell. Air Corps Information Circular, vol. 6, no. 597, Nov. 1, 1928, 21 pp., 23 figs. Section properties for series of sections similar to Clark Y section are given for use in propeller design; sections based on same median line, camber ratio being increased above and below; areas, centre of gravity location, and moment of inertia determined by integrating machine; moment of inertia about axis parallel to chord checked by computation.

AIRPLANES

Brakes. Landing and Braking of Airplanes (L'atterrissage et le freinage des avions), L. Breguet. Académie des Sciences—Comptes Rendus (Paris), vol. 186, no. 23, June 4, 1928, pp. 1516-1518. Braking in air is described and some experiments with planes landing with wheel brakes.

Control, Automatic. Semi-Automatic Piloting of Airplanes (Le pilotage semi-automatique des avions), R. Mioche. Aeronautique (Paris), vol. 10, no. 108, May 1928, pp. 155-158, 5 figs. Three types of servo-pilots in use: electric, compressed air, or oil; description of each and its method of controlling flight.

Design. The Application of Aerodynamic Data to the Structural Design of Aircraft, F. Radcliffe. Flight (Lond.), vol. 20, no. 25, June 21, 1928; (Aircraft Engr.), pp. 464c-464g, 7 figs.

Metal. Uses of Metal Grow in Canadian Aeroplane Plant. Can. Machy. (Toronto), vol. 39, no. 13, June 28, 1928, pp. 87-88, 2 figs. Designers are turning more and more towards metal construction; metal construction, however, offers many difficulties; large use of dies; rust prevention; ordinary acid-bath methods of rust prevention quite unsuitable for airplane manufacture; metal construction calls for welded joints.

AIRPLANE TRAINS

GERMANY. Airplane Trains Tested in Germany. Can. Aviation (Toronto), vol. 1, no. 1, June 1928, p. 45. Very brief announcement of tests of small motorless gliders attached to airplanes just as coaches are attached to engines on railroads.

WIND-TUNNEL TESTS. Preliminary Biplane Tests in the Variable Density Wind Tunnel, J. M. Shoemaker. Nat. Advisory Committee for Aeronautics—Tech. Note, no. 289, June 1928, 15 pp., 7 figs. on supp. plates. Biplane cellules using N.A.C.A.-M6 airfoil section tested in N.A.C.A. variable-density wind tunnel; three cellules differing in amount of stagger tested at two air densities; indications that positive stagger increases induced drag, decreases maximum lift at Reynolds numbers near full scale, and displaces moment coefficient in positive direction.

WINGS. Aerodynamic Characteristics of Thin Empirical Profiles (Caracteristiques aérodynamiques des profils empiriques minces), M. Toussaint and M. Carafoli. Aérophile (Paris), vol. 36, nos. 11-12, June 1-15, 1928, pp. 179-183, 4 figs. Applications to fins and curved ailerons of method proposed by Munk; principle of method; aerodynamic characteristics.

AIRPORTS

HARBOR GRACE. International Airport at Harbor Grace. Can. Aviation (Toronto), vol. 1, no. 1, June 1928, p. 15. Realizing importance of Newfoundland as safety point on transatlantic flight, association of some 20 citizens of that country, mostly of Harbor Grace, has formed Harbor Grace airport.

MARKINGS. Size and Marking of Airports. Can. Aviation (Toronto), vol. 1, no. 1, June 1928, pp. 18 and 44-45. Directions given by Canadian Air Board with regard to ground marking of air harbors; cases where no marker is needed; information received recommending runways to be not less than 3,000 ft. in length and to have good approaches; planning for future; Board gives full information to civic authorities planning airports. (To be continued.)

RAILROAD CONTROL. Railroads and Airplanes, H. H. Thompson. Ry. Jl., vol. 34, no. 7, July 1928, pp. 33-35, 2 figs. Need at present time for proper guidance of various towns and cities of United States in selecting sites and determining what prospects of such airport will be; assuming that railroads will sometime in future operate air transport lines; airport will be located near or on main line of operating railroad company; cities which are railroad and shipping centres should locate and set aside one or more sections of ground large enough to qualify in future as AAA airport.

AIRSHIPS

BALLAST RECOVERY. Recovery of Ballast on Board Dirigibles (La récupération du lest à bord des dirigeables), A. Tourrette. Aeronautique (Paris), vol. 10, no. 108, May 1928, pp. 160-164, 4 figs. Examines possible solutions of problem of increasing or reducing powers of dirigible; recovery of ballast in flight; air and water radiators; choice of systems.

ALLOYS

AGE HARDENING. Age-Hardening of Alloys, R. Hay. Am. Metal Market, vol. 35, no. 134 (2nd section), July 14, 1928, pp. 10-11 and 23. Treats of influence of various operations on age-hardening effect; temperature, size of particles; application of age-hardening. Paper presented before Scottish Local Section of Inst. on Metals.

ALUMINUM. *See Aluminum Alloys.*

BRONZES. *See Bronze.*

MANGANESE. *See Manganese Steel.*

COPPER. *See Copper Alloys.*

CHROMIUM. *See Chromium Alloys.*

NICKEL. *See Nickel Alloys.*

ALUMINUM ALLOYS

AUTOMOTIVE ENGINES. Aluminum Alloys in Engine Construction (Aluminiumlegierungen im Motorbau), H. Steudel. Zeit. fuer Metallkunde (Berlin), vol. 20, no. 5, May 1928, pp. 165-178, 29 figs. Discussion of general advantages of light metals; presents table showing parts of engine which can or cannot be produced from light metal, conditions governing its use and reasons why it can or cannot be used; light-metal pistons; use of malleable alloys; properties of most commonly used alloys.

CRYSTALS. Elastic Properties of Crystals of a Heat-Treated Aluminum Alloy (Festigkeitseigenschaften von Kristallen einer veredelbaren Aluminiumlegierung), R. Karnop and G. Sachs. Zeit. fuer Physik (Berlin), vol. 49, nos. 7 and 8, 1928, pp. 480-497, 20 figs. Report from Kaiser Wilhelm Institute of Metals, of Berlin-Dahlem on method of production and on tensile strength, elastic limit and other properties of single crystals of heat treated aluminum alloy containing 5 per cent of copper; X-ray photographs of crystal structure.

ELECTROPLATING. Electroplating on Aluminum and Its Alloys, H. K. Work. Metal Industry (N.Y.), vol. 26, no. 7, July 1928, pp. 313-315. Abstract of paper read before Am. Electrochemical Soc., previously annotated.

ARCHES

STRESS MEASUREMENT. The Beggs Deformeter. Engineering (Lond.), vol. 126, no. 3261, July 13, 1928, pp. 31-35, 9 figs. Ingenious method of determining stresses by direct measurement of deformation of model, devised four or five years ago by G. E. Beggs; apparatus has already been employed in Europe and America for finding stresses in highly redundant arch bridges; apparatus is based on Clerk Maxwell's reciprocal deflection thereon; employed to determine stresses in arches of Arlington Memorial Bridge; other applications.

AUTOMOBILES

BODIES, ALUMINUM STANDARDS. S.M.M.T. Provisional Standards. Automobile Engr. (Lond.), vol. 18, no. 243, July 1928, p. 260, 5 figs. Provisional standards of Society of Motor Manufacturers and Traders for use of aluminum in automobile body construction; bimetallic contracts, method of fixing aluminum painting, dopes, and condition of wood are covered.

SPRINGS AND SUSPENSION. Researches on Springs. Dept. of Sci. & Indus. Research, Eng. Research—Special Report, no. 8, 1928 (Lond.), 42 pp., 32 figs. partly on supp. plates. Results of experiments with 30-cwt. and 60-cwt. army truck and with 2-seater high-speed automobile; National Physical Laboratory was asked to design mechanism which could be fitted to vehicle and which would give continuous record with time of displacement of springs relative to body of vehicle when run at different speeds and on different road surfaces; gives description of apparatus and results obtained.

STEERING KNUCKLE PIVOTS. Mechanical Principles of Inclined Knuckle Pivots, A. L. Vargha. Automotive Industries, vol. 59, no. 4, July 28, 1928, pp. 130-131, 4 figs.

TRANSMISSION GEARS, LAPPING. Transmission Gear Lapping. Machy. (Lond.), vol. 32, no. 822, July 12, 1928, pp. 470-472, 4 figs. Improved method of lapping transmission gears is described; why gears wear less at pitch line; advantages of shifting gears while lapping; arrangements of lapping fixture; how lapping motions are derived; many gears previously scrapped were salvaged by method; gear noises reduced.

AUTOMOTIVE FUELS

ANTI-KNOCK COMPOUNDS. Engine Knock and Related Problems, A. C. Egerton. Nature (Lond.), vol. 122, no. 3062, July 7, 1928, pp. 20-26, 2 figs. Results of test show that anti-knocks do not affect a rapidly accelerating explosion in tube; that this influences igniting temperatures and it is metal part of organo-metallic anti-knock which is mainly instrumental in action. Discourse delivered at Royal Instn.

AVIATION

CANADA. The Aviation League of Canada. Can. Aviation (Toronto), vol. 1, no. 1, June 1928, pp. 8-9 and 44. League should be greatest single factor in promoting commercial aviation; charter received from Government; aims and objects of League; spreading gospel of aviation; encouraging aviation among boys; education of air mechanics; necessity for technical training in aeronautical engineering.

B

BAKELITE

MOULDS. Sectional Bakelite Mould for Radio Parts, F. Martindell. Machy. (N.Y.), vol. 34, no. 11, July 1928, pp. 829-830, 2 figs. Construction of moulds for bakelite where several parts are to be made in single mould; matching of number of separate impressions calls for skill; duplicate sections simplify construction; machining mould sections; assembling mould.

BEAMS, CONTINUOUS

MOMENTS. Moments in Two-span Continuous Beams with Varying Span Ratios, C. S. Gray. Concrete and Constr. Eng. (Lond.), vol. 23, no. 6, June 1928, pp. 427-435, 8 figs. Considers beams of two spans only; with each type of loading there are three methods of loading beams, namely: (1) both spans fully loaded; this case gives maximum negative moment at centre support; (2) loading applied only to longer span; this gives maximum positive moment in that span; (3) loading applied only to shorter span; this gives minimum support moment.

BEAMS, STEEL

STRUCTURAL SHAPES (BETHLEHEM). Elements of the New 33-In. Rolled Structural Sections. Eng. News-Rec., vol. 101, no. 1, July 5, 1928, p. 16, 1 fig. 33-in. beams and girders recently added to line of wide-flanged structural shapes of Bethlehem Steel Co. are deepest sections that have yet been rolled in United States; weights ranging from 125 to 152 lb. per ft., and section moduli from 394.3 to 478.4; girders are in four weights, of from 202 to 230 lb. per ft., and section moduli from 676.0 to 778.0; table of dimensions and properties.

BEARING METALS

CASTING. Pouring and Casting of Bearing Metals. Lubrication, vol. 14, no. 6, June 1928, pp. 62-64, 2 figs. Extent to which bearing can be expected to function effectively will depend upon its initial formation; melting metal; preheating of bearing parts; treatment of shells; pouring bearing metals.

BENZOL

RECOVERY PLANTS. Modern Coke Plants, Recovery of By-Products; Benzol (Les cokeries modernes. La récupération des sous-produits: Le Benzol). Nature (Paris), no. 2787, June 15, 1928, pp. 535-542, 10 figs. Extractors; removing benzol by washing gas; methods of obtaining benzol and apparatus used are described; also refining of raw benzol.

BLAST FURNACES

PRODUCTIVITY. Productivity Per Man Employed, E. Stewart. Iron Age, vol. 122, no. 1, July 5, 1928, pp. 33-34, 1 fig. Great and continuous spread over three-quarters of century between number of employees and volume of production; study of pig-iron output as symptomatic of manufacturing in general; enormous gain in 75 years. From Monthly Labor Rev.

BOILER FURNACES

DESIGN. N. E. L. A. Report on Stokers and Furnaces. Combustion, vol. 19, no. 1, July 1928, pp. 33-34. Report is arranged in standard form adopted; principal phase is in application of automatic combustion control; stokers; water walls and furnaces; air preheaters.

ELECTRIC. Utilizing Off-peak Power in Automatic Electric Steam Generator, E. V. Buchanan. Elec. News (Toronto), vol. 37, no. 14, July 15, 1928, pp. 44-46, 4 figs. London, Ont., Public Utilities Commission dispenses with coal and uses 300-kw. electric boiler, max. steam pressure 15 lb., for heating large office building; economic installation while power is available; describes use of steam generator in special case of making use of surplus or off-peak power; alternating current is always used, and voltage may vary from 110 up to 13,000 volts; satisfactory operation.

HEAT TRANSMISSION. Heat-Transmission Laws and Conceptions of Modern Boilers (Les lois de la transmission de la chaleur et la conception des chaudieres modernes), C. Roszak and M. Veron. Société des Ingenieurs Civils de France—Compte Rendu Des Travaux (Paris), vol. 81, no. 3-4, 1928, pp. 341-383, 16 figs. General summary of laws of heat transmission in steam boilers; grates with large angular factor of radiation and some examples; means of promoting convection from gas to walls; superheaters.

HIGH PRESSURE (BENSON). The Benson Process of Generating High-Pressure Steam (Das Benson-Verfahren zur erzeugung hoechstgespannten dampfes), H. Gleichmann. V.D.I. Zeit. (Berlin), vol. 72, no. 30, July 28, 1928, pp. 1037-1046, 21 figs. Principles of Benson process; details of experimental Benson boilers of Siemens-Schuckert plant and Charlottenburg Institute of Technology, generating as much as 3.5 tons of steam per hour; oil, lignite, and pulverized-coal firing of Benson boilers; test data; feedwater problems; design of high-pressure steam plants.

HIGH PRESSURE, PARIS. A Big Boiler in Paris. Power, vol. 68, no. 3, July 17, 1928, pp. 98-99, 2 figs. Compagnie Parisienne de Distribution d'Electricté 19,400-sq. ft. boiler to evaporate 265,000 lb. of water hour at 615 lb. gauge superheated to final temperature of 824 deg. fahr.; this boiler is fired by pulverized coal and equipped with air preheaters and fin-tube walls.

LOCOMOTIVE. *See Locomotive Boilers.*

WASTE-HEAT. Recovery of Waste Heat and Waste-Heat Boilers (La récupération des chaleurs perdues et les chaudières de récupération), M. Varinois. Vie Technique et Industrielle (Paris), vol. 9, no. 105, June 1928, pp. 337-341, 6 figs. Utilization of heat from steel furnaces, recovery of heat lost from gas and Diesel engines; design of boilers for recovery of heat.

WOOD-WASTE FIRED. Wood Refuse Burning Over Underfeed Stokers. Power, vol. 68, no. 4, July 24, 1928, pp. 142-143, 1 fig. Boilers are of three-pass, bent-tube type with furnace volume approximately 4,200 cu. ft.; wood refuse available from manufacturing plant as valuable auxiliary fuel to be burned practically in suspension on top of stoker fire.

BOILER PLATES

TEMPERATURE EFFECT. Boiler and Container Materials with Increased Resistance at High Working Temperatures (Kessel- und Behälterhaustoffe mit gesteigerter Widerstandsfaehigkeit bei hohen Betriebstemperaturen), P. Proemper and E. Pohl. Archiv. für das Eisenhüttenwesen (Düsseldorf), vol. 1, no. 12, June 1928, pp. 785-793, 23 figs. Notes on properties of soft vanadium and molybdenum steels at temperatures of 500 deg. cent., in form of rolled steel; short-time tests, and prolonged load tests; machinability; aging; metallographic analysis; corrosion and weldability. See brief abstract in Stahl u. Eisen (Düsseldorf), vol. 48, no. 27, July 5, 1928, pp. 908-909, 1 fig.

BRIDGES

CONCRETE, ARCH. Method of Concrete Control and Some Test Results in the Construction of Concrete Arch Bridges Across the Mississippi River between St. Paul and Minneapolis, Minnesota, C. R. Hansen. Minn. Federation of Arch. and Eng. Soc.—Bul., vol. 8, no. 7, July 1928, pp. 21-28, 3 figs. Project locally known as Inter-City Bridge; notes on methods and results of concrete control in construction of this project; specifications; design and control of mix; concreting plant and pouring.

DESIGN. The Architect as Collaborator With the Engineer, P. P. Cret. Arch. Forum, vol. 49, no. 1, part 2, July 1928, pp. 97-104, 18 figs. Outlines place of architect in design of bridges from æsthetic standpoint and effect on engineer and illustrates how this was applied in case of Delaware River Bridge at Philadelphia.

MOVABLE, WELLAND SHIP CANAL. Discussion of Paper on Bridges Over the Welland Ship Canal by M. B. Atkinson. Eng. Jl. (Montreal), vol. 11, no. 7, July 1928, pp. 431-433. Discussed by W. C. Thomson, P. Gillespie, P. L. Pratley and author. Paper presented published in Eng. Jl., Feb. 1928.

RAILROAD, ARC WELDING. Arc-Welding Strengthens Railway Bridge. Can. Machy. (Toronto), vol. 39, no. 12, June 14, 1928, p. 42. Welding new plates and angles to old members of 110-ft. bridge over Missouri river at Leavenworth, Kan.

First Arc-Welded Railway Truss Bridge, G. D. Fish. Eng. News-Rec., vol. 101, no. 4, July 26, 1928, pp. 120-123, 4 figs. Structure at Chicopee Falls, Mass., utilizes practically all classes of welding; excessive skew complicated design; 72-deg. skew required span of 134 ft. 8 in.; design for welding; joint details; butt welds vs. fillet welds; criticism of design.

STEEL, ARCH CONSTRUCTION. Erecting a Large Steel Arch Bridge in England. Eng. News-Rec., vol. 101, no. 1, July 5, 1928, pp. 28-29, 2 figs. Steel arch highway bridge, over Tyne River between Newcastle and Gateshead, is of two-hinged type of 531-ft. span and 170-ft. rise and gives shipway clearance of 84 ft.; cost of bridge about $6,250,000; erection from both ends, first six panels of each rib supported by falsework, but as erection proceeded weight transferred to cables connected to top chord and carried back over temporary cable bents to anchorage in web of approach spans.

STEEL EADS, ST. LOUIS. Eads Bridge Strength and Safety Indorsed by Engineers. Eng. News-Rec., vol. 100, no. 26, June 28, 1928, pp. 1009-1010, 1 fig. Steel unimpaired after 54 years' service and stresses from maximum modern loads are within designed stresses; safety of famous arch bridge, built in 1874, questioned last year, has been indorsed by engineering board of investigation.

STRESSES. Bridge Stresses, E. G. Coker. Engineering (Lond.), vol. 125, no. 3259, June 29, 1928, p. 810, 3 figs. Discovery by David Brewster, about 1815, of artificial double refraction produced in glass when loaded, led to discovery that stresses in arches could be determined by aid of glass models; Mesnager in 1913 constructed glass model of reinforced-concrete bridge over Rhone, of 95 m. span, to check calculations of designers; noteworthy feature was use of Babinet compensator to measure artificial double refraction produced in stressed members; drawings of indications of Babinet compensator are given confirming stresses measured.

BRONZE

ALLOYS. Alloys Affect Properties, E. R. Thews. Foundry, vol. 56, no. 13, July 1, 1928, pp. 532-535. Gives effect of various metallic additions such as zinc, lead, nickel, cobalt, manganese, phosphorus, silicon, etc., on casting properties of bronze; cobalt bronzes; tin replaces nickel; Brinell hardness of bronzes is increased from 63 to 71 decreasing to 60 if phosphorus content rises to 0.50 per cent.

BUILDINGS

RADIANT HEATING. Radiant Heating in Buildings, H. M. Vernon and M. D. Vernon. Engineering (Lond.), vol. 125, no. 3259, June 29, 1928, p. 791. Account of investigation to ascertain practical merits of panel heating as compared with other methods; authors conclude from their observations that panel heating, or its equivalent, is likely to replace to considerable extent systems of convection heating, such as hot-water radiators and plenum air installations.

WELDED STEEL. Welding and Industrial Building, A. Vogel. Engrs. and Eng., vol. 45, no. 7, July 1928, pp. 156-162 and (discussion) 162-165, 13 figs. Design of trusses and other structural features of building at West Philadelphia; two essentials of truss design; two main incentives to welding, saving in cost and silence; development of trusses interesting study; in design of welded trusses it is desirable that symmetrical sections be stiff in two planes. In discussion, some points of interest to structural designer and fabricator are added.

C

CABLEWAYS

ELECTRIC TRAMWAY. Mammoth Tramway to Span Western Canyon. Eng. World, vol. 33, no. 1, July 1928, p. 3. Electric tramway to be erected by Michigan California Lumber Co., at Camino, Cal.; single loaded with maximum of 24,000 lb. of sawed lumber; distance between terminals is approximately 2,700 ft.; speed of operation 20 mi. per hr.; four steel cables support tram carried.

CADMIUM

PLATING. Corrosion Protection of Light Metals by Cadmium (Cadmium als Korrosionsschutz für Leichtmetalle), J. Dornauf. Korrosion u. Metallschutz (Berlin), vol. 4, no. 5, May 1928, pp. 98-102, 20 figs. Corrosion tests of light metals used in aviation, mostly aluminum alloys, protected by cadmium coating vs. other protective coatings show considerable advantages of cadmium.

CARBON DIOXIDE

MOLLIER DIAGRAM. A Mollier Diagram for Carbon Dioxide, N. H. Hiller, Jr. Ice and Refrig., vol. 75, no. 1, July 1928, pp. 45-50, 8 figs. Its use with regard to simple and multiple-effect compression; charts and indicator diagrams based on Mollier's law on same basis as ammonia charts. Paper read at 5th Int. Congress of Refrigeration held in Rome, Italy.

REFRIGERANT. Recent Improvements in Carbon-Dioxide Equipment, J. C. Goosmann and F. R. Zumbro. Refrig. Eng., vol. 16, no. 1, July 1928, pp. 1-10, 18 figs. Various features of carbon-dioxide compression system are considered in descriptive fashion; experimental questions previously considered are discussed by author and others; liquefaction of carbon dioxide; carbon dioxide as refrigerant; selective cycle; displacement, theoretical and actual, condensers.

CARDBOARD TESTING MACHINES

DESCRIPTION. New Instrument for Testing the Bending Strength and Bending Angle of Boards. Instruments, vol. 1, no. 6, June 1928, pp. 291-292, 2 figs. Detailed description of machine of service to card-board and folding-box industries for controlling manufacturing process, determining influences of thickness of layers, obtaining comparative data on methods of grinding, check on raw materials, etc.

CARGO HANDLING

BULK, GREAT LAKES. Shipping on the Great Lakes is An Indispensable Asset to Business, J. F. Froggett. Mar. Rev., vol. 58, no. 7, July 1928, pp. 78-82, 10 figs. Unloading by machinery; story of development of lake port equipment for handling materials in bulk; efficient bulk material handling shapes destiny of lake shipping; number of fast coal-loading plants at lower lake ports which pick up entire car, turn it over and dump contents at one operation into hold of vessel; records for unloading at upper lake docks.

CARS

BRAKES. Brakes and Brake Equipment Committee's Report. Can. Ry. and Mar. World (Toronto), no. 365, July 1928, pp. 388-389, 1 fig. Braking power on refrigerator cars; triple valve gaskets; brake leverage ratio for passenger cars; bushing triple-valve exhaust ports; centrifugal dirt collectors; cleaning, lubricating and testing air brakes on passenger equipment cars. Report to Am. Ry. Assn.

CASE HARDENING

FACTS. Facts and Principles Concerning Steel and Heat Treatment, H. B. Knowlton. Am. Soc. Steel Treating—Trans., vol. 14, no. 1, July 1928, pp. 127-148. Discussion of solid carburizing materials, method of packing carburizing, carburizing protection, reuses of carburizing materials, carburizing furnaces, carburizing containers, gas carburizing, and methods of control of depth of case; action of base materials and chemical energizers in carburizing compounds is explained.

NITRATION. Steels for Case Nitrification, A. B. Kinzel. Am. Soc. Steel Treating—Trans., vol. 14, no. 2, Aug. 1928, pp. 248-253 and (discussion) 253-254.

CASEIN

MANUFACTURE. Casein Plastic Material (La caséine matière plastique), M. Fouassier. Nature (Paris), no. 2788, July 1, 1928, pp. 20-22, 5 figs. Manufacture of casein in plates or rods; formaldehyde treatment; uses of hardened casein; market for casein.

CAST IRON

IMPROVEMENT. High-Grade Cupola Cast Iron (Hochwertiges Kupolofengusseisen), F. Dengler. Zeit. für die Gesamte Giessereipraxis (Berlin), vol. 49, nos. 26 and 27, June 24 and July 1, 1928, pp. 221-223 and 229-231, 17 figs.

Manufacture of High-Grade Cast Iron (La fabrication des fontes résistantes), M. Girardet. Société Industrielle de l'Est—Bul. (Nancy, France), no. 188, Jan.-Feb.-Mar. 1928, pp. 5-23, 1 fig. Composition of mixture; action on graphite; use of single cupola; accessories to improve cupola castings; shaking hearth of Dechesne for desulphurizing of cast iron, and its mode of operation; gyratory hearth according to author's system. Bibliography.

TESTING. Engineering Tests for Cast Iron, J. G. Pearce. West of Scotland Iron and Steel Inst.—Jl. (Glasgow), vol. 35, part 5, Feb. 1928, pp. 80-90, 4 figs. partly on supp. plates.

CEMENT INDUSTRY

HEALTH OF WORKERS. The Health of Workers in Dusty Trades. Pub. Health Reports, vol. 43, no. 24, June 15, 1928, pp. 1497-1498. Brief digest of investigation of effect of dust upon health of workers in large portland-cement plant made by U. S. Public Health Service; complete report published as Public Health Bulletin, No. 176.

CHEMICAL ENGINEERING

DEVELOPMENTS. The Genesis of Industrial Chemistry, A. D. Little. Technology Rev., vol. 30, no. 8, July 1928, pp. 481-485, 7 figs.

CHEMICAL INDUSTRIES

ONTARIO. London's Contribution to the History of Chemical Industry, J. H. Bowman. Can. Chem. and Met. (Toronto), vol. 12, no. 7, July 1928, pp. 193-195. Article deals chiefly with manufacture of sulphuric acid by Canada Chemical Co. at London, Ontario; works erected in 1866; review of progress; enumerates other chemicals manufactured and also mentions soap and other industries established in same city in Ontario.

CHIMNEYS

REINFORCED CONCRETE. Noranda's Reinforced Concrete Chimney, E. H. Macdermott. Can. Min. Jl. (Gardenvale, Que.), vol. 49, no. 24, June 15, 1928, pp. 486-487, 1 fig. Tallest reinforced-concrete chimney on American continent erected during 1927 at plant of Horne Copper Corp., Noranda, Rouyn District, Province of Quebec, Canada; 442 ft. 6 in. high from bottom of base to top of shaft, and 18 ft. in diameter inside lining at top; lined with 4-in. acid-resisting, vitreous brick laid up in special acid-proof mortar; 110 ft. of outside and entire inside of concrete wall is covered with acid-resisting bitumastic paint.

CHROMIUM ALLOYS

CHROMIUM-COPPER STEEL. The Development of High-Grade Structural Steel (Zur Fortentwicklung des hochwertigen Baustahles), E. H. Schulz. Stahl u. Eisen (Düsseldorf), vol. 48, no. 26, June 28, 1928, pp. 849-853, 4 figs. Discussion of development and properties of structural steel; strength, corrosion resistance, and technological properties of new chromium-copper structural steel with 0.5 to 0.8 per cent copper, 0.4 per cent chromium, and 0.15 per cent carbon, having strength properties of silicon steel with 1 per cent silicon.

CHROMIUM-NICKEL STEEL. A Note on the Hardness and Impact Resistance of Chromium-Nickel Steel, B. F. Shepherd. Am. Soc. Steel Treating—Trans., vol. 14, no. 1, July 1928, pp. 67-71, 1 fig. Results are given of Izod impact, hardness, and tensile tests of chromium-nickel steel of S.A.E. 3250 type with varying nickel and carbon content; higher carbon reduces resistance to impact without production of increased hardness; tempering to 300 deg. fahr. increases impact resistance without materially affecting hardness, but best use of this type of steel is with 550-deg. fahr. temperature.

CHROMIUM STEEL

OXYACETYLENE WELDING. Welding Chrome Irons and Steels. Iron and Steel of Can. (Gardenvale, Que.), vol. 11, no. 6, June 1928, pp. 182-183. Must prepare clean joints, use proper flux and strictly neutral flame of minimum dimensions, ending with properly adjusted heat treatment; commercial high-chromium alloys can be welded with oxyacetylene flame; heat treatment of welded joints; rustless chrome-nickel irons give ductile welds; castings should be welded hot. Abstracted from Oxy-Acetylene Tips, Apr. 1928.

CITIES AND TOWNS

SANITATION. Place of Sanitation in City Planning, G. W. Hayler. Can. Engr. (Toronto), vol. 55, no. 2, July 10, 1928, p. 127. Sanitation must be considered in any system of town planning when sewage-disposal plans or sewer outfalls come outside municipal boundary; creation of metropolitan districts to amalgamate various sanitary units within given areas; regional planning now thinks of sanitation as regional and bound up with many other subjects and in this sense it is being placed on equal footing with regional highways, transportation, parks, etc.

COAL

BY-PRODUCTS. Increasing Coal Value (Die Auswertung der Kohle), O. Huppert. V.D.I. Zeit. (Berlin), vol. 72, no. 28, July 14, 1928, pp. 975-983, 8 figs. Synthetic ammonia by Haber-Bosch process; sulphate of ammonia and sodium salpeter as by-products; distillation of coal; hydrogen by Bronn-Linde-Concordia process; low-temperature-tar process; Prudhomme process; obtaining liquid fuels with carbon monoxyde; gas generators working with oxygen; hydrogenation of coal and tars; coke-oven water gas.

CARBONIZATION, LOW TEMPERATURE. A General Review of Low-Temperature Carbonization, F. S. Sinnatt. Fuel (Lond.), vol. 7, no. 7, July 1928, pp. 305-317. Objects of paper are to examine products of chief processes of low-temperature carbonization, and to collect suggestions as to ways in which products can be utilized; gives list of plants of which large-scale units exist in Great Britain using different processes.

CARBONIZATION, LURGI PROCESS. Lurgi's Distillation Process (Das Lurgi-Schwelverfahren), F. A. Oetken and O. Hubmann. Montanistische Rundschau (Berlin), vol. 20, no. 14, July 16, 1928, pp. 525-530, 5 figs. Description of modern German method of coal distillation introduced by Lurgi Combustion Engrg. Co. of Frankfort-on-Main, used for lignite, peat, and similar fuels in current of hot gases; examples of installations for daily capacities of, respectively, 25, 120, 360, and 500 tons per 24 hrs.

CARBONIZATION, RESEARCH. The Influence of Inorganic Constituents in the Carbonization and Gasification of Coal, J. J. Priestley and J. W. Cobb. Gas Jl. (Lond.), vol. 182, no. 3396, June 16, 1928, pp. 951-954, 5 figs.

DISTILLATION. Oils From Shale, Lignite and Coal, J. W. Horne and A. D. Bauer. Oil and Gas Jl., vol. 27, no. 7, July 5, 1928, pp. 168 and 170 and 172 and 174-177, 1 fig.

DISTILLATION, LOW TEMPERATURE. Manufacturing Oil from Oil Shale and Bituminous Coal, G. W. Wallace. Combustion, vol. 19, no. 1, July 1928, pp. 23-28, 4 figs. Description of Dundas-Howes process; low-temperature distillation of oil shale and bituminous coal; units in Santa Barbara County, Calif.; general arrangement of N-T-U Company's plant in California; capacity of plant is 200 tons per day; cost of operating plant.

PULVERIZERS. How Does a Coal Pulverizer Do Its Job? J. K. Blum. Power, vol. 68, no. 3, July 17, 1928, pp. 100-102. Author analyzes performance of coal pulverizing mills and shows how to study given mill and how to estimate its measure of excellence; fundamentals; practical application.

SPONTANEOUS COMBUSTION. Spontaneous Heating of Coal, J. D. Davis and D. A. Reynolds. U. S. Bur. of Mines—Tech. paper, no. 409, 1928, 74 pp. 20 figs. Purpose of paper is to assemble results of investigations, previously reported on in part, and correlate with those of other investigations; review of previous investigations; theory of spontaneous heating; relative tendency of various coals to oxidize; methods for determining such tendency; oxidation of banded constituents and of those separable by solvents; weathering; effect of preheating; factors affecting spontaneous heating of coal; recapitulation. Bibliography.

COAL INDUSTRY

STATISTICS, CANADA. Coal and Coke Statistics for Canada. Can. Dominion Bur. of Statistics (Ottawa), vol. 7, no. 1, Jan., Feb., Mar. 1928, 15 pp. Increase of 3 per cent in output from Canadian mines; total 4,498,561 tons produced in first quarter of 1928; imports; exports; men employed; statistical tables; key map of principal importing areas.

COAL MINES AND MINING

ELECTRIC POWER. Electricity in Coal Mines, E. L. Martheleur. Can. Min. and Met. Bul. (Montreal), no. 195, July 1928, pp. 865-915, 21 figs. Great progress in development of electric mining apparatus in last decade; potential dangers of electricity in coal mines; shocks; fire; explosions of gas or coal dust, or of circuit-breaker apparatus; alternating or direct current; transmission; substations; transformers; switchgear; motors; enclosures; control; earthing; testing and records.

UNDERGROUND TRANSPORTATION. A New Portable Turnout, B. E. Schonthal. Coal Mine Mgmt., vol. 7, no. 5, June 1928, pp. 42-44, 4 figs. Describes advantages of special track necessary in increasing efficiency of loading machines.

COAL TAR

BY-PRODUCT. Values in By-Product Tar, J. M. Weiss. Iron and Steel of Canada (Gardenvale, Que.), vol. 11, no. 7, July 1928, p. 215. Coal-tar disposal in steel industry is discussed; special conditions of plant location, quality of tar, and location of markets may combine to set minimum profitable tonnage either somewhat above or below figure stated; marketing proposition very easy as only product to sell is creosote oil; supply limits use of creosote at present time; profit figures are given.

CONCRETE

PAINTING. The Proper Way in Which to Paint Concrete, M. Toch. Contract Rec. (Toronto), vol. 42, no. 29, July 18, 1928, pp. 751-752. Colors that are safe to use and how they should be applied; treatment of concrete to prevent peeling; list of colors that are not acted upon by ordinary alkali can be furnished by any reputable manufacturer of oil colors; method of described decorating concrete also applies to new plaster.

TESTING. A New Mold and Concrete Test Methods on Port of N. Y. Authority Bridges, A. W. Munsell. Eng. News-Rec., vol. 101, no. 4, July 26, 1928, pp. 140-141, 2 figs. Description of type of mould used by bridge department of Port of New York Authority for making test cylinders in field, and form used for recording necessary data; mould consists of three pieces, 8 x 16-in. cylinder, bottom plate with band attached, and top plate.

VIBROLITHIC, TESTING. Beam Tests of Pavement Concrete Placed by Two Methods, T. R. Beeman. Eng. News-Rec., vol. 101, no. 6, Aug. 9, 1928, pp. 200-202, 2 figs. Tests of slabs of standard 1:2:3 concrete and of slabs of compacted (vibrolithic) 1:2:4½ concrete showing that standard specimens carried average applied load 12.1 to 15 per cent greater than that shown by compacted; comments by A. R. Hirst, chief engineer of Am. Vibrolithic Corp., stating that these tests cannot be considered as of standard vibrolithic construction; recalls satisfactory results of tests of vibrolithic concrete by U. S. Bur. of Pub. Roads.

CONCRETE CONSTRUCTION

REINFORCED, DESIGN. Designing Reinforced Concrete Against Bending and Compression, C. L. Christensen. Eng. News-Rec., vol. 101, no. 4, July 26, 1928, pp. 127-128, 2 figs. Method of designing beams and columns permits direct calculation of steel without preliminary computations; presents direct method which is believed to be both simple and usable; reinforcement on tension side only; reinforcement at both faces; factor of safety.

Reinforced Concrete Design Simplified, J. R. Griffith. Concrete, vol. 33, no. 1, July 1928, pp. 27-31, 8 figs. Diagonal tension and shear; chart D-1 is designed to determine unit shear in reinforced-concrete beams; web stresses; continuous beams with concentrated loads.

COPPER ALLOYS

COPPER-NICKEL ALLOYS. Copper-Nickel Alloys. Machy. (Lond.), vol. 32, no. 821, July 5, 1928, pp. 450-451. Properties and industrial applications of copper-nickel alloys; addition of relatively small amounts of nickel increases hardness of copper and its resistance of oxidation at elevated temperatures; influence of carbon, sulphur, and manganese; corrosion-resisting property.

HEAT TREATMENT. The Effect of Heat Treatment on Some Mechanical Properties of 86:4:6:3:1 Copper-Nickel-Tin-Zinc-Lead Alloy, R. J. Anderson. Am. Metal, vol. 35, no. 134 (2nd Section), July 14, 1928, pp. 1-3 and 14, 12 figs. Object of present investigation was to examine effect of heating at different temperatures and for various periods of time, followed by air cooling, on tensile properties and hardness of sand-cast alloy having nominal composition 86:4:6:3:1 copper-nickel-tin-zinc-lead; method of investigation; results of tests. Selected bibliography.

CRANKSHAFTS

STIFFNESS CALCULATION. An Empirical Formula for Crankshaft Stiffness in Torsion, B. C. Carter. Engineering (Lond.), vol. 126, no. 3261, July 13, 1928, pp. 36-39, 2 figs. Formula put forward was evolved from results of stiffness tests on crankshafts of marine, aircraft and automobile types; in all cases shafts were twisted in bearings with clearances approximating to those used in ordinary working, and all stiffness relate to transmitted torque.

CULVERTS

DESIGN. Design and Location of Culverts, A. Sedgwick. Contract Rec. (Toronto), vol. 42, no. 30, July 25, 1928, pp. 782-783. Important points for highway engineer to take into consideration when making provision for carrying watercourses across road site; results of inexperience and carelessness; wide culverts are safer; culverts beneath embankments.

SIPHON, WELLAND SHIP CANAL. Discussion of paper on the Chippewa Creek Syphon Culvert of the Welland Ship Canal by A. H. Grant. Eng. Jl. (Montreal), vol. 11, no. 7, July 1928, pp. 427-431. Discussion by A. S. Dawes, O. O. Lefebvre, T. K. Thomson, G. S. G. Rogers, D. W. McLachlan. Published in Eng. Jl., Feb. 1928.

D

DAMS

ARCH, DESIGN. Multi-Centred Fixed Ended Arch Rings of Arch Dams, and Their Analysis, F. W. Hanna and T. L. E. Haug. West. Const. News, vol. 3, no. 12, June 25, 1928, pp. 414-417, 5 figs. Important to have convenient method for analysis of multi-centred arch rings of dams, and there are presented in this article two such methods; second method is especially adapted to inclined arches of multiple-arch dams, whereon water loading is not uniform; three centred multi-centred arch rings.

FAILURES, ST. FRANCIS. Deficiencies in Dam Design as Illustrated by the St. Francis Failure, M. H. Gerry, Jr. Eng. News-Rec., vol. 100, no. 25, June 21, 1928, p. 983. Author holds strongly to following tenets: (1) that failure of St. Francis dam was due, primarily, to deficiencies in design; (2) that design used was result of unwise confidence in theory now generally applied to masonry dams; (3) that this theory ought to be replaced by more accurate and logical methods of design.

DIE CASTING

METALS AND ALLOYS. A.S.T.M. Report on Die Cast Metals and Alloys. Am. Metal Market, vol. 35, no. 134 (2nd section), July 14, 1928, pp. 16-21, 1 fig. Co-operating producers; co-operating testing laboratories; standardize certain variables; standardization of tension testing procedure; information is also needed regarding relative corrosion resistance of various die-casting alloys; standard testing procedure specifications for Rockwell special "E" scale. Report presented before Am. Soc. of Testing Materials.

DIES

HARDENING. Hardening Cold Heading Dies, L. S. Cope. Am. Soc. Treating—Trans., vol. 14, no. 1, July 1928, pp. 51-60, 11 figs. Author describes quenching apparatus which has been successfully used to quench die so that portion around hole will be hard to withstand wear and remainder of die will be soft enough to withstand shock produced by cold heading; pair of tongs is also described by which header hammers may be quenched so that ends only will be hardened.

DIESEL ENGINES

FUEL INJECTORS. Manufacture of Diesel Fuel Injectors, C. R. Alden. Am. Soc. Mech. Engrs.—Advance paper for mtg., June 14-16, 1928, 5 pp., 7 figs. Need for extreme accuracy in certain parts of fuel-injection system is keenly realized; it is author's opinion that designer and builder have been slow to co-operate to their maximum advantage. Read at National Oil and Gas Power Mtg. See also Motorship, vol. 13, no. 7, July 1928, p. 581.

HEAT TRANSMISSION. Variation in the Rate of Heat Transmission in a Sulzer Marine Diesel Engine During One Revolution. Sulzer Tech. Rev. (Winterthur, Switzerland), no. 2, 1928, pp. 11-15, 19 figs. Rate of heat transmission between products of combustion and cylinder walls; actual flow in cylinder can be subdivided according to manner in which it originates.

HIGH SPEED. The High-Speed Diesel Engine as a Competitive Power Generator, C. E. Lucke. Soc. Automotive Engrs.—Jl., vol. 23, no. 1, July 1928, pp. 46-49, 2 figs.

LARGE. The Economic Field for Large Diesel Engines, E. B. Pollister. Am. Soc. Mech. Engrs.—advance paper for mtg., June 14-16, 1928, 7 pp., 10 figs. Important market analysis by one of foremost executives in Diesel industry; large Diesel may be considered as of from 2,500 to 25,000 b.hp.; estimate of cost of 4-unit 15,000-b.hp. 10,000-kw. Diesel installation; use of large Diesel by public utilities has been alone considered. See also Motorship, vol. 13, no. 7, July 1928, p. 582; and Oil Engine Power, vol. 6, no. 7, July 11, pp. 446-452, 7 figs. Read at Nat. Oil and Gas Power Mtg.

MANUFACTURE. Specialization in Manufacturing Diesel Engines, O. D. Treiber. Am. Soc. Mech. Engrs.—advance paper for mtg., June 14-16, 1928, 2 pp. See also Motorship, vol. 13, no. 7, July 1928, p. 579.

POWER PLANTS. Some Considerations Regarding the Peak-Load Problem and High-Powered Peak-Load Diesel Engines, M. Gercke. Diesel Engine Users' Assn. (Lond.)—Paper no. S85, 1928, pp. 1-22 and (discussion) 23-51, 17 figs. Load conditions of some typical German electric power plants; economical effect of peak loads on efficiency of steam power plants; peak-load equipments; general comparison of "primary" and "secondary" peak-load installations; individual comparison of primary peak-load units; application of high-powered gas engines for peak-load purposes. See abstract in Combustion, vol. 19, no. 1, July 1928, pp. 33-34.

PULVERIZED FUEL. The Coal-Dust Engine Upsets Traditions, R. Pavolikowski. Power, vol. 68, no. 4, July 24, 1928, pp. 136-138, 4 figs. Engine burning pulverized coal has been developed in Germany; operates equally well with pulverized coal or oil or with mixture of two; initial compression of 440 lb. abs.; delivers 1 b.hp. on 8,000 B.t.u. of pulverized coal; 3-cylinder Diesel arranged with pulverized-coal attachments; operation described briefly; Diesel advantages retained.

Powdered Fuel in Diesel Engines. Times Trade and Eng. Supp. (Lond.), vol. 2, no. 521, June 30, 1928, p. 395. Of recent years progress has been made at Kosmos works and trial engine of fair size built to plans of R. Pawlikowski has been running for some time; combustion is now so good that only entirely non-combustible matter remains as very fine dust, which is blown out with combustion gases; only about 8,000 B.t.u. required for one horsepower per hour.

SUPERCHARGING. Tests on a Diesel Engine With Büchi Turbo-Charging. Analysis of Results, A. Stodola. Mar. Engr. and Motorship Bldr. (Lond.), vol. 51, no. 611, July 1928, pp. 265-268, 9 figs. Fuel consumption amounts to 0.391 lb. per b.hp. per hour; turbo-supercharging improves specific fuel consumption of engine tested by about 4 per cent; calculation of charging air quantity; results of tests on six-cylinder four stroke-cycle single-acting Diesel with Büchi exhaust-gas turbine charging.

DISKS, ROTATING

STRESS ANALYSIS. A Simplified Method of Determining Stresses in Rotating Disks, M. G. Driessen. Am. Soc. Mech. Engrs.—advanced paper for mtg., Aug. 27-30, 1928, 5 pp., 7 figs. Problem of determination of stresses in revolving disk is discussed; manner by which results once obtained can be used for different loads at circumference and for different speeds is indicated disadvantages in Donath method of determining stresses in rotating disks, such as disks of steam turbine rotors, are shown.

DOCKS

MATERIALS HANDLING. Modern Equipment Speeds Work on Lake Docks. Can. Machy. (Toronto), vol. 39, no. 13, June 1928, pp. 90, 92 and 94. Scope of this paper does not include handling of bulk commodities in small capacities, but rather methods which have resulted in vast production of today; reviews briefly historical side of development of modern equipment; latest plant of Western Maryland Railway is first step in revolutionary revision of modern coal-loading methods; superior advantages; loading of ore; almost eliminates shovel; progressive steps.

E

ELECTRICAL ENGINEERING

CALCULUS APPLICATIONS. Heaviside's Operational Calculus as Applied to Engineering and Physics, E. J. Berg. Gen. Elec. Rev., vol. 31, nos. 2 and 3, Feb. and Mar. 1928, pp. 93-96 and 143-146, 8 figs. Feb.: Nature and practical value of operational solution; expansion theorem. Mar.: Expansion theorem applied to some definite problems; operations on unit function squared have no physical significance; additional operators employed when network is suddenly connected to alternator instead of to battery of constant voltage. (Continuation of serial.)

RESEARCH. Annual Report of the Committee on Research. Am. Inst. Elec. Engrs.—Jl., vol. 47, no. 7, July 1928, pp. 531-533. Examples of outstanding research during year; advance in television; Knowles tube and its application to televox; radio beacon system for aviators; researches of fundamental nature; operation by Coolidge of three cathode-ray tubes in series at 900,000 volts; lightning generator; work on insulation and lightning measurements on transmission lines; research organizations; Public Utilities are entering research field; training of research workers.

ELECTRIC APPARATUS

DIELECTRIC TESTING. Measurement of Test Voltage in Dielectric Tests. Am. Inst. Elec. Engrs. (A.I.E.E. Standards), no. 4, May 1928, pp. 5-10. Standards are set forth for measurement of test voltage in dielectric tests of electric apparatus; voltage measurement; needle spark gap; sphere spark gap; testing equipment and arrangement.

ELECTRIC BUSBARS

CONCRETE, TESTING. Concrete Bus-Structure Tests, W. A. Kates. Elec. World, vol. 91, no. 26, June 30, 1928, pp. 1379-1382, 17 figs. Characteristic failures of monolithic, thin-wall bus structures and supporting equipment developed in laboratory tests; tension and compression strength values established.

ELECTRIC CABLES

HIGH TENSION, INSULATION. Residual Air and Moisture in Impregnated Paper Insulation, J. B. Whitehead, W. B. Kouwenhoven and F. Hamburger, Jr. Am. Inst. Elec. Engrs.—advance paper, no. 53, for mtg. Apr. 17-20, 1928, 11 pp., 14 figs. Paper describes further experiments on drying and impregnating processes of impregnated paper insulation for high-voltage cables; qualities of product are discussed from standpoint of conductivity, dielectric absorption and power factor.

LEAD SHEATHING. The Physical Properties of Lead Cable-Sheaths. Instn. Elec. Engrs.—Jl. (Lond.), vol. 6, no. 378, June 1928, pp. 638-641, 2 figs. Discussion of paper which appeared in Mar. 1928 issue of same journal, previously annotated.

SPLICING. Electricity Used in Cable Splicing. Elec. World, vol. 92, no. 2, July 14, 1928, p. 60, 2 figs. Recent development of successful electric solder pot for field use has led New York Edison Co. to equip several tool carts so that power can be supplied to solder pots, compound kettles, soldering irons, portable lamps and other appliances required for cable splicing; current is taken from nearest lamp post over 250-ft. flexible cable wound on reel inside of tool cart.

ELECTRIC CAPACITORS

SERIES. The Series Capacitor Installation at Ballston, N.Y., E. K. Shelton. Gen. Elec. Rev., vol. 31, no. 8, Aug. 1928, pp. 432-434, 4 figs. Three-phase 1,245-kva. rating; connected in loop circuit; increases load-carrying capacity of line; improves voltage regulation; equipment and operation; first installation of its kind in world; series capacitor for compensator of transmission-line reactance.

TRANSMISSION. Direct-Current Transmission Approximated with Alternating Current. Power, vol. 68, no. 2, July 10, 1928, p. 80, 1 fig. Transmission characteristics closely approaching those of high-voltage direct current were realized for first time with installation by General Electric Co. of three series capacitors (static condensers) on tie-line operated by New York Power & Light Corp.; at Ballston Spa, N.Y.; capacitors, connected directly in series with 33,000-volt 7,500-kva. line running from Amsterdam to Ballston substation, compensate completely for transformer and line reactance at all loads.

ELECTRIC CIRCUIT BREAKERS

ALARM SWITCHES. Circuit-Breaker Alarm-Switch, A. Lekstrom. Power, vol. 67, no. 26, June 26, 1928, p. 1152, 1 fig. In plant where author is employed it sometimes happens that circuit breaker releases while engineer is in boiler room, and as there is nothing to indicate position of circuit breaker without looking at it, electrician built alarm-switch described.

OIL. Operating Experience with High-Speed Oil Circuit Breakers, B. F. Bardo. Am. Inst. Elec. Engrs.—Jl., vol. 47, no. 7, July 1928, pp. 496-499, 7 figs. Outlines experience of New York, New Haven and Hartford Railroad with three high-speed oil circuit breakers serving electrified branch line; electrical and mechanical characteristics of these are set forth in detail and illustrated; detailed record of service operations of circuit breakers along with statement of failures.

ELECTRIC COMMUNICATION

INFORMATION. Transmission of Information. R. V. L. Hartley. Bell System Tech. Jl., vol. 7, no. 3, July 1928, pp. 535-563, 7 figs. Quantitative measure of information is developed based on physical as contrasted with psychological considerations; how rate of transmission of this information over system is limited by distortion resulting from storage of energy is discussed from transient viewpoint; several illustrations of application of this principle to practical systems; in case of picture transmission and television, special variation of intensity is analyzed by steady-state method.

ELECTRIC CONVERTERS

WINDINGS. Synchronous Converter Armature Windings, B. L. Robertson. Gen. Elec. Rev., vol. 31, no. 8, Aug. 1928, pp. 436-439, 10 figs. Article is written for purpose of clarifying some of details of construction of converter windings; treatment of wave windings in converters; definitions; lap-wound and wave-wound converters.

ELECTRIC FURNACES

ANNEALING. Annealing of Non-Ferrous Metals in the Electric Furnace, R. M. Keeney. Am. Metal Market, vol. 35, no. 111, June 12, 1928, pp. 24-26. Non-ferrous metal-annealing furnaces in Connecticut; brass; copper; nickel-silver; rolling mill. Paper presented before Am. Electrochem. Soc.

FOUNDRY. The Electric Furnace in Making Cast Iron. Heat Treating and Forging, vol. 14, no. 6, June 1928, p. 648. Cheap grades of scrap may be used in making synthetic cast iron of superior quality in any desired composition; product is of high strength, toughness and easily machined; investigation involved year's successful operation of jobbing foundry; in electric furnace superior iron, having about twice strength of ordinary cupola iron, can be made; total cost of iron in ladle would be $28 per ton.

New Products from an Old Iron Foundry. Iron Age, vol. 122, no. 2, July 12, 1928, pp. 78-80, 5 figs. Modern equipment transforms Chicago plant for American Manganese Steel Co., so that electric manganese steel castings can be made; sand-handling and annealing-furnace features; ball and roller bearings used throughout electrode-operating gear mechanism; electrodes are counterbalanced; annealing furnace has reducing atmosphere.

HIGH FREQUENCY. Small High-Frequency Induction Furnaces. Metallurgist (Supp. to Engineer, Lond.), June 29, 1928, p. 83. Reference is made to furnace described by J. R. Cain and A. A. Peterson (Jl. of Am. Electrochem. Soc., 1925, vol. 48, p. 139) in which inductor coil and supports, as well as charge, crucible, lagging, etc., were all contained within evacuated bell jar; and also to a furnace inside a bell jar, developed by E. W. Fell (Archiv füer das Eisenhuettenwesen, Apr. 1928) for preparation of iron and steel meltings of 1 kg.

ELECTRIC GENERATORS

EXCITER DRIVE. Drive for Engine Generator Set Exciters, G. E. Leavitt, Jr. Power, vol. 67, no. 26, June 26, 1928, p. 1153, 1 fig. Comparison of chain and belt drives may be summarized as follows: chain drive is more economical of space, has lower first cost, is cheaper to maintain, has longer life, is more efficient, and is more reliable than belt; with belt drive there is belt slipping and tightening to contend with.

LOAD DROPPING. Effect of Sudden Loss of Load, C. B. Hawkins, S. M. Jones and O. E. Charlton. Elec. World, vol. 91, no. 26, June 30, 1928, pp. 1385-1389, 21 figs. To determine increase in voltage and speed when full load is suddenly dropped from generator and to obtain data on operation of over-voltage, overfrequency relay, tests were made by Alabama Power Co. at its Mitchell Dam plant on Coosa River; overvoltage, overfrequency relay used was designed to open main field circuit and low-tension breaker when speed and voltage had increased to some predetermined value.

ELECTRIC INDUSTRY

DEVELOPMENTS. Development in the Past Year, S. E. M. Henderson. Elec. News (Toronto), vol. 37, no. 13, July 1, 1928, pp. 44-45. Welded-steel construction; mercury-arc power rectifiers; summary of advantages and disadvantages of rectifier as compared with synchronous converter.

ELECTRIC LINES

CONSTRUCTION, ONTARIO. Gatineau-Toronto Power Line. Can. Engr. (Toronto), vol. 54, no. 25, June 19, 1928, p. 627, 1 fig. Progress on construction of 200-mile transmission line being built between Gatineau River and Toronto for Ontario Hydro Commission.

INTERCONNECTED. Best Service, Fewest Interruptions, G. N. Tidd. Pub. Service Mgmt., vol. 45, no. 1, July 1928, pp. 9-10. Brief discussion of some of advantages of interconnection which is more matter of distribution than long-distance transmission.

OVERHEAD CONSTRUCTION. The Construction of Isle Maligne Transmission Line, T. M. Montague. Eng. Jl. (Montreal), vol. 11, no. 7, July 1928, pp. 424-427, 6 figs. General features of design, organization and construction of 3-phase, 60-cycle, 165,000-volt line through 130 mi. of undeveloped territory; construction organization and equipment; construction of tower bases; paper is written from construction viewpoint; erection of towers; stringing of conductors; method of hauling tower material.

OVERHEAD, ONTARIO. Developments in Distribution Line Construction, E. F. Hinch. Elec. News (Toronto), vol. 37, no. 14, July 15, 1928, pp. 36-39, 5 figs. Scheme evolved by Ontario Commission and Manufacturers; wet-process porcelain cutout; steel insulator pins; strain insulator clevis; solderless connectors; universal 8,000-volt transformer; wood poles; choice of voltage; 4,000 volts, 3-phase, 3-wire.

SURGES. Lightning Investigation on New England Power Company System, E. W. Dillard. Am. Inst. Elec. Engrs.—Jl., vol. 47, no. 7, July 1928, pp. 489-491, 7 figs. Analysis of surges recorded during 1927 on 75-mi. 110-kv. double-circuit transmission line of New England power system; surges are classified according to cause of surge-voltage damping, extent, etc.; general conclusions are drawn regarding nature of surges and protection afforded by ground wires.

Surge-Voltage Investigations. Elec. World, vol. 92, no. 1, July 7, 1928, pp. 5-8, 13 figs. Observations on six different systems reported at convention of Am. Inst. Elec. Engrs.; effect of ground wires, choke coils and lightning arresters; polarity, magnitude, wave front and attenuation. See also brief review of papers on p. 10.

ELECTRIC LOCOMOTIVES

MINE, STORAGE BATTERY. Storage Battery Locomotives for Mine Safety. Am. Inst. Elec. Engrs.—Jl., vol. 47, no. 7, July 1928, p. 487. Editorial comment on report by L. C. Ilsley issued by Bureau of Mines; Bureau of Mines has always looked upon permissible-type storage-battery locomotive with favor because of its inherent safety advantages; that its energy is self-contained and limited to immediate zone of locomotive is a safety factor of great importance; it can operate in any part of mine with same factor of safety.

ELECTRIC MEASURING INSTRUMENTS

DESCRIPTION. Electrical Measuring Instruments Other than Integrating Meters, C. V. Drysdale. Instn. Elec. Engrs.—Jl. (Lond.), vol. 66, no. 378, June 1928, pp. 596-616. Commercial indicating and recording instruments; electro-magnetic ammeters and voltmeters; induction, thermal, and electrostatic instruments; phase or power-factor indicators; frequency meters; leakage indicator; portable insulation-resistance and conductor-resistance testing sets; recording instruments; carbon-dioxide recorders; electric gas meters; water-testing apparatus.

ELECTRIC METERS

METHODS. Totalizing and Remote Metering Methods, H. S. Baker. Elec. News (Toronto), vol. 37, no. 13, July 1, 1928, pp. 51-53, 7 figs. Author explains details of multi-element totalizing graphic meters developed by him and outlines few methods of remote metering and totalizing of power. (Continuation of serial.) Read before New England branch of N.E.L.A. at Boston.

ELECTRIC MOTORS

BEARINGS. Industrial Motor Bearings, J. L. Brown. West Machy. World, vol. 19, no. 6, June 1928, pp. 242-245, 4 figs. Great bulk of industrial-motor applications successfully served by either ball, roller, or sleeve bearings when mounted in modern housings, and given care; considerations which influence choice of bearing for given application; sleeve bearing with appropriate housing is most suitable type for general-purpose motors; details of sealed-sleeve bearing.

DIRECT CURRENT, REVERSING. Structural Features of an 8,000 H.P. Reversing Direct-Current Mill Motor, H. E. Stokes and C. P. Croco. Elec. Jl., vol. 25, no. 7, July 1928, pp. 348-350, 4 figs. Built for Homestead Steel Works of Carnegie Steel Co.; weight of motor complete is 646,735 lb.; motor has continuous rating of 8,000 hp., 700 volts, 40 to 80 r.p.m.; magnet frame is of cast steel heavily ribbed on outer diameter; construction of commutator, armature coil supports and cross connections described.

INDUCTION. The Wound-Rotor Induction Motor, R. R. Sheely. Elec. Jl., vol. 25, no. 7, July 1928, pp. 342-344, 5 figs. Its performance and operation at reduced speeds; ratio of mechanical and electrical components of rotor output; very great speed reductions are undesirable on account of low efficiency; curves shown determined from tests on several motors.

INDUCTION STARTERS. Induction Motor Starter. Engineering (Lond.), vol. 126, no. 3260, July 6, 1928, p. 12, 2 figs. Details of starter put out by Igranic Electric Co.; switch is controlled by two push buttons, which are visible in open cover; upper of these is used for starting and lower, which is colored red, is employed for stopping and also for resetting overload trip mechanism.

MATERIALS. Changing from Cast Iron and Steel to Fabricated Steel, H. V. Putman and C. C. Brinton. Elec. Jl., vol. 25, no. 7, July 1928, pp. 331-339, 15 figs. Substitution of punched, pressed and rolled steel for castings; supplemented by further substitution of fabricated (usually arc-welded) structural steel instead of castings for largest and most complicated frames; equipment; tolerances; design; limitations of fabricated-steel construction.

SYNCHRONOUS. Design and Application of Two-Pole Synchronous Motors, D. W. McLenegan and I. H. Summers. Am. Inst. Elec. Engrs.—Jl., vol. 47, no. 8, Aug. 1928, pp. 585-590, 10 figs. Paper presents brief résumé of problems encountered in design of two-pole high-speed synchronous motors, and description of how they are met; satisfactory design is worked out; theory of starting winding is given in non-mathematical language, and curves showing results obtained insofar as current and torque are concerned; operating characteristics and method of controlling motors. Bibliography.

Synchronous Motors and Magnetic Clutches. Mech. World (Manchester), vol. 83, no. 2165, June 29, 1928, p. 465, 1 fig. Installation of synchronous motors in conjunction with magnetic clutches to permit starting without load, so that extra power load may be added without necessity for additional generators or transformers.

SYNCHRONOUS CONTROL. What It Pays to Know About Control Equipment for Synchronous Motors, D. W. McLenegan. Indus. Eng., vol. 86, no. 7, July 1928, pp. 333-336, 5 figs. Elements necessary for starting and operating any synchronous motor; advantages of remote control; semi-automatic starting has been developed; load interruption and resynchronizing; failure of excitation; use of panel meters.

ELECTRIC RAILROADS

REGENERATIVE CONTROL. Regeneration and Its Effect on Virtual Lengths on Electric Railways, F. Corini. Int. Ry. Congress—Bul. (Lond.), vol. 10, no. 6, June 1928, pp. 453-470, 9 figs. What it is in concrete terms; importance of regeneration and in what way its characteristics are shown; formulas can be applied approximately to lines operated by electric traction using locomotives which do not admit of regeneration; formulas given cannot be applied in case in which line is operated with locomotives which regenerate current; purpose to determine formulas for calculating virtual lengths to be applied in such case.

ELECTRIC STOVES

WIRING. California Range Wiring Requirements. Electragist, vol. 27, no. 9, July 1928, p. 31, 1 fig. Minimum has now been approved for State and typical layout is shown; requirements apply only to already wired buildings which are about to be wired for range.

ELECTRIC TRANSFORMERS

CUT-OUTS. Low Voltage Cut-Outs for Series Street-Lighting Transformers, E. J. Haverstick. Elec. Jl., vol. 25, no. 7, July 1928, pp. 340-342, 8 figs. Requirements for satisfactory cut-out; form of cut-out; effect of radiated discharge.

METHOD OF MEASURING. A Method of Measuring the Ratio and Phase Angle of a Current Transformer, W. I. Place. Instn. Elec. Engrs.—Jl. (Lond.), vol. 66, no. 378, June 1928, pp. 657-662, 8 figs. Method introduced in 1923 by E. Biffi is discussed; formulas are obtained for ratio and phase angle and for galvanometer current; application of method to comparative tests.

VOLTAGE REGULATORS. The Step Induction Regulator for Transformer Voltage Control, R. M. Field. Elec. Jl., vol. 25, no. 7, July 1928, pp. 351-354, 8 figs. Typical step-induction regulators are shown; schematic diagram of transformer winding with its taps connected through switching equipment to series transformer and induction regulator is shown; contactor switching equipment; equipment is normally motor operated and remotely controlled.

ELECTRIC TRANSMISSION AND DISTRIBUTION

AUTOMATIC SUBSTATIONS. Transmission and Automatic Substations. Elec. World, vol. 92, no. 1, July 7, 1928, pp. 11-12, 1 fig. Review of reports and discussion at session of Am. Inst. Elec. Engrs.; proposed standards for lightning arresters prepared by subcommittee; developments in current-limiting reactor practice; work of subcommittee on relays; report on automatic stations; general power applications; mechanization of mines, etc.; application of electricity to transportation, etc.

ELECTRIC WELDING

ARC, ELECTRONIC TORNADO. Magnetics Control Welding Arc, A. F. Davis. Iron Age, vol. 121, no. 26, June 28, 1928, pp. 1810-1811, 5 figs. Magnets produce electronic tornado and stabilize carbon arc; joints welded at high speed have superior ductility, appearance and strength; automatic machine for welding special piece of oil-field equipment; two new types of welding heads with their electrode holders crossing each other at sharp angle; cost of welding ½-in. plates.

ARC. Stability of the Welding Arc, P. Alexander. Can. Machy. (Toronto), vol. 39, no. 13, June 28, 1928, pp. 112-113, 132-134, 1 fig. Metallic welding arc is combination of two factors; conduction of electric current, and transfer of material across arc stream; first factor is discussed in this paper; thermionic emission; cooling of arc; series of experiments; conclusions drawn from above observations.

ELECTRICITY SUPPLY

INTERCONNECTION. Conowingo Hydroelectric Project With Particular Reference to Interconnection, W. C. L. Eglin. Am. Inst. Elec. Engrs.—advance paper, no. 24, for mtg. Feb. 13-17, 1928, 10 pp., 22 figs. Paper discusses interconnection between three of leading power-supply companies in eastern part of country; outlines physical aspects of tie-in between companies which is 220-kv. ring of high-load capacity, triangular in shape with sides respectively 49 mi. and 77 mi. long; advantages of interconnection are enumerated as well as some of operating problems; discusses Conowingo hydroelectric project.

ELEVATORS

ELECTRIC, OPERATION. Are Your Elevators Giving the Service That They Should? F. A. Annett. Power, vol. 68, no. 1, July 3, 1928, pp. 18-21, 4 figs. Author tells how practically 100 per cent elevator service is obtained by one large office building; operating records kept; car schedules maintained; inspection and maintenance procedure and costs of operation are given.

ENGINEERING MATERIALS

SPECIFICATIONS. Specifications and Procurement of Manufacturing Materials, D. F. Miner. Am. Mach., vol. 69, no. 2, July 12, 1928, pp. 37-40. Description of methods employed by Westinghouse Elec. & Mfg. Co., showing how design engineer co-ordinates efforts to obtain best material for products; although responsibility for material rests on one capable executive, choice is actually result of suggestions from all departments.

ENGINEERS

FAILURES. Too Many Engineers? Iron and Steel of Canada (Gardenvale, Que.), vol. 11, no. 7, July 1928, p. 209. Men who drift out of engineering are failures as engineers; if entering freshmen students could be weeded out by more searching entrance test, both mental and physical, enormous amount of misspent energy on part of those foredoomed to failure in engineering would be saved.

F

FACTORY BUILDINGS

WELDED STEEL. Factory Building is of All-Welded Steel Construction. Can. Machy. (Toronto), vol. 34, no. 14, July 12, 1928, pp. 36, 38, 3 figs. Steel-frame factory building, welded instead of riveted, is being erected by General Electric Co., at its new plant in Philadelphia; 140 feet wide, 600 feet long and 50 feet high; will cost less; results of tests; principal elements from which building framework was constructed were welded in shops of American Bridge Co., in Trenton, N.J.

FEEDWATER HEATERS

HIGH-PRESSURE. High Pressure Feed Water Heaters for Philo. Heat. Eng., vol. 3, no. 6, June 1928, pp. 10-11, 2 figs. Feedwater will be heated by stage feedwater heaters to temperature of 320 deg. fahr.; each heater will be supplied with bled steam at 100 lb. per sq. in. absolute; water spaces of heaters designed for 900 lb. working pressure; water ends made up entirely of rolled steel.

FLOOD CONTROL

SLOPE CORRECTION, MISSISSIPPI. Flood Control Through Slope Correction, W. E. Elam. Eng. News-Rec., vol. 100, no. 26, June 28, 1928, pp. 996-1001, 9 figs. Principle of uniform discharge through uniform slope and channel width applied to Mississippi; control may be attained through revetment, levees, delta reservoirs, and possibly channel shortening; twelve main reaches of Mississippi proposed for study of straightening and shortening river channel; coincident high- and low-water channels desirable; swiftest currents in bends causing caving where slopes are flattest; high-water profiles of Mississippi from Cairo to Gulf; where cutoffs are possible.

FLOORS

CONCRETE, CODES. Code Provisions for Concrete Floors. Concrete, vol. 33, no. 1, July 1928, pp. 23-24, 1 fig. Analysis of provisions in several building codes; new formula now proposed by Building Code Committee of Syracuse, N.Y.; reduced live-load chart; purpose of formula and recognition it gives to heavier dead weight of certain types of floor.

FLOW OF FLUIDS

PIPES. The Flow and Measurement of Petroleum Products in Pipe-Lines, S. W. Adey. Inst. Petroleum Technologists—Jl. (Lond.), vol. 14, no. 67, Apr. 1928, pp. 222-235, 3 figs. Mathematical discussion on measurement of flowing gas and oil.

The Flow of Fluids in Pipes, E. S. L. Beale and P. Docksey. Instn. Petroleum Technologists—Jl. (Lond.), vol. 14, no. 67, Apr. 1928, pp. 236-232, 3 figs. Mathematical discussion on theory of flow of fluids of different viscosities in pipes of various materials; temperature factors; viscosity-temperature charts; example of calculation, using given conversion formulas and graphs.

FORESTRY

BRITISH COLUMBIA. Forest Conservation in British Columbia, P. Z. Caverhill. Eng. Jl. (Montreal), vol. 11, no. 6, June 1928, pp. 366-370, 6 figs. Résumé of work being carried on by British Columbia Forest Service; forest protection; forest reserves; forest research.

FOUNDRY PRACTICE

FOUNDRYMEN CONFER. British Foundrymen Confer. Can. Foundrymen (Toronto), vol. 19, no. 7, July 1928, pp. 30-31 and 35. Review of papers presented at annual conference of Institute of British Foundrymen at Leicester; "Aluminum Casting Alloys," G. Mortimer; "The Cohesion of Rammed Sand," M. Lamoreaux; "Steel Castings for Severe Service," J. H. Hall; "Malleable Castings," W. T. Evans and H. E. Peace; "Iron Foundry Casting," W. R. Wintle.

FOUNDRIES

LAYOUT. Circular Foundry Built in Denmark Uses Every Inch of Space, V. Delport. Iron Trade Rev., vol. 83, no. 3, July 19, 1928, pp. 143-145, 6 figs. Circular foundry erected by Burmeister and Wain, Copenhagen, is 265 ft. in diam. and is connected to harbor on one side by canal extending into shop for 60 ft.; locomotive cranes on circular track outside handle flasks and other materials; two-storey structure of building houses office, store department, canteen and sanitary stations; steel mast serves as pivot for six electric traveling cranes.

FREQUENCY CHANGERS

VARIABLE RATIO. Interconnection of Power and Railroad Traction Systems by Means of Frequency Changers, L. Encke. Am. Inst. Elec. Engrs.—Jl., vol. 47, no. 7, July 1928, pp. 507-511, 20 figs. Several types of variable-ratio frequency changers are discussed and installations of such apparatus on electrified section of New York, New Haven & Hartford Railroad are described in some detail; functioning of regulating machines and auxiliary equipment to obtain desired results is explained, together with description of switching equipment installed in connection with main units.

FUEL UTILIZATION

SOLID AND LIQUID. Utilization of Solid and Liquid Fuels, C. H. Lander. Gas Jl. (Lond.), vol. 182, no. 3395, June 13, 1928, p. 719. Gas has greatest availability and highest efficiency; motor fuel and heavy oils gasified simply; pulverized fuel analogous to gas; modern boiler furnaces extract more energy from coal than can processes involving treatment before combustion; economic application of pretreatment depends upon local conditions. Abstract of paper read at Instn. Civil Engrs. See Colliery Guardian (Lond.), vol. 163, no. 3520, June 15, 1928, pp. 2349-2350, and Iron and Coal Trades Rev. (Lond.), vol. 116, no. 3144, June 1, p. 833.

FUELS

TECHNOLOGY. Modern Fuel Technology, D. Brownlie. Motor Transport (Lond.), vol. 46, no. 1215, June 25, 1928, pp. 781-782. Rapid advances in fuel research of great importance to British development of motor transport because of tax on imported motor fuel; fuels from bituminous coal; low-temperature carbonization; hydrogenation and synthetic processes; activity on Continent; steam vehicles and producer gas fuel; need for intensified research.

FURNACES, INDUSTRIAL

WALLS. Optimum Thickness of Furnace Walls (Ermittlung günstigster Wanddicken von Industrieöfen), H. Repky. Archiv. für Wärmewirtschaft (Berlin), vol. 9, no. 5, May 1928, pp. 145-149, 9 figs. Mathematical discussion dealing with heat losses by conductivity radiation, etc.; proper wall thickness for various operating conditions; analysis balancing cost of masonry and thermal insulation against higher operating costs due to heat losses.

FURNACES, REVERBERATORY

COPPER SMELTING. The Development of Reverberatory Furnace Smelting of Copper Ores and Concentrates, J. N. Anderson. Can. Min. Jl. (Gardenvale, Que.), vol. 49, nos. 21 and 22, May 25 and June 1, 1928, pp. 420-423 and 440-442, 5 figs. May 25: First practised on large scale at Swansea in Wales; practise in Chile, Montana, Colorado, Arizona, Utah and Mexico; first successful application of pulverized-coal firing, 1911, by D. H. Browne. June 1: Side feeding; fuel saving effected by charging calcines at higher temperature.

G

GARAGES

VENTILATION. Ventilating Garages to Remove Exhaust Fumes. Travelers Standard, vol. 16, no. 7, July 1928, pp. 147-150, 1 fig. Description of satisfactory systems installed garages to remove dangerous fumes and thus prevent carbon-monoxide poisoning.

GAS HEATING

DOMESTIC. Gas Heating for the Heating Contractor, G. C. Carnahan. Heat. & Vent. Mag., vol. 25, no. 7, July 1928, pp. 68-71 and 84, 6 figs. Climatic conditions on Pacific Coast favor gas heating and southwestern states enjoy advantages of natural gas; gas heating is further advanced on Pacific Coast than elsewhere; development slow in mountain states; Denver may be all-gas city; Texas uses local fuel; oil heating is popular in New Orleans; gas leads as domestic fuel in Oklahoma; low heat requirements permit use of small fixed and portable heating units. (Continuation of serial.)

GAS PIPE LINES

CORROSION. Corrosion in Gas Supply Practice, F. C. Smith. Gas Age Rec., vol. 44, no. 626, June 1928, pp. 155-158, 2 figs. Method of setting up cell in test to determine usefulness of method rather than effect of sulphur and manganese upon rate of corrosion; effect of admission of oxygen into cell upon resistance; detailed statement of basis of calculation for conductivity of solution; detailed results with discussion.

GAS PURIFICATION

DETAILS. Purification, L. G. Slack. Gas Jl. (Lond.), vol. 182, no. 3394, June 6, 1928, pp. 669-672 and (discussion) 672. Paper does not go into details of wet purification; deals with gas as it enters oxide boxes; suspended tarry matter; ammonia; sulphur compounds; sulphuretted hydrogen; description of plant; factors influencing oxide purification; alterations to purifying plants. Paper read before North of England Gas Mgrs. Assn. See also Gas World (Lond.), vol. 88, no. 2288, June 9, 1928, pp. 586-588.

GAS TANKS

WATERLESS. Waterless Gasholders, F. Prentice. Gas Jl. (Lond.), vol. 182, no. 3395, June 13, 1928, pp. 720-723, 1 fig. Lutes to cup and uncup; pressure remains constant and can be varied within limits to suit individual requirements; especially suitable for ground liable to subsidence; painting each year is no longer necessary; easily erected; in cold climates, absence of water in lutes and tanks minimizes all difficulties arising from low temperatures; figures of costs. Abstract of debate at Instn. Civil Engrs. Conference.

The Waterless Holder at Toronto, W. R. Gardner. Gas World (Lond.), vol. 89, no. 2293, July 14, 1928, p. 35. Description of construction and operation of holder with capacity of 4 million cu. ft., 161 ft. diam. and 222 ft. high, installed by Consumers Gas Co. Digest of papers presented before Canadian Gas Assn. See also Gas Jl. (Lond.), vol. 183, no. 3400, July 18, 1928, p. 142.

GASES

COMBUSTION. Gaseous Combustion at High Pressures, D. M. Newitt. Roy. Soc. Proc. (Lond.), vol. A119, no. A782, June 1, 1928, pp. 464-480, 2 figs. Discussion of co-volume corrections, maximum temperatures and dislocation of steam and carbon dioxide in explosions.

GASOLINE

PROPERTIES. How and Why of Gasoline Performance, J. B. Hill. Oil and Gas Jl., vol. 27, no. 8, July 12, 1928, pp. 78 and 116 and 119-120, 2 figs. Properties required by engine are points covered suitably by volatility and detonation tests; odor, corrosive qualities of fuel or exhaust gases, crankcase dilution and formation of solid deposits are important secondary requirements of automobile; color and gravity are not considered in modern tests. Paper presented before Am. Soc. Testing Materials.

GAS TURBINES

EXHAUST GAS. The Diesel-Engine Exhaust, H. A. Hepburn. Brit. Motorship (Lond.), vol. 9, no. 100, July 1928, pp. 150-151, 2 figs. Suggested method of increasing efficiency by 10 per cent; appears to be sounder proposition for large Diesel engines of 10,000 b.hp. and upwards to discharge at constant-exhaust pressure of say two to three atmospheres into receiver from which gases would expand from constant-pressure conditions through nozzle into turbine moving blades shows diagrammatically combined engine and turbine, latter being placed in line with cylinders and geared on to main engine shaft.

GEAR CUTTERS

REVIEW OF. Gear Cutting and Testing Machines. Am. Mach., vol. 69, no. 3, July 19, 1928, pp. 80-81, 6 figs. Semi-annual résumé of gear-cutting machines described in shop equipment news section during first six months of 1928; details of hobbers, shapers and generators and testing machines are given.

GEARS

POLISHERS. Gear Tooth Burnishing. Automobile Engr. (Lond.), vol. 18, no. 243, July 1928, pp. 255-256, 2 figs. Design and operation of machine made by Fellows Gear Shaper Co. for finishing gears of oil-hardening steels; chief object is to smooth working surfaces of gear teeth to reduce frictional resistance of teeth during period of sliding contact; gear to be burnished is supported entirely by burnishing gears and has no bearing on centre hole.

GEARS AND GEARING

FRICTION. Friction Gearing, L. T. Rutledge. Can. Machy. (Toronto), vol. 39, no. 12, June 14, 1928, pp. 30-31 and 68, 1 fig. Bevel friction gearing used to transmit power from one shaft to another; starting and running conditions; thrust on shafts.

LAMINATED. Laminated Gears in Industry. Plastics, vol. 4, no. 6, June 1928, pp. 342-349, 1 fig. Contrary to usual lay idea, laminated gears are in use for other and much heavier duties than auto timers; industrial applications; gear types installation.

LUBRICATION. Influence of Tooth Profile on Gear Lubrication (Einfluss der Zahnform auf die Schmierung bei Wälzzahnraidern), F. G. Altmann. Maschinenbau (Berlin), vol. 7, no. 12, June 21, 1928, pp. 596-600, 14 figs.

STRENGTH FORMULAS. Modification of the Lewis Formula for Determination of the Strength of Gears, H. T. Davey. Machy. (Lond.), vol. 32, no. 822, July 12, 1928, pp. 465-466. Discussion of formula for determining strength of gears with modifications to provide direct means of solving practical problems; tabulated values of formulas to give direct reading number of teeth.

GEOPHYSICAL EXPLORATION

METHODS. Gravitational Methods of Geophysical Prospecting, A. H. Miller. Can. Min. Jl. (Gardenvale, Que.), vol. 49. no. 24, June 15, 1928, pp. 476-481, 11 figs. Variation of gravity over earth's surface; pendulum; torsion balance and quantities it measures; principles upon which balance depends; survey of area with torsion balance; interpretation of results; corrections; difficulties and disadvantages; deflection of vertical or deviation of plumb line.

GIRDERS, PLATE

WELDING. A Study in Welded Plate Girders, F. P. McKibben. Am. Welding Soc.—Jl., vol. 7, no. 7, July 1928, pp. 13-21, 7 figs. Complete calculation for typical welded girder is presented, together with comparison between weights of several welded and riveted types.

GOLD MINES AND MINING

ONTARIO. Hollinger and McIntyre Compared. Can. Min. Jl. (Gardenvale, Que.), vol. 49, no. 23, June 8, 1928, p. 463. Tabulation of total and per share data on issued capital, ore reserves, surplus, dividends and market value of shares; Hollinger stock is valued on exchange at value of its known ore reserves plus surplus, whereas McIntyre stock is valued at figure which is about $5.50 per share higher than total of ore reserves and surplus.

GRAIN ELEVATORS

SARNIA, ONTARIO. New Grain Elevator at Sarnia, Ontario, W. B. Beatty. Can. Engr. (Toronto), vol. 54, no. 26, June 26, 1928, pp. 635-637, 6 figs. First unit of 4,000,000-bu. elevator constructed at Sarnia Bay; present storage capacity is 1,004,000 bushels; elevator is of reinforced-concrete construction; principal features of piling and construction contracts and equipment; 22 main circular bins 22 ft. 6 in. in diameter and 108 ft. deep; 14 smaller bins; concrete was 1:2:4 mix; marine unloading leg designed to handle 25,000 bushels of wheat per hour on dip.

GREAT LAKES

CHARTS. Survey of Northern and North-Western Lakes. U. S. Lake Survey Office—Bul., No. 37, Supp. No. 2, June 22, 1928, p. 11. To supplement information given upon charts of Great Lakes and issued with those charts from U. S. Lake Survey Office, Detroit, Mich.

GRINDING MACHINES

REVIEW OF. Grinding Machines. Am. Mach., vol. 69, no. 3, July 19, 1928, pp. 81-86, 28 figs. Semi-annual résumé of grinding machines described in shop equipment news section during first six months of 1928; details of surface, cylindrical, internal, portable, tool, and special-purpose machines are given as well as attachments. For grinding machines in European editions see pp. 129-131.

H

HANGARS

CONSTRUCTION. Airplane Hangar Door Construction. Contract Rec. (Toronto), vol. 42, no. 26, June 27, 1928, pp. 687-689, 3 figs. Arrangements of doors and tracks recommended by company that has made special study of hangar requirements; floor rollers and floor track eliminated; in two articles appearing in Contract Rec. of May 9 and 16, airplane-hangar construction was discussed as new field for contractors; drawings were shown and descriptions given of accordion-folding and sliding doors; in this article supplementary information concerning these types of doors is given; two methods of hanging the track are shown.

HEAT CONVECTION

LAWS OF. Laws of Heat Transmission by Convection (Les lois de la transmission de chaleur par convection), A. Leveque. Annales des Mines (Paris), vol. 13, no. 5, May 1928, pp. 305-362, 34 figs. Examination and interpretation of principal works on transmission of heat by convection; tests of M. V. Kammerer; problem of gas current inside a tube; experiments of Ser. Nicholson, Josse, Jordan, Nusselt, Poensgen, and comparison of them. (Continuation of serial.)

HEAT TRANSMISSION

SOLIDS. Heat Conduction in Solids (Zeichmerische Verfolgung der Wärmeleitung in Festen Koerpern), F. Nussbaum. Zeit. für angewandte Mathematik u. Mechanik (Berlin), vol. 8, no. 2, Apr. 1928, pp. 133-142, 7 figs. Author has developed graphic method of calculating flow of heat through solids which permits fairly accurate solution of uni-dimensional problems, and is also applicable to two-dimensional cases, although procedure is more complicated. See brief abstract in Archiv. fuer Wärmewirtschaft (Berlin), vol. 9, no. 6, June 1928, p. 179.

HEATING

RADIATION TABLES. Standard Radiation Estimating Table. Heat. and Piping Contractors Nat. Assn.—Official Bul., vol. 35, no. 7, July 1928, p. 69. Heating and Piping Contractors National Association standard radiation estimating table, showing radiation required for quantities indicated.

HIGH BUILDINGS

WIND STRESSES. Wind Stresses in Many-Storied Buildings, R. Fleming. Eng. and Contracting, vol. 6, no. 7, July 1928, pp. 371-375, 4 figs. Summary of engineering practice given; wind pressure on structures; surprising variation is found in requirements of codes; methods of determining stress; cantilever method; portal method; design of details; unit or working stresses.

HOTELS, CONSTRUCTION

OTTAWA. The Chateau Laurier Extension—One of Canada's Outstanding Pieces of Construction. Contract Rec. (Toronto), vol. 42, no. 30, July 25, 1928, pp. 769-774, 10 figs. Rapid progress is being made in erection of new wing to C.N.R. Hotel in Ottawa; steel-frame construction on concrete footings with floors of concrete; records progress that has been made to date; construction methods described commencing with excavating and foundation work; aerocrete for roof, partitions and floor fill; stone and sand supplies; stonework.

HOT WATER HEATING SYSTEMS

OXYACETYLENE WELDING. Construction Industry Welds Awkward Corners. Can. Machy. (Toronto), vol. 34, no. 14, July 12, 1928, pp. 40 and 42-45, 18 figs. Methods of applying oxyacetylene process to best advantages; tees, branches and special fittings are quickly made as desired; hot-water heating system of residence was welded; evident that oxyacetylene process offers plumbing and heating contractors new tool. Reprinted from Dominion Service Tips.

HOUSES

INSULATION. The Insulation of Dwellings. Eng. and Contracting, vol. 67, no. 8, Aug. 1928, p. 413. Example of heat saving; advantages not problematical; constant-temperature houses; there are in United States four private homes so planned that they have uniform temperature throughout year; factors needed to attain this. Abstract of paper presented before Int. Congress of Refrigeration, Rome, Italy.

HYDRAULIC PRESSES

TYPES. Guide Apparatus, Pressure Reducers and Pressure Transmitters for Hydraulic Presses and Machines (Les distributeurs, réducteurs et multiplicateurs pour presses et machines hydrauliques), A. Lambrette. Technique Moderne (Paris), vol. 20, no. 12, June 15, 1928, pp. 418-424, 17 figs. Treats of types of apparatus used for distribution of water under pressure and indicates their advantage and disadvantages; classification.

HYDRAULIC RAMS

OPERATION. Operation of the Hydraulic Ram, J. A. MacDonald. Can. Engr. (Toronto), vol. 54, no. 25, June 19, 1928, pp. 625-626, 2 figs. Cheap and efficient method of conveying water where there are no water works; how ram is installed; construction, operation and installation of ram.

HYDRAULIC TURBINES

TESTING, SWEDEN. Arrangements for Tests at the Machine Works in Kristinehamn (Anordningar for provning av turbiner vid Verkstaden Kristinehamn), H. Lind. Tekniska Foreningens I Finland Forhandlingar (Helsingfors), vol. 48, no. 5, May 1928, pp. 103-108, 4 figs. Causes of cavitation; description of cavitation laboratory completed in 1924, and its testing methods; description of high-pressure laboratory and its operation.

HYDRAULIC TURBINES

CAPACITY, EUROPE. Capacity of European Turbines, J. V. Zahlen. Eng. News-Rec., vol. 100, no. 26, June 28, 1928, pp. 1017-1018. Letter to editor noting large recent increase in number of Kaplan installations in Europe, particularly in Germany, Austria, Switzerland, Italy, Sweden and Finland; capacity of European Francis turbines and of high-pressure spiral type turbines; efficiencies of Francis and Kaplan installations.

HYDRO-ELECTRIC POWER DEVELOPMENTS

BRITISH COLUMBIA. Some Engineering Aspects of the Bridge River Project, E. E. Carpenter. Eng. Jl. (Montreal), vol. 11, no. 7, July 1928, pp. 410-423, 14 figs. Description of hydro-electric power development of British Columbia Elec. Ry. Co.; power possibilities of river; proposed programme of stages of development and progress of construction.

CANADA. Canada Active on Hydro Plants. Elec. World, vol. 92, no. 4, July 28, 1928, p. 183. Chute-a-Caron project to occupy three years; Gatineau power augmented; Ontario Commission to add 14,300 hp.

Year's Hydro Growth in the Dominion. Elec. World, vol. 92, no. 2, July 14, 1928, p. 83. Increase of 11½ per cent in 1928 by addition of well over a half-million horsepower; all provinces share.

NOVA SCOTIA. Hydro-Electric Power in Nova Scotia. Can. Engr. (Toronto), vol. 55, no. 1, July 3, 1928, pp. 101-103, 4 figs. Over 350,000 hp. available in province of which 71,000 hp. has been developed; some water powers are developed by Nova Scotia Power Commission and some by private interests; lakes aid in maintaining uniform flow; large proportion of total developed waterpower in Nova Scotia is used in hydraulic turbines which transmit power mechanically to various industrial operations, particularly to pulp and saw mills; table shows some large undeveloped water powers in province.

ONTARIO. Capacity of Bryson Power Development Increased by 25,000 Hp. Power, vol. 68, no. 6, Aug. 7, 1928, p. 255, 1 fig. International Paper Co. recently added what is known as Bryson plant, on Ottawa River; plant has installed capacity of 25,000 hp. and possible development of 75,000 hp.; dam is concrete gravity section 380 ft. long and 70 ft. high, containing 12 sluices and log slide of V-section, all covered by reinforced-concrete deck.

I

INDUSTRY

CANADA. Canada Prospering in 61st Year, C.M.A. Annual Meeting Hears. Can. Machy. (Toronto), vol. 39, no. 12, June 14, 1928, pp. 46-47. Review of annual meeting of Can. Mfrs. Assn.; international trend during past year has indicated growing political stability throughout world; research in business; industry needs safeguards.

Commercial and Industrial Conditions in Canada. Engineering (Lond.), vol. 126, no. 2360, July 6, 1928, pp. 4-6. For past year, regarded as ending in March 1928, sufficient data have been compiled to render possible fairly accurate estimate of year's trading; imports show heavy increase as compared with those of preceding year, and are in neighborhood of 225,000,000 pounds; striking feature is growing predominance of United States in Canadian commerce; British manufacturers do not, as a class, adapt their products and selling methods to requirements and practices of Canada; mineral resources; lumber and motor industry.

INGOT IRON

CREEP. Creep Tests as Made on Armco Iron, H. J. Tapsell. Heat Treating and Forging, vol. 14, no. 7, July 1928, pp. 746-750 and 756, 2 figs. Description of experiments on creep characteristics of metals at high temperatures, being made at National Physical Laboratory; conclusion that strain-hardened Armco iron may be further hardened by temperatures at least between 150 and 390 deg. cent., and both strain and temperature hardening occur during creep tests. Abstract of special report No. 6, Department of Scientific and Industrial Research, Eng. Research.

INSULATING MATERIALS, ELECTRIC

TESTING. Report of Committee D-9 on Electrical Insulating Materials. Am. Soc. Testing Matls.—Preprint, no. 77, for mtg. June 25, 1928, 34 pp., 5 figs. Recommended revisions of existing and tentative standards; proposed methods of test for volatile matter and dielectric strength of insulating varnishes; proposed methods of testing laminated sheet insulating materials; proposed tentative methods of testing insulating materials for resistance to impact, and of testing varnished cloth tapes.

INTERNAL COMBUSTION ENGINES

HIGH SPEED. Light High-Speed Internal-Combustion Engines, H. R. Ricardo. Automobile Engr. (Lond.), vol. 18, no. 243, July 1928, p. 263. Thermal efficiency, fuel requirements, weight, durability, and speed limitations of various types of internal-combustion engines are discussed; speed of engines limited by breathing capacity, dissipation of heat from connecting-rod big-end bearings, and mechanical operation of valves; reducing limitations. Abstract of paper presented to Instn. Civil Engrs.

[*See also Aircraft Engines, Diesel Engines, Oil Engines.*]

IRON

ANALYSIS. An Assumption as to the Cause of the Allotropic Changes of Iron, D. Jones. Am. Soc. Steel Treating—Trans., vol. 14, no. 2, Aug. 1928, pp. 199-210, 8 figs. Author attempts to show that changes occurring in iron when heated and cooled are due to changes in iron atom and suggests probable changes with their cause and mechanism; it is postulated that crystal structure and properties of other metals may be similarly connected with their atom structure.

IRON ALLOYS

NICKEL. The Influence of Nickel on Iron-Carbon-Silicon Alloys Containing Phosphorus, A. B. Everest and D. Hanson. Iron and Coal Trades Rev. (Lond.), vol. 116, no. 3145, June 8, 1928, pp. 862-866, 20 figs. Refers to paper on earlier investigations; recent experiments involve phosphorus; phosphorus increases hardness, tendency to chill, and difficulty of machining; more nickel required to produce given result in presence of high phosphorus, where there is tendency to chill, than would be required in presence of lower phosphorus. Paper read before Iron and Steel Inst. previously annotated.

IRON AND STEEL

TESTING. Creep in Ferrous Materials, H. J. Tapsell and W. J. Clenshaw. Iron and Steel Industry (Lond.), vol. 1, no. 5, Feb. 1928, pp. 164-165, 1 fig. Discussion of report on properties of materials at high temperatures, issued by Department of Scientific and Industrial Research; results of tensile, creep, torsion and hardness tests on Armco iron and 0.17 per cent carbon steel.

IRON AND STEEL INDUSTRY

ELECTRIC DEVELOPMENTS. Yearly Review Electrical Developments Iron and Steel Industry, W. H. Burr. Iron and Steel Engr., vol. 5, no. 6, June 1928, pp. 211-217. Review of main-roll motor installations made in steel mills in 1927; cranes; improvements to old equipment made during 1927; centralized switchboard control has been developed for air-blast valves on blast-furnace plants; oil-switching equipment.

ELIMINATING WASTE. Eliminating Waste in Distribution, C. M. Schwab. Iron and Steel of Canada (Gardenvale, Que.), vol. 11, no. 7, pp. 206-207. Outstanding facts of economic ills of steel industry; low margin of profit in steel industry is not conducive to sustained national prosperity; hunger for tonnage and desire to operate at capacity chief causes of cross hauling of steel products; committee of expert steel men proposed to study problem and recommend plan for eliminating waste in distribution. From address of President, Am. Iron and Steel Inst.

PRODUCTION STATISTICS, CANADA. May Canadian Output of Pig Iron and Steel. Iron Age, vol. 121, no. 26, June 28, 1928, p. 1861. Production of pig iron in Canada in May amounted to 87,811 gross tons, which was 18 per cent over 74,736 tons produced in preceding month and compares with 78,987 tons reported for May 1927; production of foundry iron fell off sharply; increased output of basic and malleable iron.

IRON AND STEEL PLANTS

ELECTRIC DRIVE. Motor Selection, Anti-Friction Bearing and Power Cost Feature Proceedings at A.I.S.E.E. Convention. Power, vol. 68, no. 1, July 3, 1928, pp. 36-37. Review of papers read at meeting of Assn. Iron and Steel Elec. Engrs.; increasing use of electric drives on main rolls in steel plants and trends toward synchronous motors for constant-speed and d.c. motors for variable speed; full sessions were devoted to motor selection for main drives and use of anti-friction bearings; papers on purchase of coal and new method figuring steam and power costs.

ELECTRIC MOTORS. Inductive Time Limit Control, W. G. Cook. Elec. Jl., vol. 25, no. 7, July 1928, pp. 327-332, 13 figs. Author discusses recent developments in auxiliary motor control; equipment for operation must be electrically adequate, must be easy to manufacture, and have long life; most promising of such control schemes is described; several types of relay which are giving good service when correctly applied; application of relays.

ELECTRIFICATION. Electrification of the Minnequa Works of the Colorado Fuel and Iron Company. Engrs. Bul., vol. 12, no. 6, June 1928, pp. 10 and 28. Largest steel-mill electrification ever carried out at one time; programme of electrification; feature of fuel supply for this plant is use of blast-furnace gas which is cleaned by electric precipitators; equipment for electrification; tremendous savings in power costs have resulted.

IRON

INCLUSIONS. Inclusions in Iron, C. R. Wohrman. Am. Soc. Steel Treating—Trans., vol. 14, no. 1, July 1928, pp. 81-126, 39 figs. Photomicrographic study; outline of inclusion problem and of author's work; preparation of artificial known inclusions; polishing for inclusions; microscopic examination; oxide inclusions (and silicates); 2-page bibliography.

IRON MINES AND MINING

ELECTRIC POWER. Use of Electric Power in Iron Mining, A. C. Butterworth. Am. Soc. Mech. Engrs.—advanced paper for meeting Aug. 27 to 30, 1928, 3 pp.

MECHANIZATION. Mechanical Engineering in Iron-Ore Industry, A. Tancig. Am. Soc. Mech. Engrs.—advanced papers for meeting Aug. 27-30, 1928, 4 pp. Modernization of mines on iron range of Minnesota, with their almost complete mechanization, credited to ability of profession in solving complex problems as operation developed; steam hoist of nineties; advent of steam shovel; mechanizing under-ground operations; pumping equipment of today; electric power shovel; types of ore-hauling cars; modernization without accident increase.

NEWFOUNDLAND. Wabana Iron Mines and Deposits, Newfoundland, A. O. Hayes. Min. and Met., vol. 9, no. 260, Aug. 1928, pp. 361-366, 8 figs. Extensive beds of iron ore are worked under sea from Bell Island; they are of sedimentary origin; constitute great reserve strategically well situated; working methods described. Paper to be read before Am. Inst. Min. & Met. Engrs.

IRON ORES

MICROSCOPY. Technique of the Investigation of Iron Ores, F. F. Osborne. Economic Geology, vol. 23, no. 4, June-July 1928, pp. 442-450, 4 figs. Paper based on results of study of titaniferous iron ore deposits in New York, Quebec and Ontario; etching, by placing mineral surface in contact with considerable volume of reagent, proved helpful in mineral identification under microscope and in revealing texture of minerals; use of polarized reflected light.

L

LACQUER

NITROCELLULOSE. Formulation of Nitrocellulose Lacquers, H. E. Hofmann and E. W. Reid. Indus. and Eng. Chem., vol. 20, no. 7, July 1928, pp. 687-693, 12 figs.

LATHES

REPORT ON. Lathes. Am. Mach., vol. 69, no. 3, July 19, 1928, pp. 86-89, 16 figs. Semi-annual résumé of lathes described in shop equipment news section during first six months of 1928; details of engine, speed, turret, and special lathes are given, as well as attachments. For lathes in European edition see pp. 131-133.

LIGHTHOUSES

CONSTRUCTION. Building an Offshore Lighthouse in Lake Huron, I. L. Gill. Eng. News-Rec., vol. 101, no. 4, July 26, 1928, pp. 129-131, 5 figs. Crib and concrete base carries steel-frame structure for living quarters and lamp; construction methods; lighthouse to replace lightship at Martin Reef in Lake Huron; located in 6 ft. of water over dangerous reef composed of boulders overlying hard pan; tower 25 ft. sq. and over 70 ft. high is founded on heavy concrete pier with top or deck.

LIME, HYDRATED

MANUFACTURE. Another Patented Process for Making High Calcium Finishing Hydrate. Rock Products, vol. 31, no. 13, June 23, 1928, pp. 74-75. Description of U. S. patent no. 1,670,425 granted E. O. Schnell, of process based on use of bentonite with urea as protective colloid; invention relates generally to finishing lime and process of making same, and more particularly to high plastic, hydrated finishing lime which is produced from high calcium or any other kind of limestone.

LOCOMOTIVE BOILERS

CORROSION PREVENTION. Electro-Chemical Method for the Prevention of Locomotive Boiler Corrosion. West. Ry. Club—Proc., vol. 40, no. 7, Mar. 1928, pp. 12-48, 4 figs. Article clarifies function of chemical arsenic used in coordination with electric current; conception of process which has proved so successful in overcoming pitting and corrosion-electrochemical polarization system of corrosion prevention; system requires that current shall be supplied to electrodes at all times locomotive is in service.

CORROSION. Boiler Corrosion and Pitting. Ry. Jl., vol. 34, no. 7, July 1928, pp. 26-28. Committee report before Master Boiler Makers Assn.; inquiries sent to 17 railroads having total number of locomotives of 22,392; comparison of conditions on pitting and non-pitting territory; effect of trouble and extent; preventive measures; pitting resistance of various boiler metals; progress as to control of corrosion and pitting.

THERMIC SIPHONS. Water Circulation in Relation to Steaming Capacity, C. A. Seley. Baldwin Locomotives, vol. 7, no. 1, July 1928, pp. 73-74, 1 fig. Demand for increased power in locomotive boiler met by increasing dimensions of active and secondary heat-transfer surfaces and by making steam more fluid by superheat; provision for adequate circulation to cover these needs in locomotive boilers has been provided by installation of Nicholson thermic siphons in firebox; thermic siphons have also demonstrated their value as safety appliance in preventing explosion of boiler in event of low water.

LOCOMOTIVE TERMINALS

RECOMMENDATIONS. Recommendations for the Design of a Locomotive Terminal. Can. Ry. and Mar. World (Toronto), no. 366, Aug. 1928, pp. 458-461, 1 fig. Committee on Shop and Locomotive Terminal Design recommendations for layout of locomotive terminal capable of handling from 75 to 90 locomotives in each 24-hr. period; capacity of terminal; turntable; building floors and smoke jacks; stalls, pits and clearances; drop tables; material and stores; cranes; heating and ventilating; washing platform or inspection pits. Presented before Am. Ry. Assn.

LOCOMOTIVES

DESIGN. Locomotive Design and Construction Committee's Report. Can. Ry. and Mar. World (Toronto), no. 365, July 1928, pp. 385-387. Exhaust-steam injectors and exhaust-steam feedwater heaters; example of use of poppet valves is Buechli locomotive which represents simplest possible conception of ultra-high-pressure locomotive; oil-electric locomotive development; back pressure and initial pressure gauges, and cut-off control. Report to Am. Ry. Assn.

OIL ELECTRIC. New Three-power Locomotive. Gen. Elec. Rev., vol. 31, no. 7, July 1928, p. 372, 1 fig. Locomotive carrying its own power plant and first of its kind ever built, was recently tested in New York by New York Central Railroad for which it was constructed to serve in freight yards that are not completely electrified and where part of time it is required to operate through city streets; battery is charged by 300-hp. Ingersoll Rand oil engine connected directly to 200-kw. General Electric generator; four available methods of operations.

VALVE GEARS. Caprotti Valve Gear. Engineer (Lond.), vol. 145, no. 3781, June 29, 1928, pp. 720-721, 4 figs. Gear consists of one admission and one exhaust valve of double-beat poppet-valve type for inlet and outlet of steam from each end of each cylinder, i.e., in all four valves per cylinder; in newer designs springs on admission and exhaust valves are superseded by small steam receptacle into which downward elongation of valve spindle fits; most noticeable feature of gear is gear box itself; each box acts on eight valves of one pair of cylinders, one outside and one inside cylinder next to it.

LOGS

HIGH PRESSURE. High Steam Pressure and Condensing Exhaust for Locomotives, J. M. Taggart. Railroads (A.S.M.E. Trans.), vol. 50, no. 13, May-Aug. 1928, pp. 33-43 and (discussion) 43-49, 22 figs. Discussion of present progress; cycle efficiencies; auxiliary requirements; machine, transmission and thermal efficiencies; value of locomotives; possible turbine arrangements; tentative design of super-pressure locomotives.

High Steam Pressures in Locomotive Cylinders, L. H. Fry. Railroads (A.S.M.E. Trans.), vol. 50, no. 13, May-Aug. 1928, pp. 5-9 and (discussion) 9-12, 11 figs.

MAINTENANCE. Locomotive Maintenance. C. F. Adams. Junior Instn. Engrs.—Jl. (Lond.), vol. 33, part 9, June 1928, pp. 425-447, 5 figs. Washing out of boilers; economical boiler-washing plant; engine cleaning; firelighting and preparing engine; running repairs to engine; hot axleboxes and crankpins; lubrication troubles; boiler repairs; superheater elements; heavy running repairs; repair shop.

MECHANICAL HANDLING. Odd Shapes and Sizes Are No Obstacle to Mechanical Handling, E. J. Tôurnier. Indus. Eng., vol. 86, no. 7, July 1928, pp. 357-359 and 367, 7 figs. Handling of logs and wood chips; storing logs by means of conveyor over storage area; piled by movable stacker; conversion to new uses of well-known forms of conveying apparatus is exemplified by application of modified flight conveyors referred to in present article.

STEAM TURBINE. German Condensing Steam-Turbine Locomotive, F. W. Allport. Commerce Report, no. 29, July 16, 1928, pp. 148-149, 1 fig. Krupp Works, Berlin, have recently developed condensing steam-turbine locomotive along novel lines, incorporating many new elements; technical details of locomotive; turbines used are Zoelly type, supplied by Escher Wyss & Co., Zurich; normal capacity is 2,000 b.hp. at speed of 6,800 r.p.m.; operation of locomotive.

LUBRICATING OILS

AIR COMPRESSORS. Essential Requirements of Air Compressor Oils. Lubrication, vol. 14, no. 5, May 1928, pp. 52-57, 7 figs. Relation of viscosity; flash and fire points; carbon deposits; methods of air-cylinder lubrication; type of compressor must be considered; effects of unsuitable oils; amount of oil required.

STEAM TURBINES. Chemist Tells Engineer About Turbine, H. L. Kauffman. Power Plant Eng., vol. 32, no. 14, July 15, 1928, pp. 762-764.

LUBRICATION

THEORIES. Spreading of Lubricants on Solid Surfaces (De l'extension des lubrifiants sur les surfaces solides), P. Woog. Académie des Sciences—Comptes Rendus (Paris), vol. 186, no. 2, Jan. 9, 1928, pp. 71-73. Consideration of effect of very low temperatures, when all that is necessary is to choose oil which remains liquid when cold and at very high temperatures; it was shown that at 100 deg. cent. stearic acid reacts with steel, so that thin neutralizing layer no longer has properties of polarity and orientation which are necessary to prevent oil from spreading; other metals than steel have been experimented with and some non-metallic substances.

M

MACHINE SHOP

EQUIPMENT. Miscellaneous Equipment, Materials and Supplies. Am. Mach., vol. 69, no. 3, July 19, 1928, pp. 116-119, 17 figs. Semi-annual résumé of miscellaneous equipment, materials and supplies for machine shops described in shop equipment news section during first six months of 1928. For miscellaneous equipment in European edition see pp. 140-141.

MATERIALS HANDLING EQUIPMENT. Material Handling Equipment. Am. Mach., vol. 69, no. 3, July 19, 1928, pp. 102-103, 5 figs. Semi-annual résumé of materials handling equipment described in shop equipment news section during first six months of 1928; details of tractor, lift trucks, hoist chain and crane are given.

MACHINE TOOLS

LUBRICATION. Modern Methods of Lubrication. Machy. (Lond.), vol. 32, no. 819, June 21, 1928, pp. 369-370, 3 figs. General plan for organizing for proper lubrication of machine tools; capable man needed to attend to lubrication; reasons why machinery is not successfully lubricated by operators; examples of what has been accomplished by modern lubricating methods; lubricating large machines.

MACHINERY

ELECTRIC WELDING. Using Electrically Welded Steel Construction for Machinery, B. L. Barnes. Elec. News (Toronto), vol. 37, no. 15, Aug. 1, 1928, pp. 49-50, 4 figs. Manufacturers, by adopting welding as standard practice in large machine design and utilizing standard structural-steel shapes, are developing electric welding in industry.

MALLEABLE CASTINGS

CORRECT METHODS. Malleable Castings, W. T. Evans and A. E. Peace. Foundry Trade Jl. (Lond.), vol. 38, nos. 617 and 618, June 14 and 21, 1928, pp. 423-426 and 453-457, 21 figs. Authors endeavor to convince engineers and users of malleable castings that reliable product from black-heart and white-heart varieties is being produced by application of correct methods; air-furnace melting for black-heart; conditions influencing life of refractories; melting for white-heart; use of refined irons; common defects; moulding, feeding, annealing. (To be continued.)

OBSOLESCENCE. To Appraise Obsolescence of Machinery. Iron Age, vol. 122, no. 3, July 19, 1928, p. 165. Explanation of difference between obsolescence and depreciation given with object and plans for industrial-equipment survey to be undertaken by Department of Commerce under direction of H. C. Dunn; conditions affecting cost-accounting allowance for obsolescence factor in machinery to be studied.

WHITE-HEART. Malleable Iron, F. H. Hurren. Iron and Steel of Canada (Gardenvale, Que.), vol. 11, no. 7, July 1928, pp. 196-199. Effect of different elements in whiteheart malleable iron castings used for general engineering work and conforming to B.E.S.A., standard of 20 tons tensile with 5 per cent elongation on 2 in.; in author's opinion best results are secured when silicon lies between 0.40 and 0.80 per cent; the longer the annealing time, the greater the elimination of carbon; grain size persists; influence of sulphur, phosphorus, manganese, nickel, and chromium; troubles peculiar to malleable castings. Paper read before Inst. Brit. Foundrymen.

WORK METERS. Idleness and Output Recorders. Engineer (Lond.), vol. 146, no. 3785, July 27, 1928, pp. 97-99, 6 figs. Details of device known as "Pul-syn-etic" idle machine recorder, made by Gent & Co., Ltd., Faraday Works, Leicester; it fulfills duty of indicating when and for how long machine is idle; it does not, however, provide measure of output of machine, or whether it is working above or below its normal speed; to fulfil that duty, different but related device, the "Pul-syn-etic" output recorder is available.

MANGANESE STEEL

CASTING. Make Steel in a Converted Iron Foundry, F. B. Fletcher. Foundry, vol. 56, no. 14, July 15, 1928, pp. 572-575, 6 figs. Conversion of gray-iron foundry into plant for production largely of manganese and other alloy-steel castings; new unit known as Plant D of American Manganese Steel Co.; steel melted in 1½-ton electric furnace; sand handling, cleaning room and moulding-machine equipment; 12 ovens in coreroom; 2 generators for oxyacetylene welding.

PROPERTIES. Medium Carbon Pearlitic Manganese Steels, J. Strauss. Am. Soc. Steel Treating—Trans., vol. 14, no. 1, July 1928, pp. 1-25 and (discussion) 25-26, 7 figs. Discussion of metallurgical and mechanical characteristics of steel of 0.30 to 0.50 per cent carbon and 1.00 to 2.00 per cent manganese; both wrought and cast forms are considered in both light and heavy sections; author points out similarity of these steels to other structural alloy combinations, limitations of heavy sections and of low tempering temperatures and advantages in respect to cutting qualities, resistance to corrosion, and strength at moderate temperatures. Bibliography.

METALS

X-RAY ANALYSIS. Applied X-Rays in the Metal Industry, H. R. Isenburger. Metal Industry (N.Y.), vol. 26, no. 6, June 1928, pp. 271-272, 5 figs. Inspection of rough structure of metals by means of X-rays serves to discover slags, shrinkage, blowholes and like in unfinished, semi, and manufactured products; method is based upon capacity of X-rays to penetrate materials; most important practical applications of X-rays in metal-working industry are enumerated.

MINERAL RESOURCES

CANADA. Pre-Cambrian Misconceptions Canadian Mineral Resources, Admittedly Large, Grossly Exaggerated in Propaganda, C. M. Campbell. Eng. and Min. Jl., vol. 126, no. 5, Aug. 4, 1928, pp. 165-171, 4 figs. Discusses geological conditions, shows extent of precambrian area, and states that only 5 per cent of area is favourable as mineral-bearing ground; quotes various items of propaganda and of geological reports; arraigns optimists as illogical; suggests that mine hunters stop off 50 to 200 miles from Toronto, instead of rushing 1,000 miles to north.

NEWFOUNDLAND. Mining in Newfoundland, D. J. Davies. Can. Min. Jl. (Gardenvale, Que.), vol. 49, nos. 30 and 31, July 27 and Aug. 3, 1928, pp. 603-606 and 620-622, 5 figs. Extract from pamphlet arranged for Empire Mining Congress; brief history review; iron deposits and four operating mines; copper mining at standstill since 1918; three principal copper areas described, with notes on some individual mines; silver-lead-zinc district at Placentia Bay; minor occurrences of lead ores; pyrite deposits mentioned in connection with copper; existence of chrome iron and molybdenite ores is noted.

MOTOR TRUCKS

SPRINGS AND SUSPENSION. Researches on Springs. Dept. of Sci. & Indus. Research, Eng. Research—Special Report no. 8, 1928 (Lond.), 42 pp., 32 figs. partly on supp. plates. Results of Experiments with 30-cwt. and 60-cwt. army truck and with 2-seater high-speed automobile; National Physical Laboratory was asked to design mechanism which could be fitted to vehicle and which would give continuous record with time of displacements of springs relative to body of vehicle when run at different speeds and on different road surfaces; gives description of apparatus and results obtained.

MOTOR VEHICLES

BRAKES. Are Two Entirely Separate Braking Systems Necessary? Operation and Maintenance, vol. 38, no. 1, July 5, 1928, p. 20. Question of whether it is desirable with four-wheel brakes, under present conditions, to require complete separation of service and parking brakes; recommendation made by Eastern Conference of Motor Vehicle Administrators, representing Eastern states and provinces; proposed brake law considered by other states.

EXPORTS. UNITED STATES AND CANADA. U. S. Exports of Cars, Trucks, Tires and Parts for April, 1928—Canadian Exports. Automotive Industries, vol. 58, no. 26, June 30, 1928, pp. 1020-1021. Two-page table of exports of passenger cars, motor trucks, tires and parts for United States and Canada for April 1928, showing destination, number and value.

MOTOR VEHICLE TRANSPORTATION

Railroad Operation. Executives Comment on Results of Motor Coach and Truck Operation. Ry. Age (Sec. 2), vol. 84, no. 25, June 23, 1928, pp. 1476-1481, 12 figs. Presidents of railways operating motor vehicles report increased passenger and freight traffic; Atchison, Topeka and Santa Fe; Baltimore and Ohio; Boston and Maine; Central of Georgia; Chicago, Milwaukee, St. Paul and Pacific; Chicago, Rock Island and Pacific; Great Northern; Maine Central; Nashville, Chattanooga and St. Louis; New York, New Haven and Hartford; other lines.

N

NICKEL

Electrodeposition. The Hardness of Electro-Deposited Nickel, D. J. MacNaughtan and A. W. Hothersall. Faraday Soc.—Trans. (Lond.), vol. 24, no. 7, July 1928, pp. 387-400, 8 figs. Results of investigation to develop practical methods of determining hardness and stress in deposits and to ascertain value of such tests for control of condition of deposition for production of deposits for specific purposes; influence of composition, temperatures, etc., of electrolyte on hardness and stress in electro-deposited nickel.

NICKEL ALLOYS

Properties. Nickel, An Account of Its Alloys and Its Uses, A. C. Sturney. Min. Mag. (Lond.), vol. 38, no. 6, June 1928, pp. 341-347. Properties of nickel; commercially pure metal is generally brittle and non-malleable; small percentage magnesium renders it ductile, malleable, and amenable to fabrication, soldering, and welding by arc or acetylene; uses enumerated; nickel steels; ferronickel alloys of low thermal expansion, and of high magnetic permeability; non-magnetic nickel iron; nickel cast iron; nickel-copper alloys; nickel-brass, bronze and aluminum bronze; heat-resistance alloys; nickel in aluminum.

NICKEL SILVER

Press Work. Press Work on Nickel Silver, A. L. Walker. Machy. (Lond.), vol. 32, no. 822, July 12, 1928, pp. 466-467. Composition of nickel-silver sheet commonly adopted for drawing and forming operations; nickel silver possesses to great extent property of work hardening; methods of avoiding overwork on nickel-silver parts; rules for forming and drawing nickel silver; press-tool design.

O

OFFICE BUILDINGS

Steel. Steelwork for the 23-Storey Royal Bank Building, Montreal, Que., R. M. Robertson. Eng. and Contracting, vol. 67, no. 7, July 1928, pp. 359-365, 12 figs. Design features outlined; floor construction; loading and unit stresses; main stresses; columns and slabs; wind stresses; tanks, etc. Paper presented before Eng. Inst. of Canada.

Toronto. The Atlas Building, Toronto. Contract Rec., vol. 42, no. 27, July 4, 1928, pp. 705-708, 10 figs. Recently completed office structure, 13 storeys high, of reinforced-concrete with some steel girders, dignified architectural treatment.

OIL BURNERS

Domestic. A.P.I. Committee Report Recommends Support of Oil Heating Institute. Fuel Oil, vol. 7, no. 1, July 1928, pp. 21-22. Recommendations made by committee appointed by president of Am. Petroleum Inst. to investigate programme of Oil Heating Inst.; urge complete endorsement of oil heating by Am. Petroleum Inst., and contribution of $175,000 for support of Oil Heating Institute's 1928 programme.

Design and Performance of Domestic Oil Burners, W. C. McTarnahan. Plumbers Trade Jl., vol. 85, no. 2, July 15, 1928, pp. 194-197 and 205. Natural-draft vaporizing burners; mechanical atomizing burners; mechanical-draft burners; atomizing from vertical rotary cup or disk. Paper read at Am. Soc. Heat. and Vent. Engrs.

OIL ENGINES

Marine. Progress in the Adoption of the Internal-Combustion Engine for Marine Purposes, C. J. Hawkes. Engineering (Lond.), vol. 125, no. 3256, June 8, 1928, pp. 721 and (discussion) 701. While early difficulties with marine oil engine have been largely overcome, increase in dimensions of cylinders has introduced further difficulties; more attention is being given to balancing of engines and to scantlings of shafts; author does not think that any appreciable increase in efficiency of oil engine can be expected without further complication. Abstract of paper read before Instn. Civil Engrs. See also Engineer (Lond.), vol. 145, no. 3778, June 8, 1928, pp. 627-628.

Rating. Is a Uniform Rating Desirable for Oil Engines? P. H. Schweitzer. Power, vol. 68, no. 3, July 17, pp. 108-109, 1 fig. Absolute maximum horsepower that engine is capable of delivering is never used for rating; formula used for rating automobile engines in United States except California and England mostly for taxation purposes; standard rating of same general principle refers to tractors; fixing different m.e.p. ratings for various types of oil engines is not very promising.

OIL HEATING EQUIPMENT

Points. Essential Points in Selecting Oil Heating Equipment, R. Richart. Contract Rec. (Toronto), vol. 42, no. 31, Aug. 1, 1928, p. 805. Principal importance of mechanical design is in its relation to safety; probably 30 heaters now on market will satisfactorily measure up to all of requirements which are given; making choice.

OIL SHALE

Distillation, Low Temperature. Manufacturing Oil from Oil Shale and Bituminous Coal, G. W. Wallace. Combustion, vol. 19, no. 1, July 1928, pp. 23-28, 4 figs. Description of Dundas-Howes process; low-temperature distillation of oil shale and bituminous coal; units in Santa Barbara County, Calif.; general arrangement of N-T-U Company's plant in California; capacity of plant is 200 tons per day; cost of operating plant.

OPEN HEARTH FURNACES

Regenerator Insulation. The Insulation of Open-Hearth Furnace Regenerators, L. B. McMillan. Iron and Steel Engr., vol. 5, no. 6, June 1928, pp. 257-262, 9 figs. Calls attention to highly satisfactory and very practical results which are being accomplished on actual installations; advantageous results attained through use of insulation on checker chambers; heat losses from walls and roofs; value of savings effected by insulation; savings expressed as percentages of total fuel cost; insulation of new and old checker chambers; conclusions.

ORE DEPOSITS

Theory. Operative Causes in Ore Deposition, H. C. Boydell. Instn. Min. and Met. Bul. (Lond.), no. 285, June 1928, pp. 1-5. Contributed remarks on paper read before Instn. Min. and Met. at earlier meeting; influence of pressure on composition of solutions where soluble gases are present; influence of silica; chemical influence of rockwall; electrolytic influence.

P

PACKING

Fibrous and Metallic. The Story of Packing, Fibrous and Metallic, C. J. Mason. South. Power Jl., vol. 49, no. 7, July 1928, pp. 58-63, 13 figs. Rod, stem and shaft metallic packing; requirements of metallic packing; principle involved; flexible ring type; metallic packing for ammonia; France vanadium metallic packing; description of Cooke seal ring; choosing metallic packing.

PAPER

Discoloration. The Yellowing of Paper, M. Marini. Paper Trade Jl., vol. 87, no. 5, Aug. 2, 1928, pp. 59-60. Causes of alteration in color with time are varied in nature and depend on oxidation of certain substances contained naturally or accidentally in paper; pressure of groundwood; presence of iron; effect of rosin.

PAPER MAKING

Newsprint. Making News Print at Higher Speeds, C. O. Bachman. Paper Mill, vol. 51, no. 29, July 21, 1928, p. 4. Writer figures that at present time it is possible to obtain speed of 1,500 ft. per min. and in near future speed in excess of 2,000 ft. will be attached on some grades of paper; brief outline of few of fundamental changes and requirements; construction of vacuum drier press is along entirely new principles; layout is not only applicable to newsprint but to practically all grades of paper.

PAPER MILLS, NEWSPRINT

Quebec. Modern Engineering Answers the Call for Lower Costs in News Print, A. E. Buchanan, Jr. Paper Trade Jl., vol. 86, no. 26, June 28, 1928, pp. 45-49, 5 figs. Describes new mill of Ste. Anne Paper Co., Ltd., at Beaupre, Quebec; Ste. Anne mill producing 240 tons per day at present, at speed of 950 ft. per min.; system of drier drive; there are 46 steam-heated drying rolls, 60 in. in diameter, over which paper is carried by broad felt belts; electric boiler of 100,000 kw.-hr. per day capacity is used as auxiliary source of process steam.

PAPER MILLS

Process Steam. Stabilizing Low-Pressure Steam Saves Money In a Paper Mill, D. Ross-Ross. Power, vol. 67, no. 26, June 26, 1928, pp. 1134-1137, 6 figs. Uniformity of steaming conditions does not exist to any extent in paper mills manufacturing high-grade papers, especially where product is particularly diversified; problem resolves down to putting entire exhaust steam into such form that it can be used not only for drying steam, but for such other low-pressure purposes as are required around mill; in specific instance first step was joining up of all engine exhausts to common steam line.

Pumps Trash. The Wood Trash Pump in Paper Mills, R. K. Annis. Paper Mill, vol. 51, no. 26, June 30, 1928, pp. 9, 12 and 14. Wood trash pump was first applied to problem of pumping paper stock in paper mill; analysis of over 70 installations shows that 3-in. pumps have been used principally on lime sludge and white water; experience of Great Northern Power Co. at its East Millinocket, Me., plant with Fairbanks-Morse stock pumps; size of motor; series of tests were run on 8-in. Fairbanks-Morse wood-paper stock pump and chart has been prepared. Paper read before Am. Pulp and Paper Mill Superintendents' Assn.

PAPER AND PULP MILLS

Oxyacetylene Welding. Oxy-Acetylene Welding Reduces Overhead in Paper Mill. Paper Trade Jl., vol. 87, no. 4, July 26, 1928, pp. 55-58, 6 figs. Brief survey of application of oxyacetylene welding; groundwood mill; sulphite mill; beater room; wet machines; paper machine; machine shop; overhead trolleys; emergency work; typical examples of what may be accomplished in various departments of paper mill have been cited.

PAVEMENTS

Black Base. Black Base in Southern States, W. H. Booker. Mun. News, vol. 74, no. 5, May 1928, pp. 127-128. Triaxial diagram for black base issued by Asphalt Assn. for selecting and proportioning sheet-asphalt sands; improving subgrade; green fills; sewer trenches; water trenches; examples of bad subgrade. Extracts from paper presented at Asphalt Paving Conference.

Concrete, Drilling. Studies of Concrete Pavement Cores, C. E. Foster. Can. Engr. (Toronto), vol. 55, no. 2, July 10, 1928, pp. 129-132, 6 figs. Value of drill core to highway engineer; factors involved in successful construction of concrete pavement; subject is limited in scope having to do principally with quality of work performed; information secured from study of specimen taken from concrete roads; core-drill outfit; object of core drilling; tolerances in thickness of pavement; studies from special cores; facts briefly reviewed. Paper read before Mich. Highway Conference, Univ. of Mich.

Wood, Failures. Water Under Wood Pavement: Its Cause and Prevention. Surveyor (Lond.), vol. 73, no. 1899, June 15, 1928, pp. 627-629. Views and experience of metropolitan engineers and surveyors; observations on various details of wood-pavement construction, jointing, sealing and surfacing; main causes of water logging; water finding its way beneath wood-block paving, causing looseness and upheaval.

PETROLEUM INDUSTRY

Equipment, Welding. Welding in the Oil Field, R. R. Robinson. Oil Field Eng., vol. 4, no. 1, July 1, 1928, pp. 17-22, 12 figs.

Fire Prevention. Causes of Fire in the Petroleum Industry With Methods of Prevention, C. Dalley. Instn. Petroleum Technologists—Jl. (Lond.), vol. 14, no. 67, Apr. 1928, pp. 154-166 and (discussion) 166-173. First precautions are reduction of leakage to minimum, control of gas, and provision of high-grade fittings and plant; storage tanks; spontaneous combustion; static electricity; frictional sparks; lightning; foam solutions as extinguishers. Full text of paper previously annotated from abstracts.

PHOTOELECTRIC CELLS

Rubidium. Very Thin Films of Rubidium, A. L. Johnsrud. Bell Laboratories Rec., vol. 6, no. 5, July 1928, pp. 371-373. Describes relation between film thickness and photoelectric response; thickness of film to be measured as little as one atomic diameter one half of one millionth of millimeter.

PILE DRIVERS

Mounting. Simple Roller Mounting for Piledriver, E. Smith. Eng. News-Rec., vol. 101, no. 1, July 5, 1928, p. 21, 1 fig. Pile driver mounting of two round oak logs 12 in. in diameter and 24 ft. long; framework 24 ft. long and 5 ft. wide, made of 12 x 12-in. timber, rests directly on rollers and is held in place by recessed blocks bolted to under side; upon this framework pile driver is set up, leads at one end and boiler at other; it can be moved by its own power forward, backward, or to side.

PILES

Concrete. Water Jets Help Pull Concrete Piles. Eng. News-Rec., vol. 101, no. 4, July 26, 1928, p. 143, 1 fig. Using water jets to assist in pulling old concrete foundation piles was tried with success in preparing for erection of 25-storey apartment building on Lake Shore Drive, Chicago; water jets loosened sand so that power shovel could easily pull piles.

Steel, Beach Protection. Save Beaches With Steel Piling. Constr. Methods, vol. 10, no. 7, July 1928, pp. 30-32, 10 figs. Details of 3,900 ft. of bulkhead and total of 3,000 ft. of groins constructed by City of Miami Beach, Fla.; built of Larssen deep-section copper-bearing steel-sheet piling; groins extending into water at right angles to bulkhead were 200 ft. long.

PLUMBING SYSTEMS

Design. Design of Plumbing Systems. Contract Rec. (Toronto), vol. 42, no. 28, July 11, 1928, pp. 729-731, 1 fig. Important conclusions developed as result of series of tests carried out to determine effectiveness of various of traps stack connections and venting; purposes of tests conducted by Engineering Experiment Station of University of Illinois and reported in recently issued bul. No. 178.

PNEUMATIC TOOLS

Lubrication. Air Tool Lubrication. Lubrication, vol. 14, no. 5, May 1928, pp. 57-60, 6 figs. Lubrication under water conditions; abrasive material is detrimental; method of lubrication a factor; lubricating requirements; application of pneumatic-tool lubricants; air-line lubricators.

PORTS

Montreal. The Port of Montreal, L. C. Tombs. Dock and Harbour Authority (Lond.), vol. 18, no. 93, July 1928, p. 273. History and facilities of great inland harbour; marine insurance; rates on cargo out of St. Lawrence to Europe during summer season; passenger service; comparison of Canadian Pacific Atlantic fleets of 1905 and 1925; railway facilities. (Concluded.)

POTASH DEPOSITS

Canada. Discovery of Potash Salts in New Brunswick, L. H. Cole. Can. Min. Jl. (Gardenvale, Que.), vol. 49, no. 24, June 15, 1928, p. 481. At Gautreau village, Westmorland County, New Brunswick, well was drilled in research of oil and gas; sunk 1,878 ft. and penetrated bed of rock salt 485 ft. thick; chip samples taken every five ft.; twelve analyzed for potassium with results ranging from .25 to 1.77 per cent and averaging .59 per cent.

POWER GENERATION

Tropical Seas. Utilization of Thermal Power of Oceans (Sur l'utilisation de l'énergie thermique des mers), G. Claude and P. Boucherot. Académie des Sciences—Comptes Rendus (Paris), vol. 186, no. 23, June 4, 1928, pp. 1491-1495, 1 fig. Information on installation at Ougrée of plant built according to process developed by Claude and Boucherot; plan of installation and system of operation; gives results of test carried out on new plant, which show that in large installations, power available would be about three-quarters of total power supplied by turbines.

POWER PLANTS

Ash Handling. Development of Ash Handling Plant for Power Station Boilers, A. Powell. Indus. Mgmt. (Lond.), vol. 15, no. 7, July 1928, pp. 246-247, 249, 251 and 253, 2 figs. Data concerning various mechanical methods of disposing of boiler-house refuse, principally ashes; handling of ash by manual labor; suction ash-handling plant; soot disposal; drag-link conveyors; paddle type and sluicing type of ash conveyor; ash trough; dumping of ash direct into railway cars; capital and operating costs. Paper read before Junior Instn. Engrs.

Auxiliary Equipment, Control. Control Equipment for Central Station Auxiliaries, W. C. Plumer. Power House, vol. 22, no. 13, July 5, 1928. pp. 33-35, 4 figs. Control for central-station auxiliaries presents inherently different problems than in industrial applications; chief features wherein this control differs from industrial; slip-ring induction motors; synchronous motors; shunt characteristics; automatic combustion control.

Baltimore. Design Studies for Gould Street Generating Station, F. T. Leilich, C. L. Follmer and R. C. Dannettel. Am. Inst. Elec. Engrs.—advance paper, no. 49, for mtg. Apr. 17-19, 1928, 6 pp., 6 figs. This paper covers briefly various studies and investigations upon which design was based; number and size of steam generators; type of firing.

Conowingo, Md. Electrical Features of the Conowingo Generating Station and the Receiving Substations at Philadelphia, R. A. Hentz. Am. Inst. Elec Engrs.—advance paper no. 54 for mtg. Apr. 17-20, 1928, 10 pp., 16 figs.

Electric, Substations. Transformer Station at Leaside. Can. Engr. (Toronto), vol. 55, no. 1, July 3, 1928, pp. 114-115, 1 fig. Progress on transformer station for Ontario Hydro-electric Power Commission to receive power from Gatineau River; site of this station is in town of Leaside, south of C.P.R. main line between Toronto and Montreal; 220,000-volt circuits and apparatus; transformers; 110,000-volt and 13,200-volt circuits and bus; control room.

Hydro-Electric. Mechanical Reliability of Hydro-Electric Units—1926. Nat. Elec. Light Assn.—Serial Report no. 278-79, July 1928, 13 pp., 3 figs. Results of third year's study of subject by Hydraulic Power Committee are summarized; table lists principal characteristics of all units comprised in 1926 investigation. Serial report of the Hydraulic Power Committee 1927-1928, Engineering National Section.

Hydro-Electric, Ice Jams. Ice Jam Relief, H. T. Barnes. Power Plant Eng., vol. 32, no. 13, July 1, 1928, pp. 736-737. Use of Thermit in breaking jams; Thermit is mixture of finely powdered aluminum and oxide of iron; when ignited, it burns, generating very high temperatures, producing liquid steel and giving off radiant heat rays that penetrate ice for many feet; in Norway and Sweden, and at Shawinigan Falls plant, heating racks by means of electric current has been used effectively.

Hydro-Electric, Location. Power House Supported on Piers Over Dam. Eng. News-Rec., vol. 100, no. 26, June 28, 1928, pp. 1003-1005, 2 figs. Elevated power house supported on tall piers above dam in order to avoid shortening spillway length, adopted for hydro-electric development at Lock and Dam No. 7 on Kentucky River by Kentucky Hydro-electric Co., to supplement its main power development at Dix River dam; three piers about 50 ft. high, supporting power house; three wheel pits beneath piers, turbine shafts passing up through piers into generator room; roof of wheel pits level with crest of dam.

Hydro-Electric, Quebec. Another 600,000 hp. for Quebec. Elec. News (Toronto), vol. 37, no. 15, Aug. 1, 1928, pp. 33-34, 2 figs. Early development of Upper St. Maurice by Shawinigan Co.; contract with provincial government may involve $45,000,000 expenditure in ten or twelve years; power will be produced by 1932; this power is all within distance of 150 mi. from Montreal; present developments on St. Maurice; power to be developed has river mileage of 75 mi.

Low-Pressure Steam. Utilizing Low-Pressure Steam, W. B. Lewis. Power, vol. 68, no. 1, July 3, 1928, pp. 34-35. Author claims that power installations in industries using process steam should be based on industrial heat requirements and not on considerations of power-house efficiency; emphasizes following points: (1) temporarily forget mechanical power requirements and boiler plant and study uses of heat; (2) every operation requiring heat should be done with low-pressure steam wherever possible; (3) reduce amount of low-pressure steam through study of machine and processes, etc.

Paper Mills. Installing Modern Power Plant. Paper Mill, vol. 51, no. 26, June 30, 1928, p. 8. New central plant designed to supply power and steam for both mills of Crooker-Burbank Co.; pulverized-coal system to be supplemented by oil burners; three Babcock & Wilcox boilers with 500-hp. rating; three 36,000-lb. aero-type impact pulverizers.

Pulverized Lignite. Pulverized Lignite Experiments At the University of North Dakota, R. L. Sutherland, N. T. Bourke and E. J. O'Keefe. Power, vol. 67, no. 26, June 26, 1928, pp. 141-144, 5 figs. University has been conducting experiments with pulverized lignite for steam generation; late experiments have been carried on with unit of commercial size installed in University power plant; boiler used was Babcock & Wilcox type F-14 Stirling with 2,400 sq. ft. of heating surface, set 6 ft. 11.5 in. above floor; furnace volume of 1,140 cu. ft. and burner of fishtail type.

Reheat Cycle. Reheat Cycle Practice Not Yet Standardized. Power Plant Eng., vol. 32, no. 14, July 15, 1928, p. 775. No uniformity of reheating pressure temperature or practice is apparent from conditions reported by Nat. Elec. Light Assn.; tabulation of operating conditions at five stations using reheat cycle; no difficulty experienced with excessive superheat.

Steam Electric, Alberta. A New Western Steam Station. Elec. News (Toronto), vol. 37, no. 14, July 15, 1928, pp. 29-35, 11 figs. First 5,000-kw. high-speed turbo-alternator at East Kootenay Power Co.'s supplementary generating plant, Crow's Nest Lake, Alberta, produces kw.-hr. at switchboard with less than 20,000 B.t.u.; design of building; turbo-alternator; pump room and intake; cooling-water system; boiler room; coal handling; feedwater; combustion and steam-control instruments; electrical features.

Steam Electric, Toronto. Unit Costs and Performance of Toronto Station. Elec. World, vol. 92, no. 4, July 1928, p. 156, 1 fig. Data on equipment and performance of Toronto station of Ohio River Edison Co. have recently been made available in booklet form; accompanying graph and figures are based on data reported.

Steam, High Pressure. The First Commercial 1,200-Pound Steam Plant in the World, I. E. Moultrop. Eng. Jl. (Montreal), vol. 11, no. 6, June 1928, pp. 357-365, 14 figs. Features of ultra-high-pressure steam-electric generating station of Edison Electric Illuminating Co. of Boston, Mass.; progress in increasing thermal efficiency; steam pressures and temperatures studied; comparison of costs; operating features; equipment of extension.

Steam, Oil Firing. Oil Fuel for Toronto's New Boxboard Plant, D. M. Duncan. Power House (Toronto), vol. 22, no. 1, July 20, 1928, pp. 21-23 and 26-28, 9 figs. Steam generating plant is definite precedent in design of medium-power boiler installation in Canada; air-cooled walls; simple boiler frontage; fuel supplied to boilers is heavy tar oil delivered to burners at pressure of 60 lb. per sq. in. and temperature of 212 deg. fahr.; feedwater treatment; electrical equipment.

Steam, Paper Mills. Modernizing the Mill and Power Plant. Paper Trade Jl., vol. 86, no. 26, June 28, pp. 34, 38 and 40. Illustrates weight of characteristics of high-pressure steam in paper-mill practice by abstract from report made some time ago by Superheater Co. of New York; predominance of water-tube boilers; mean rated capacity of 250 units installed in paper-mill power plants relatively recently being 384 hp.; new boiler plant of Fitchburg Paper Co. fired on pulverized coal; steam regeneration and resuperheating steam accumulator economies.

PRESSES

Report on. Presses. Am. Mach., vol. 69, no. 3, July 19, 1928, pp. 90-92, 13 figs. Semi-annual résumé of presses described in shop equipment news section during first six months of 1928; details of inclinable, pneumatic, embossing, screw, and punch presses are given. For presses in European edition see pp. 135-136.

PRESSURE VESSELS

Welding. Design of Pressure Vessels for Petroleum Industry, T. McL. Jasper. Power, vol. 68, no. 4, July 24, 1928, pp. 164-167, 8 figs. Question of vessel design; strength of various steels at elevated operating temperatures; principal underlying tests described briefly; correct shape of head to develop full strength of cylinder of vessel; paper does not deal with question of theory except so far as it has been used to arrive at what might be considered best shape in design. Abridgment of paper presented before West. Refiners Assn.

PROTECTIVE COATINGS

Testing. Report of Committee D-1 on Preservative Coatings for Structural Materials. Am. Soc. Testing Matls.—Preprint, no. 71, for mtg. June 25, 1928, 53 pp., 7 figs. Reports of sub-committees on linseed oil, on definitions, on accelerated tests for protective coatings, on methods of analysis of paint materials, on varnish, on shellac, on preparation of iron and steel surfaces for painting, on specifications for pigments dry and in oil when marketed in that form, and on method of application of paint by spraying.

PUBLIC BUILDINGS

Mechanical Equipment. Operating Data on Federal Buildings, N. Thompson. Am. Soc. Heat. and Vent. Engrs.—Jl., vol. 34, no. 7, July 1928, pp. 555-564. Author gives certain data concerning operation of mechanical equipment in buildings which are under control of U. S. Treasury Department; repairs; operating supplies; conservation of coal. isolated plants and street service; examples of isolated plant and outside service conditions.

PULP DIGESTERS

Requirements. Steam Consumption in Digesters. Paper Trade Jl., vol. 87, no. 5, Aug. 2, 1928, pp. 54-56. Calculation of steam requirements; amount of heat required for cooking; value of coefficient K; comparison of heat and steam consumption of lagged and unlagged boilers.

PULP GRINDING MACHINES

Control. Pulp-Grinder Control Reduces Paper Costs, A. F. Meyer. Am. Soc. Mech. Engrs.—advance paper for mtg. Aug. 27-30, 1928, 8 pp., 12 figs. Paper describes governor for controlling water-wheel-driven and motor-driven pulp grinders and points out economies effected through such regulation; Meyer governor maintains uniform friction load, and thereby uniform speed, by varying pressure with which wood is pushed against grindstones; also describes master regulator by means of which total kilowatt load on given system is maintained constant; no electrical contacts or relays are used, yet great sensitiveness is secured.

PULP MANUFACTURE

Quality Control. Quality Control in the Sulphite Pulp Industry, A. Lampen. Paper Trade Jl., vol. 87, no. 1, July 5, 1928, pp. 55-61. Uniformity prime requisite; chemical pulp on market is produced by heating raw material under pressure with solutions of certain chemicals; digesters used in modern sulphite mills; pressure, temperature and time; old method; variations in pulp wood; paper requirements. relation to pulp; length of fibers; testing chemical purity of pulp; use of oxidizing agents; rayon pulp; T.A.P.P.I. strength testing of pulp; Lampen mill; hydraulic pressing of sheets.

ROD MILLS. Some Experiments in Processing Pulp in the Rod Mill, G. H. Chidister. Paper Trade Jl., vol. 86, no. 25, June 21, 1928, pp. 51-64, 26 figs. Paper describes attempts made to measure accurately effect of varying conditions of milling and effect of rod mill on various raw materials; development of semi-chemical pulping processes at Forest Products Laboratory involved reduction of partially softened chips into pulp form suitable for making paper; milling experiments; comparison of rod and beater; refining for Kraft wrapping paper; milling tests.

PULP MILLS, SULPHITE

CONTROL. Modernizing the Mill and Power Plant. Paper Trade Jl., vol. 87, no. 2, July 12, 1928, pp. 44, 46 and 48. Instrument control for sulphite-pulp mills; instruments for sulphur-dioxide control; instrument control of tower processes; control of digester operations; instrument control for commercial pulp preparation.

PUMPS, CENTRIFUGAL

AIR LEAKAGE. What Air Leakage Does to a Centrifugal Pump, R. W. Angus and C. V. Armour. Power, vol. 68, no. 4, July 24, 1928, pp. 149-151, 5 figs. Experiments made in hydraulic laboratory of Department of Mechanical Engineering, University of Toronto; 3-in. four-stage Rees pump; curves show method of procedure; experiments bring information forward in marked way.

EFFICIENCY. Methods of Computing Efficiencies of Centrifugal Pumping Machinery, J. L. Hunter. Hydraulic Eng., vol. 4, no. 7, July 1928, pp. 456 and 459. Summation of mathematics used in computing pump efficiencies, some steps of which are sometimes overlooked.

PUMPING STATIONS

PRACTICE. Pumping Station Practice, F. W. Dean. New England Water Works Assn.—Jl., vol. 42, no. 2, June 1928, pp. 109-131. Economy of fuel is given great consideration in pumping plants; pumping engines driven by steam; classes of toilers; reciprocating pumps; results of tests of certain three-crank vertical triple-expansion pumping engines; direct-acting pumps; means of driving centrifugal pumps; condensers.

PUNCHING AND SHEARING MACHINES

REPORT ON. Shearing and Punching Machines. Am. Mach., vol. 69, no. 3, July 1928, pp. 92-93, 7 figs. Semi-annual résumé of shearing and punching machines described in shop equipment news section during first six months of 1928; details of shearing, notching and combination machines are given.

Q

QUARRIES AND QUARRYING

AIR COMPRESSORS, DIESEL. Diesel Driven Compressor Serves Quarry. Power Plant Eng., vol. 32, no. 14, July 15, 1928, pp. 776-777, 2 figs. Cost of compresed air is important item in quarry operation; advantages of Diesel operated compressor that are of peculiar importance in plant of this type; unit characterized by small number of parts; economy of operation; cost of operation per 10-hr. day was $9.40.

R

RADIO APPARATUS ON AIRCRAFT

BIBLIOGRAPHY. Bibliography On Aircraft Radio, C. B. Jolliffe and E. M. Zandonini. Inst. Radio Engrs.—Proc., vol. 16, no. 7, July 1928, pp. 985-999. References on file in Bureau of Standards have been compiled in this bibliography, which is fairly complete on subject up to June 1928.

RADIO RESEARCH STATIONS

EXPERIMENTAL. IXV-IXAN, An Experimental Station with the World as Its Laboratory, G. G. Macintosh. QST Amateur Radio, vol. 12, no. 7, July 1928, pp. 19-22, 6 figs. Some of experimental work conducted formed basis of treatment of antenna problems; station has means and facilities for short-wave radio experimentation under supervision of Electric Engineering Department, Communications Division, of Mass. Inst. of Technology; description of apparatus; arrangement of station and experimental work carried on at South Dartmouth, Mass.

RADIO TELEPHONE

TRANSATLANTIC. Special Joint Meeting with the American Institute of Electrical Engineers (Through the Medium of Transatlantic Wireless Telephony), 16th February, 1928. Instn. Elec. Engrs.—Jl. (Lond.), vol. 66, no. 378, June 1928, pp. 663-666. Brief speeches by T. F. Purves, B. Gherardi, A. Page, F. B. Jewett, J. J. Carty and Oliver Lodge.

RADIO WAVES, SHORT

TRANSMISSION. Radiotelephony by Directed Short Waves and Test Station for Paris-Algeria Communication (La transmission radiotélèphonique par ondes courtes dirigées et la station d'essais de communication Paris-Alger), R. Villem. Revue Générale de l'Electricité (Paris), vol. 23, no. 24, June 16, 1928, pp. 1035-1043, 8 figs. Study of transmitter; stages of amplification, system of modulation and description of installation; use of directive antennas; system of Chireix and Mesny.

RAILROADS

CONSTRUCTION, CANADA. Flin Flon Railway Being Built With Unusual Speed. Eng. News-Rec., vol. 100, no. 26, June 28, 1928, p. 1008. Building of railway from The Pas, in Manitoba, to Flin Flon mining property, distance 90 miles; bonus of $250,000 if line completed and trains running before Dec. 31, 1928; laying ties and rails on frozen ground for first 50 miles, to reach system of lakes navigable for scows and rafts, along shores of which runs final stretch of this line; three gravel pits opened up along first section; ballasting and lifting roadbed pushed in both directions from each of these three points.

CONSTRUCTION, HUDSON BAY. Work on Hudson Bay Railroad Progressing Rapidly. Eng. News-Rec., vol. 101, no. 2, July 12, 1928, pp. 58-59, 2 figs. Character of country; in entire line there will be 6 steel bridges and 72 timber trestles; 19 water stations planned; estimated that full expenditure will be $28,500,000, not including costs of ocean terminal port.

ROADBEDS, CONCRETE. Forty Miles of Concrete Road Bed and Results Obtained, P. Chipman. Central Ry. Club of Buffalo—Official Proc., vol. 36, no. 3, June 1928, pp. 2672-2683 and (discussion) 2684-2693. Account of experiment Pere Marquette is making with concrete roadbed; located between Detroit and Plymouth, Michigan; 1326 ft. long, 10 ft. wide and 21 in. thick; proves whether or not permanent roadbed is practicable; probable that this design can be so improved and simplified that cost will be reduced to $40,000 or $45,000 per mile; experience with test section has brought to light number of ways in which present design can be improved.

TERMINALS, CANADA. Passenger Terminal at Hamilton for Canadian National Railway. Can. Ry. and Mar. World (Toronto), no. 366, Aug. 1928, pp. 474. Plans provide for stone structure of 90 x 180 ft. together with concourse 140 x 50 ft.; station will be operated wholly on through-track principle, and there will be six station tracks, most northerly to have capacity for locomotive and 20 passenger cars; 3 passenger and 3 baggage and express platforms to be 20 ft. wide and others 14 ft. wide.

WATER SUPPLY. Use of Exchange Silicate (Zeolite) Water Softeners in Railroad Practice, G. L. Baxter. Indus. and Eng. Chem., vol. 20, no. 7, July 1928, pp. 755-758. Exchange silicate (zeolite) treatment at certain points on Southern Pacific Lines has been found less expensive than treatment with lime and soda ash and has resulted in more satisfactory operation of stationary and locomotive boilers.

RAILS, STEEL

HEAT TREATMENT. Improvement of Rail Steel (Wege zur Verbesserung des Schienenbaustoffes), H. Viteaux. Stahl u. Eisen (Düsseldorf), vol. 48, no. 28, July 12, 1928, pp. 940-945, 11 figs. Author refers to article by O. Pilz, published in same journal, 1927, p. 1645, in which he deals with different methods of heat treatment of rails and increase of wear resistance; present author points to great improvement in resistance against widening of cracks, which has been accomplished by heat treatment at Neuves-Maison; includes reply by Pilz.

SECTIONS (ROACH). A Proposed New Rail Section. Eng. News-Rec., vol. 100, no. 26, June 28, 1928, p. 1016, 1 fig. New form designed by H. F. Roach with special aim of preventing arching of rail on cooling beds and thus eliminating certain stresses in rails; comparison of Roach and A.R.E.A. rail sections; Roach rail section weighs 133.36 lb. per yard as against 130 lb. per yard of A.R.E.A. section; thickening web in proposed section minimizes internal strains and affords opportunity for better metal in head of rail.

RECTIFIERS

ELECTRIC, MERCURY-ARC. Effect of Street Railway Mercury Arc Rectifiers on Communication Circuits, C. J. Daly. Am. Inst. Elec. Engrs.—Jl., vol. 47, no. 7, July 1928, pp. 503-506, 3 figs. Paper describes effects experienced on telephone circuits from two mercury-arc rectifier substations recently installed in Bridgeport, Conn., and shows in table form relative magnitude of interfering effects between rotating equipment and mercury-arc rectifiers as means of energizing street-railway system; method and type of apparatus used to reduce effects experienced from rectifiers are also described.

MERCURY-ARC. Advantages of Mercury Arc Rectifiers, M. L. de Angelis. Elec. Ry. Jl., vol. 2, no. 2, July 14, 1928, pp. 66-67. Advantages of this type of apparatus, from operating point of view; less switching equipment needed; limitations of rectifiers; backfires have now been diminished by means of newly developed devices; telephone interference most serious trouble. Abstract of paper presented before Can. Elec. Ry. Assn.

MERCURY-ARC, RAPID TRANSIT, BERLIN. Mercury Arc Rectifiers for Electric Traction. Elec. News (Toronto), vol. 37, no. 15, Aug. 1, 1928, pp. 41-42 and 48, 4 figs. Thirty-four substations with total installed capacity of 117,000 kw. on Berlin rapid transit railway, largest installation in world; sectionalized distribution under complete supervisory control; installation of rectifier apparatus under arches of elevated urban rapid-transit line; carefully studied decision arrived at by railway company to use mercury-arc rectifiers for electrification of important rapid transit railway system of Berlin.

REFRIGERATION

EVAPORATING SYSTEMS. Evaporating Systems, T. Shipley. Ice and Refrig., vol. 75, no. 1, July 1928, pp. 57-65, 10 figs. Purpose of this paper is to make known data which have been compiled since Nov. 1926, from results which were obtained in operation of ice-making plants in which evaporating systems were based upon heat transformer of 75 B.t.u. per sq. ft. deg. per hr.; and also to call attention to further development of such apparatus. Paper read before Phila. Chapter of Nat. Assn. of Practical Refrig. Engrs.

RESERVOIRS

COVERED. Reservoir Covering Pays Dividends, C. W. Klassen and H. F. Ferguson. Mun. News, vol. 74, no. 5, May 1928, pp. 137-138, 3 figs. Experiences of Edwardsville Water Co., Edwardsville, Ill.; conditions before reservoir was covered; total capitalized cost comparison; analyses before and after covering.

ROADS

ASPHALT. Asphalt in the Paving Industry, L. M. Law. Louisiana Eng. Soc.—Proc., vol. 14, no. 2, Apr. 1928, pp. 77-93 and (discussion) 93-103. Endeavors to show what asphalt is; describes briefly its primitive uses and its modern applications in paving industry; early uses of asphalt; kinds of asphalt.

CONCRETE CONSTRUCTION, QUEBEC. Concrete Road Construction in Quebec. Can. Engr. (Toronto), vol. 55, no. 4, July 24, 1928, pp. 168-169, 8 figs. Construction of 10.64 mi. of concrete road from St. John to Rouses Point; central mixing plant installed at St. Blaise; handling concrete on long hauls; tests show high quality concrete. Abstracted from Mun. Improvements.

CONCRETE, FIELD CONTROL. Field Control of Pavement Concrete, H. S. Mattimore. Crushed Stone Jl., vol. 4, no. 5, June 1928, pp. 1-3 and 5. Concrete quality; materials; material inspection; proportioning; placing; finishing; curing; tests on finished concrete. Presented before 14th annual Highway Conference, University of Mich.

CONCRETE, RESEARCH. Review of Research, Experiment and Practice, H. C. Badder. Roads and Road Constr. (Lond.), vol. 6, no. 65, May 1, 1928, pp. 140-141. Effects of vibration on concrete; recent tests of vibrolithic concrete; methods of fabrication; if method of applying vibration to large surfaces of concrete is used, it will mean that concrete will be denser, more even in quality than tired labor can make it, and also cost less per yard; low-cost road surfaces.

CONSTRUCTION, CALCIUM CHLORIDE. The Use of Calcium Chloride in Highway Construction. Contract Rec. (Toronto), vol. 42, no. 24, June 13, 1928, pp. 644-645. Calcium chloride has replaced old method of curing with wetted dirt or straw; speeds up setting; as dust preventive; cost of treating 16-ft. graveled road surface.

CONSTRUCTION, BRITISH COLUMBIA. The Cariboo Road, Its Origin, History and Re-construction, P. Philip. Eng. Jl. (Montreal), vol. 11, no. 7, July 1928, pp. 399-409, 10 figs. Introductory and historical; construction; Alexandra suspension bridge; Boothroyd-Lytton section; signing and patrolling of highway; reconstruction of 100 mi. of Cariboo road, when completed in fall of 1928, will have cost $2,500,000, average of $25,000 per mile; analysis of cost and classified distribution of Alexandra Bridge.

CONSTRUCTION, CANADA. Road Construction in the Fraser Canyon, P. Philip. Contract Rec. (Toronto), vol. 42, no. 31, Aug. 1, 1928, pp. 793-799, 5 figs. Rebuilding of famous Cariboo Road in British Columbia from Hope to Prince George, distance of 432 mi., involved tremendous difficulties; details of construction methods and costs; location; Alexandra suspension bridge; construction of two tunnels; large bridges.

CONSTRUCTION, SASKATCHEWAN. Highway Construction in Saskatchewan. Can. Engr. (Toronto), vol. 55, no. 3, July 17, 1928, pp. 139-141, 13 figs. Methods of building roads in province; width of main market roads; trench and featheredge construction; spreading gravel; supplies of gravel are limited; cost per mile of gravel road.

DESIGN. Forty Years' Progress in Road Design and Construction, A. W. Cross. Surveyor (Lond.), vol. 73, no. 1898, June 8, 1928, pp. 601-603. Foundations; provision for underground services; curb drains; surfacings compared; tarred macadam; asphalts; wood blocks; granite and other stone sett pavements; concrete surfaces; blue brick paving; theory and practices. From paper entitled "Roads, 1888-1928," presented before West-Midland District of Instn. of Mun. & County Engrs.

MAINTENANCE AND REPAIR. Sand-Clay and Earth Roads, H. R. Mackenzie. Mun. News, vol. 74, no. 6, June 1928, p. 169. Describes construction and maintenance methods in Saskatchewan; earth roads, crowns, slopes and alignment of earth roads; costs. Paper presented before Can. Good Roads Assn.

MAINTENANCE AND REPAIR, QUEBEC. Quebec System of Provincial Highways. Can. Engr. (Toronto), vol. 54, no. 25, June 19, 1928, pp. 615-621, 4 figs. Maintenance in 1927; dust prevention; damage due to temperature; permanent resurfacing; road signs; tree planting; main-highways system; secondary highways. Abstract of report by Department of Roads Dealing with Principal Features of Provincial Highway System and Progress on Construction and Maintenance.

MOUNTAIN CONSTRUCTION. Transmountain Highway Construction in Glacier National Park, W. G. Peters. Contractors and Engr. Monthly, vol. 16, no. 5, May 1928, pp. 321-327, 19 figs. Length of project 12.4 mi.; goes from elevation 3,537 at beginning to 6,650 at Continental Divide on Logan Pass; excavation; snow fall; rubble masonry; surfacing; tunneling; work accomplished; personnel and equipment.

STONE, MAINTENANCE AND REPAIR. Secondary Road Maintenance, R. B. F. Chisholm. Can. Engr. (Toronto), vol. 55, no. 2, July 10, 1928, p. 128. Maintenance of stone roads discussed; hard stone for roads; laying stone on road; keep road smooth; cementing value of stone. Paper read at Annual Road School, Purdue Univ.

ROAD MATERIALS

BITUMINOUS, ALBERTA. Bituminous Sands for Road Surfaces, S. C. Ells. Engineering (Lond.), vol. 126, no. 3261, July 13, 1928, pp. 55-56. Review of report on results of investigations by Canadian Department of Mines of properties and practical application of enormous deposits of bituminous sands of Alberta, which comprise largest occurrence of solid asphaltic material known to exist.

ROLLING MILLS

BEARINGS, ANTI-FRICTION. Anti-Friction Bearings, for Roll Necks, J. H. van Campen. Iron and Steel World, vol. 2, no. 7, July 1928, pp. 339-341, 4 figs. Selection and care of bearings; success depends upon three factors: selection of proper type and size of bearing; proper mounting and lubrication. Abstract of paper presented at Assn. Iron and Steel Elec. Engrs.

ELECTRIC DRIVE. Individual Roller Table Drives, J. C. Dobelbower. Iron Age, vol. 122, no. 2, July 12, 1928, p. 84. Improvement in control obtained with individual roller-table drives, is compared with inflexibility of group drives; break-down of one roller does not cripple train. Abstract of address presented before Assn. Iron and Steel Elec. Engrs.

Electrically-Driven Rolling Mills and Wire-Drawing Plant at Bromford Mills, Erdington. Iron and Coal Trades Rev. (Lond.), vol. 116, no. 3146, June 15, 1928, p. 895, 4 figs. partly on p. 896. Plant includes producer gas-fired steel furnaces, electric drive for rolling mills and novel features in wire drawing; machines driven by variable-speed motors; capacity increased, as the finer the wire, the faster may machine be operated; automatic stop when machine jams.

RUBBER

BRITTLENESS TESTING. A Device for Measuring the Brittleness of Rubber and Gutta Percha Compounds, G. T. Kohman and R. L. Peek, Jr. Instruments, vol. 1, no. 6, June 1928, pp. 275-279, 2 figs. Description of apparatus and methods used to determine brittleness by bending of strip and determination of highest temperature at which strip fractures.

S

SAND, BITUMINOUS

CANADA. The Bituminous Sand of Alberta, H. Norbury. Can. Min. Jl. (Gardenvale, Que.), vol. 49, no. 27, July 6, 1928, pp. 543-545, 3 figs. Retardation of development ascribed to market conditions as to petroleum and asphalt; probably not exploited until change occurs in oil industry; practically all technical problems overcome; one process described; productive area estimated 15,000 sq. mi.; mining process devised involves introduction of superheated steam through pipes similar to Frasch sulphur process.

SAWS, WOODWORKING

PATTERNMAKING. Circular Saws in the Pattern Shop. Can. Foundrymen (Toronto), vol. 19, no. 6, June 1928, pp. 10-12, 10 figs. Setting saw teeth; for fine work; sharp saws essential; packing of circular saws; some representative circular-saw jobs.

SEWAGE CHLORINATION

IMPROVES OPERATION. Chlorination of Sewerage Greatly Improves Operation of Disposal Plants, A. L. Frick. Hydraulic Eng., vol. 4, no. 6, June 1928, p. 402. Among beneficial results are elimination of odors; control of foaming in tanks; reduction of fly nuisance and clogging of filters; disinfection; reduction of oxygen demand.

SEWAGE DISPOSAL

ACTIVATED SLUDGE. Activated Sludge Disposal Plants at Charlotte, N.C., E. G. McConnell. Pub. Works, vol. 59, no. 7, July 1928, pp. 268-274, 16 figs. One dewaters sludge by means of vacuum filters, other digests it in separate digestion tanks and utilizes resulting gas; bottom-dump screen chambers, sludge-removal details in sedimentation tank; general type of construction and appointments of entire plant are of radical departure; preliminary operating results; construction and operating costs.

CANADA. Treatment of Waste Water (Le traitment des eaux usées), T. J. Lafreniere. Can. Chem. and Met. (Toronto), vol. 12, no. 7, July 1928, pp. 196-197. Classification of treatment methods of sewage divided into two groups; sanitary control in Quebec province.

KITCHENER, ONT. Kitchener Sewage Disposal Problem. Can. Engr. (Toronto), vol. 54, no. 25, June 19, 1928, p. 623. Report by Gore, Nasmith and Storrie on sewage-treatment situation; site at Schneider's Creek proposed for plant; sewage very strong due to tannery wastes; aeration tanks with preliminary and secondary sedimentation tanks and sludge-digestion tanks proposed; city of Kitchener, Ont.

SEWAGE DISPOSAL PLANTS

SLUDGE TREATMENT. Beddington Sewage Works, Croydon: Activated Sludge Treatment, F. E. Pipe. Surveyor (Lond.), vol. 73, no. 1900, June 22, 1928, pp. 655-656, 2 figs. Present works and process; requirements to be fulfilled by new plant; completed design is departure from usual orthodox plan, and may be described as partial purification plant in stages; operation of plant designed to treat 1,000,000 gal. per day; estimate for whole of work was 12,900 pounds sterling; further works are contemplated. Extract from paper presented before Instn. Mun. & County Engrs.

SHAFTING

CONSIDERATIONS. Considerations in Selection of Shafting. Can. Machy. (Toronto), vol. 39, no. 12, June 14, 1928, pp. 31-32 and 67-68. Cold-drawn steel shafting almost universally used for power-transmission purposes; standard shaft diameters and weights; horsepower capacities of shafting; forged steel and alloy-steel shafting for exceptional conditions; shaft keys and keyways.

SHEET STEEL

HEAT TREATMENT. Effect of Heat Treatment on the Properties of Chromium-Molybdenum Sheet Steel, F. T. Sisco and D. M. Warner. Am. Soc. Steel Treating—Trans., vol. 14, no. 2, Aug. 1928, pp. 177-192, 18 figs. Test results on chromium-molybdenum sheet of composition suitable for use in aircraft construction; effects of heat treatment on physical properties and structure are shown for sheet of several gauges; for best combination of strength and ductility sheet should be normalized, hardened by quenching in water from 1,600 deg. fahr., and tempered between 1,000 and 1,200 deg.; elongation after heat treatment decreases materially as gauge becomes thinner.

SHIP PROPULSION

ELECTRIC. Annual Report of Committee on Applications to Marine Works. Am. Inst. Elec. Engrs.—Jl., vol. 47, no. 7, July 1928, p. 524. Outstanding electrical developments in marine field during past year are: construction of five 3,000-ship-hp. turbine-electric drive U. S. Coast Guard cutters; placing in service of S. S. California 18,000-ship-hp. twin-screw turbine-electric drive passenger ship; conversion by U. S. Shipping Board of three of their largest cargo vessels to Diesel-electric drive; there have been number of smaller craft equipped with electric propulsion.

SHIPS

AUXILIARY EQUIPMENT, GREAT LAKES. Install Modern Machinery on Lake Vessels to Reduce Operating Costs, W. E. Thau. Mar. Rev., vol. 58, no. 6, June 1928, pp. 28-33, 7 figs. Author discusses application of modern propelling and engine-room auxiliary machinery to Great Lakes vessels; three principal types of vessels considered; auxiliary power from main unit; freighters for canals and rivers; Diesel-electric drive advantages; standard lake ore carriers; greater thermal efficiency; saving with electric auxiliaries. Paper before Detroit Eng. Soc.

PASSENGER. Canadian National Steamships for Canada-West Indies Service. Can. Ry. and Mar. World (Toronto), no. 366, Aug. 1928, pp. 507-509, 1 fig. Length overall 438 ft.; gross tonnage 7,650 tons; service speed 14 knots; cargo spaces; passenger accommodation; propelling machinery will consist of 2 sets of Parsons combined single-reduction steam turbines consisting of high-pressure and low-pressure turbine coupled to main shaft by single-reduction gear; steam working pressure of 220 lb. per sq. in. in 4-single-ended Scotch boilers each 16½ ft. diam., 12 ft. long; Howden system of forced draft with oil fuel.

Canadian Pacific Expansion. Shipbldg. and Shipg. Rec. (Lond.), vol. 32, no. 2, July 12, 1928, pp. 43-44, 2 figs. Second of "Duchess" class liners, Duchess of Atholl; substantially same as Duchess of Bedford; length 600 ft.; most economical steamships afloat today, having consumption of under 0.7 lb. of oil per shaft horse power per hour; two sets of single-reduction geared turbines with Yarrow water-tube boilers in combination with Scotch cylindrical boilers.

PASSENGER, TURBO-ELECTRIC VS. DIESEL. Turbo-Electric vs. Diesel Drive for Large Passenger Ships. Elec. Rev. (Lond.), vol. 102, no. 2637, June 8, 1928, p. 1022. Figures as to cost of operation of large passenger ship equipped with turbo-electric drive and similar vessel driven by direct-coupled Diesel engines; vessels in question are new liner California of 30,250 tons displacement and Swedish-American liner Gripsholm of 23,600 tons displacement.

SHOVELS

ELECTRIC. Largest Shovel Ever Built. Pit and Quarry, vol. 16, no. 6, June 20, 1928, p. 95, 1 fig. Shovel carries 12 cu. yd. dipper on 90-ft. boom and 60-ft. dipper handle; operated electrically from power lines of public-utility company serving that territory; 750-hp. motor drives motor-generator set for furnishing power to various motions.

SILK, ARTIFICIAL

UTILIZATION, WOOLENS. The Use of Spun Rayon in Woolens, J. W. Cox, Jr. Black and White, vol. 1, no. 6, July 1928, pp. 3-8, 5 figs. Brief outline of development of spun rayon yarns, and two types of yarns most used for woolens, and woolen mixes, is given; two methods of manufacture; preparation and processes.

SILVER MINING GEOLOGY

BRITISH COLUMBIA. Silver Mineralization at Beaverdell, B.C., H. E. McKinstry. Economic Geology, vol. 23, no. 4, June-July 1928, pp. 434-441. Mines located on Wallace mountain, in Boundary district of southern British Columbia; general geology; ore deposits; primary and secondary minerals; supergene processes; wall rock alteration; origin of ore attributed to Beaverdell batholith causing fractures by its intrusion and cooling, after which ore-bearing solutions entered fractures and deposited minerals; after such crystallization, faulting took place; solutions, perhaps of changed compositions, then deposited other minerals.

SNOW REMOVAL

STREETS, PARIS. Snow Removal from the Tracks of the Paris Regional Transport System (Le déblaiement des neiges sur les voies du reseau des transports en commun de la région Parisienne), A. Roubaud. Industrie des Voies Ferrées et des Transports Automobiles (Paris), vol. 22, no. 258, June 1928, pp. 161-169, 10 figs. Treats of electric sweepers; construction and operation; automobile and towed sweepers; organization for snow removal and execution of work.

STREET RAILROADS. Cars Revamped Into Snow Fighting Equipment. Elec. Ry. Jl., vol. 72, no. 2, July 14, 1928, pp. 49-50, 4 figs. Gary Railways, Gary, Ind., remodeled six of its retired passenger cars for snow fighting at total expenditure of approximately $22,000; shear plows put on two cars are operated by air from inside car; comparison of costs fighting storm of Feb. 17.

STREETS, TORONTO. Snow Removal at Toronto, G. W. Dies. Mun. News, vol. 74, no. 5, May 1928, p. 136. Toronto covers area of 32.32 sq. mi. with 562 mi. of streets, 147 mi. of lanes; organization principal factor; clearing car line streets; disposal of snow. Paper presented before Inst. Assn. of Street Sanitation Officials.

SPECIFICATIONS

EMPLOYMENT OF. Employment of Specifications, E. Grossman. Can. Engr. (Toronto), vol. 55, no. 2, July 10, 1928, p. 126. Necessary features of specifications described; purpose of specifications; methods of writing specifications; specifications should be terse, clear, and complete. From Boston Soc. Civil Engrs.—Jl.

SPRINGS, HELICAL

DESIGN. Springs From the Designer's Point of View, H. Barnes. Wire, vol. 3, no. 7, July 1928, pp. 227-228 and 244-246, 2 figs. Prejudice and lack of reliable data on performance records hinder wider application of coal springs; reliability of properly designed and heat-treated springs is established in variety of materials; new data for designers; springs properly classified as to duty with reference to "long-life factor."

STAINLESS STEEL

Chromium. Chromium Steels and Stainless Iron. Machy. (Lond.), vol. 32, no. 820, June 28, 1928, pp. 418-419. Properties conveyed by various amounts of chromium in steel and uses of such steels; chromium in steel is hardening agent but does not confer marked hardness in absence of carbon; as chromium content is raised steel becomes progressively stronger and harder and loses ductility to some extent, and corrosion-resisting properties increase; properties of special class of stainless steel known as stainless iron made with carbon content not exceeding 0.1 per cent.

Welding. The Welding of Stainless Steel. Metal Industry (Lond.), vol. 32, no. 26, June 29, 1928, p. 640.

STEAM ENGINES

Extraction. Why Bled Steam for Processing and Heating Saves Fuel, C. H. S. Tupholme. Power, vol. 68, no. 2, July 10, 1928, pp. 52-55, 4 figs. This article shows in simple way the advantage of installing back pressure or extraction engines in plants requiring both power and steam for manufacturing and heating processes; economy of back-pressure engine.

Lubrication. Internal Lubrication of Stationary Steam Engines. Mech. World (Manchester), vol. 83, no. 2163, June 15, 1928, pp. 438-439, 5 figs. Object of internal lubrication in steam engine; considerations in selecting cylinder oil; methods of lubricant application; prevention of carbon deposits.

Testing. The Practical Value of the Report of the Heat Engine and Boiler Trials Committee, G. J. Wells. Inst. Marine Engrs.—Trans. (Lond.), vol. 40, June 1928, pp. 247-261, 11 figs. This report marks another important step in standardizing methods of conducting tests for determination of efficiency of heat engines; Heat Engines Committee have ascertained standards of comparison and framed codes by means of which all necessary measurements may be made; few remarks upon standards of comparison.

STEAM HEATING

One-Pipe Systems. How to Overcome Troubles Found in One-Pipe Heating Systems, C. P. Benneche. Power, vol. 67, no. 25, June 19, 1928, pp. 1098-1099, 4 figs. System in which condensation flows back from radiator through same pipe that carries steam to radiator, is subject to various troubles; author enumerates more common of these troubles and offers simple remedies that have proved successful in practice.

STEAM PIPE LINES

Underground. Underground Steam Line at California, Ohio, W. S. McLeish. Power Plant Eng., vol. 32, no. 12, June 15, 1928, pp. 688-690, 3 figs. From river pumping station, at California, Ohio, near Cincinnati, 2,570-ft. line takes steam to filtration plant and eliminates boiler room in latter.

STEAM TURBINES

Blades, Calculation. Detailed Numerical Calculation of Multiple-Action Blading Calcul numérique détaillé d'un ailettage multiple a action), C. Colombi. Technique Moderne (Paris), vol. 20, no. 14, July 15, 1928, pp. 473-483, 10 figs. This article treats of some examples of application of method of calculation given in preceding article; it establishes for different forms of construction all elements of multiple-action blading and shows how to make exact calculations rapidly.

Design. The General Trend of Modern Development in Steam-Turbine Practice, H. L. Guy. Iron and Coal Trades Rev. (Lond.), vol. 116, no. 3146, June 15, 1928, pp. 904-905; and Engineer (Lond.), vol. 145, no. 3780, June 22, 1928, pp. 678-679. Tendency towards higher steam pressures; thermal advantages; steps in thermal efficiency; little tendency towards standardization in capacity; cost of developing particular size unit is considerable; multiplication of such charges represents serious loss. Paper read before Instn. Civil Engrs.

STEEL

Corrosion Testing. Service Is Best Test of Steel, H. M. Boylston. Iron Age, vol. 121, no. 24, June 14, 1928, pp. 1665-1668, 5 figs. Accelerated and salt-spray tests not conclusive; many acid tests for corrosion are misleading; temperature time, strength of solution, agitation and other variables which discredit tests; views of testing engineers; service only authoritative guide.

Temperature Effects. Some Effects of Heat on the Physical Properties of Steel, J. L. Cox. Am. Soc. Steel Treating—Trans., vol. 14, no. 2, Aug. 1928, pp. 225-238, 4 figs. Author describes phenomena occurring in tensile tests of steel with rising temperature, together with appearance and effects of creep; shows impossibility of making short-time creep tests and necessity for accurate knowledge of proportional limit if long-time tests cannot be made; application to design of experimental results; manufacturing methods for producing weldless pressure vessels for high-temperature work.

STEEL CASTINGS

Heat Treatment. Heat Treatment of Forgings and Castings for Selective Directional Adjustment of Residual Stresses, W. J. Merten. Am. Soc. Steel Treating—Trans., vol. 14, no. 2, Aug. 1928, pp. 193-198, 3 figs. Methods of selective abstraction of heat or selective cooling by directed quenching for producing favourable directional internal or residual stresses in forged disks or cast parts of rotating bodies; directing of coolant upon middle of rotating hollow bored or forged disk by properly placed spraying nozzles or by enclosing red-hot disk in container, immersing same into coolant and simultaneously opening ports and rotating disks.

STEEL PLATES

Shipbuilding. Low-Manganese Plates for Shipbuilding Save 10 Per Cent, W. J. Berry. Iron Age, vol. 121, no. 26, June 28, 1928, pp. 1813-1814. Lloyd's register approves D-quality high-tensile steel used by British Navy for all important hull members; 1.25 per cent manganese steel used for high strength; rapid method of determining proportional limit; D-quality steel fabricated by ordinary methods and equipment.

STREET LIGHTING

Financing. Financing Street Lighting, L. A. S. Wood. Elec. World, vol. 91, no. 24, June 16, 1928, p. 1302. Author claims that it is desirable for central station to provide two plans for financing street-lighting installations; one for lighting units with overhead construction and other for lighting units with underground construction. Abstract of paper read at Missouri Assn. Pub. Utilities.

STREET RAILROADS

Construction, British Columbia. Immense Construction Programme of the B.C. Electric Railway Co. Contract Rec. (Toronto), vol. 42, no. 25, June 20, 1928, pp. 663-666, 5 figs. This year's building activities of Company include power developments, erection of transmission lines and substations, additions to gas plant; construction of townsite and laying of street-car tracks; Bridge River development; townsite at Bridge River; several substations; activities of gas department; track rehabilitation.

Management. Are We Merely Running Cars? E. J. McIllraith. Elec. Ry. Jl., vol. 71, no. 25, June 23, 1928, pp. 1031-1033. Determination of ultimate or best development for public transportation; regulation of traffic requires co-operation; fast operation appreciated; comfortable and attractive cars are needed; importance of scheduling; training of operating force; railway management's obligation in city planning.

STREET TRAFFIC CONTROL

More Efficient Use. Making More Efficient Use of Existing Streets, J. A. Miller, Jr. Elec. Ry. Jl., vol. 71, no. 25, June 23, 1928, pp. 1038-1039. Existing roadways are ample to take care of present traffic if operation is properly regulated; entire roadway needed for moving traffic; no-parking restriction in loop district of Chicago; parking is largest single factor in obstructing free movement of vehicles in streets; traffic should move faster; co-ordinated system is most efficient and synchronous system is least satisfactory. Abstract of paper presented at N. Y. State Elec. Ry. Assn.

Traffic Regulation, G. Kelsey. Sci. Am., vol. 139, no. 1, July 1928, pp. 46-48, 10 figs. Analysis of accident causes, and suggestions for correction; traffic beacons and safety zones can be made of great value when properly placed.

STREETS

Maintenance and Repair. Patching Streets in West Palm Beach, O. F. Reynaud. Crushed Stone Jl., vol. 4, no. 5, June 1928, pp. 4-5. Unique method of patching used at West Palm Beach, Fla., presents very economical programme; materials and mixing; storage of finished mixture; laying and care of patch; labour and costs.

STRUCTURAL STEEL

Shipbuilding. Steel for Shipbuilding, W. J. Berry. Engineering (Lond.), vol. 125, no. 3256, June 8, 1928, pp. 720-721, and (discussion) 700-701. Excepting high-tensile steels referred to, mild steel has held almost undisputed sway for last 40 years for shipbuilding purposes; standard tests adopted by Admiralty and Lloyd's for mild steel have remained unaltered for that period; in case of commercial structural steels, proportional range of elasticity is extremely variable; method stipulated for recording proportional limit of elasticity. Abstract of paper read before Instn. Civil Engrs. See also Engineer (Lond.), vol. 145, no. 3778, June 8, 1928, pp. 626-627.

Welding. A List of Welded Structures, F. P. McKibben. Gen. Elec. Rev., vol. 31, no. 7, July 1928, pp. 382-384. List of steel structures in which parts are connected by welds shows that this process is no longer in experimental stage, but is means of fabrication so extensively used as to warrant attention of all structural engineers and architects; bridges, buildings, cars, etc.; cranes, frames and towers, ships, tanks, etc.

Welding, Testing. Canadians Test Welded Structural Steel Members, O. Gillespie. Can. Machy. (Toronto), vol. 39, no. 12, June 14, 1928, pp. 37-38 and 40. Progress of welding art in its relation to fabrication and erection of structural steel described; investigation of structural welding in which laboratories of University of Toronto co-operated extensively; predominating idea is to establish unit working stresses for use of designing engineer that will be safe and not wasteful as to material or labour.

SUGAR, BEET

Effluent Treatment. Beet Sugar Effluent Treatment. Can. Engr. (Toronto), vol. 55, no. 4, July 24, 1928, p. 162. Commission of Enquiry reports favorably regarding desiccation process; efficient screening and filtration; information regarding manufacture of beet sugar and treatment of effluent from such plants is contained in report issued by British Ministry of Agriculture; process effluent of diffusion waste and pulp-press water from diffusion factory of 1,000 tons day is about 450,000 gal. day.

SUPERHEATERS

Steam Dissociation. Dissociation of Steam in Superheaters. Power Plant Eng., vol. 32, no. 13, July 1, 1928, pp. 737-738, 1 fig. Because of lack of definite information and existence of conflicting theories, N.E.L.A. recently canvassed their entire membership for information; reports of tests to determine moisture content of steam show that determination of proper size and location of orifice offers most serious difficulty in this connection; although results vary considerably, attention is called to fact that moisture is indicated in every case and in considerable quantity.

SURGE TANKS

Differential. Johnson Differential Surge Tank at Allens Falls, N.Y. Water Tower, vol. 14, no. 2, July 1928, p. 7, 2 figs. Description of 22-ft. diam. by 96-ft. high surge tank; located at lower end of pipe line and on top of hill some 900 ft. upstream from and 150 ft. above power house.

SURVEYING

Levelling. A New Type of Levelling and Stadia Staff. Engineer (Lond.), vol. 145, no. 3779, June 15, 1928, p. 657, 2 figs. New type has been put on market by Cooke, Troughton and Simms, and is made in accordance with patent of A. E. Gayer; it differs from Sopwith staff in two main features; it is folding instead of being telescopic and is graduated on entirely different system.

T

TELEPHONE EQUIPMENT

Characteristics. Sensitivity Characteristics of a Low-Frequency Bridge Network For Locating Opens in Telephone Circuits, P. G. Edwards and H. W. Herrington. Bell Telephone Laboratories—Reprint, no. B-321, June 1928, 19 pp., 20 figs. Problem of locating opens in telephone cable conductors involves determination of impedances; study has been made of degree of accuracy and sensitivity obtainable in impedance measurements with different frequencies of supply voltage; mathematical and experimental analysis of sensitivity of impedance measurements in cable fault location by means of de Sauty bridge.

Humidity Tests. How the Weather Conditions Are Reproduced Accurately in Bell Telephone Laboratories, R. W. King. Telegraph and Telephone Age, vol. 46, no. 13, July 1, 1928, pp. 304 and 306, 2 figs. Bell Telephone Laboratories in New York City have specially constructed humidity rooms and chambers in which weather conditions ranging from sultriest of summer days to rigors of winter can be produced and maintained over long periods of time; rooms are large enough to permit testing of large assemblies of apparatus under actual operating conditions.

Poles, Setting. Erection of Poles with Dynamite, A. P. Vangelder. Telephony, vol. 94, no. 23, June 9, 1928, pp. 24-25, 7 figs. Use of dynamite in erecting poles in quicksand and swamps; method adopted by Florida Co. of placing pole; overcharge; blast clears hole and pole settles in; procedure was evolved by foreman of Southern Bell Telephone and Telegraph Co. in Florida.

TELEPHONE SWITCHBOARDS

Non-Multiple. A New Non-Multiple P.B.X., V. I. Cruser. Bell Laboratories Rec., vol. 6, no. 5, July 1928, pp. 363-365, 4 figs. 551-type P.B.X. was designed to improve maintenance conditions as well as to reduce cost of manufacture; in new board, stripmounted jacks and lamps are used for station lines; framework for new switchboard is made up of minimum number of parts.

TELEPHONE SYSTEMS

CARRIER. A Short-Haul Carrier System, H. S. Black. Bell Laboratories Rec., vol. 6, no. 5, July 1928, pp. 353-358, 4 figs. Requirements for proposed system as formulated by engineers of American Telephone and Telegraph Co.; system which met these requirements was developed and tested in laboratories; outstanding feature of Type D-1 system.

TELEVISION

ELABORATE APPARATUS. Television, R. W. King. Can. Ry. Club (Montreal)—Proc., vol. 27, no. 4, Apr. 1928, pp. 20-27. Elaborate apparatus is necessary to give convincing and complete demonstration; apparatus illustrative of electrical features of television demonstrated; few works on subject of synchronism.

What Can We See By Radio? R. P. Clarkson. Radio Broadcast, vol. 13, no. 4, August 1928, pp. 185-187, 5 figs. Heart of all present television devices is Nipkow disk which dates back to 1884; technical details are all that distinguish one apparatus from another; so far as reception is concerned, any receiver with sufficient amplication and power output can be used; for present, however, there is legal limit of plus and minus 5,000 cycles for width of sidebands and this limit will not be exceeded; consideration of what is to be sent and what can be seen through these whirling disks.

TIN PLATE

THIN AS PAPER. Tin Plate Thin as Paper. Iron and Steel of Canada (Gardenvale, Que.), vol. 11, no. 7, July 1928, pp. 213-214. Thin, almost like tinfoil or heavy grade of paper, 35-lb. or 48-gauge tinplate is being produced at Farrell and Pennsylvania works of American Sheet and Tin Plate Co.; marked degree of success attained in keeping material practically free from blemishes; field of application thus far limited; production and handling costs high.

TOOL STEEL

ALLOYING ELEMENTS. Tool Steels. Black and White, vol. 1, no. 3, Mar. 1928, pp. 22, 27-31. General effect of alloying elements; nickel; nickel steels with nickel contents under 1 per cent; chromium; action of chromium in steel; vanadium; tungsten; molybdenum; manganese; silicon used in practically all commercial steels as deoxidizer.

Tool Steels, Their Characteristics and Application, A. H. Kingsbury. Can. Machy. (Toronto), vol. 39, no. 13, June 28, 1928, pp. 114-118. Comparison of methods employed in tool-steel industry of years ago with those of present day; essentials to quality; metallurgical laboratory; no inspection positive; normalcy of tool steels; classifications; constituent cementite.

TOOLS

BENDING AND FORMING. Bending and Forming Tools, W. Richards. Mech. World (Manchester), vol. 83, no. 2164, June 22, 1928, pp. 450-451, 2 figs. Shearing and forming operation upon blanked component described in connection with manufacture of typewriter key lever.

GRINDING. Grinding Roll Turning Tools, R. H. Cannon. Iron Trades Rev., vol. 83, no. 2, July 19, 1928, pp. 135 and 137, 3 figs. Grinding of roll-turning tools for steel mills explained with details of wheels and special machine developed for purpose.

TRANSFORMER OIL

SLUDGE PREVENTION. Transformer Oils. World Power (Lond.), vol. 10, no. 55, July 1928, pp. 28-29. Sludge prevention by use of anti-oxidants; investigations by British Electrical and Allied Industries Research Assn. show that certain products, called anti-oxidants, which possess property of retarding oxidation, can be used to prevent formation of sludge; water and acid in insulating oils; they can also be used for retarding oxidation of cable compounds and rubber.

TUBES, STEEL, SEAMLESS

MANUFACTURE. Piercing Billets for Making Tubes, R. C. Stiefel and G. A. Pugh. Iron and Steel of Canada (Gardenvale, Que.), vol. 11, no. 7, July 1928, pp. 199-203, 5 figs. Pilger and plug processes are compared; typical modern plug-mill unit; power in piercing should be reduced to minimum and more power spent in bar mill to produce billets of smaller diameter; expanding mill for larger tubes; wide range in sizes from few sizes of billets advocated; better steel needed; ingots cast for piercing. From paper presented at Am. Soc. Mech. Engrs. See also Metal Industry (Lond.), vol. 33, nos. 2 and 3, July 23 and 30, 1928, pp. 33-38 and 59-61, 6 figs.

TUNNELING

CROSS-SECTION MEASURING. Checking Tunnel Size by Measurement From Wire Base Lines, L. T. Sogard. Eng. News-Rec., vol. 101, no. 2, July 12, 1928, p. 69, 2 figs. Construction of Salt Creek intercepting sewer, Contract No. 2, of Sanitary District of Chicago, involved driving 6,600-ft. through solid limestone for 7 x 7 ft. gothic-arch type section; shows how rods and wires were set up for checking cross-section of tunnel.

TUNNELS

CONSTRUCTION. Cascade Tunnel Construction Sets New Engineering Records, J. C. Baxter. Eng. World, vol. 33, no. 1, July 1928, pp. 6-8, 8 figs. Railroad tunnel in State of Washington is planned and operated from three different bases through temporary tunnel driven parallel to axis of main tunnel at distance of about 60 ft.; most modern up-to-minute equipment used throughout; some world's records which have been established during construction of this tunnel.

TURBO-ALTERNATORS

INSULATION. Improvements in Insulation for High-Voltage A-C. Generators, C. F. Hill. Am. Inst. Elec. Engrs.—Jl., vol. 47, no. 7, July 1928, pp. 492-496, 10 figs. Discussion is given of insulation problem in relation to increased size, rating, and voltages of turbo-alternators, and results of experimental studies showing possibilities of improving insulation to take care of such increases; mention is made of effects of high-voltage testing and use of hydrogen on insulation problem; explanation of device for elimination of corona formed around armature coils.

V

VACUUM TUBES

CATHODE, INDIRECT HEATING. The Use of Alternating Current for Heating Valve Filaments, C. W. Oatley. Experimental Wireless, vol. 5, no. 58, July 1928, pp. 380-384, 1 fig. Variation of filament temperature; numerical data; refer to thoriated tungsten filament; variation of effective grid a potential; superiority of indirectly heated cathode valves over ordinary valves in matter of mutual conductance is chiefly due to much greater filament power consumption of former.

FOUR-ELECTRODE. Detection With the Four-Electrode Tube, J. R. Nelson. Inst. Radio Engrs.—Proc., vol. 16, no. 6, June 1928, pp. 822-839, 9 figs. Mathematical analysis of plate rectification; investigation of various applications of four-element tube of screen-grid type in field of broadcast reception.

SCREENED-GRID. The Screen-Grid Tube, N. H. Williams. Inst. Radio Engrs.—Proc., vol. 16, no. 6, June 1928, pp. 840-843. In shielded grid tube feed-back is reduced to negligible amount and current through tube is very nearly independent of plate voltage over working range.

THERMIONIC. Continuous Reading of Varying Potentials by Means of Thermionic Values, D. T. Harris. Sci. Instruments—Jl., vol. 5, no. 5, May 1928, pp. 161-166, 9 figs. Assembly of apparatus, with steady zero reading, primarily designed for following changes in bio-electric potential differences, is described and illustrated.

THYRATION. The Direct-Current Transformer Utilizing Thyration Tubes, D. C. Prince. Gen. Elec. Rev., vol. 31, no. 7, July 1928, pp. 347-350, 9 figs. Research by several workers has been undertaken in order to produce and utilize tubes without incurring excessive losses; one of the most interesting of these tubes is "Thyraton," one form consists of mercury-arc rectifier with grid added to each anode arm; thyration has characteristic that current can be prevented from starting by small negative grid voltage but cannot be stopped under usual conditions of operation by applying large negative grid voltage.

VEHICULAR TUNNELS

DETROIT. Work Begun on Vehicular Tube from Detroit to Windsor. Eng. News-Rec., vol. 100, no. 25, June 21, 1928, p. 978. Tunnel under Detroit river is to be partly shield driven and partly of performed sections; single tube slightly larger in cross-section than Holland tunnel at New York; interior similar to Holland tunnel; roadway will be 22 ft. wide; traffic; private undertaking; estimated construction cost of $10,000,000.

VIADUCTS

CONCRETE, REINFORCED. Concrete Bridge Construction on Curve. Eng. News-Rec., vol. 101, no. 1, July 5, 1928, pp. 4-7, 7 figs. Design and Construction of Lindbergh Viaduct at Reading, Pa., consisting of 13 open-spandrel, three-rib arches of 41-ft. 7½-in. to 83¼-ft. clear span; details of bridge deck and arch sections, abutment pier at junction of short- and long-span arches; construction plant layout for curved plan; cableway adapted to handling materials for spans on sharp curve; careful centring aided in balancing arch thrusts; nice formwork demanded by curved cornice; total construction cost $443,937.

VOLTAGE REGULATORS

AUTOMATIC. Automatic Voltage Regulators' Application to Power Transmission Systems, C. A. Nickle and R. M. Carothers. Am. Inst. Elec. Engrs.—Jl., vol. 47, no. 7, July 1928, pp. 525-528, 6 figs. Considers means seriously for increasing maximum power and for insuring continuity of service during transient disturbances, such as load swings and short circuits; presents results of extended investigation along these lines; new regulator is described which will accomplish above; short circuits.

Computing Compensator Settings for Automatic Voltage Regulators, V. W. Palen. Elec. World, vol. 91, no. 26, June 30, 1909, p. 1382, 1 fig. Procedure to be employed with triple-loop circuits. (Continuation of serial.)

VOLTMETERS

HIGH-SPEED. A High-Speed Graphic Voltmeter for Recording Magnitude and Duration of System Disturbances, A. F. Hamdi and H. D. Braley. Am. Inst. Elec. Engrs.—Jl., vol. 47, no. 7, July 1928, pp. 512-515, 10 figs. Paper deals with graphic voltmeter for recording magnitude and duration of system disturbances; operating experiences with this device; points out importance of data obtained.

W

WALLS

HEAT TRANSMISSION, RESEARCH. Heat Transmission Research, F. B. Rowey, F. M. Morris, and A. B. Algren. Am. Soc. Heat. and Vent. Engrs.—Jl., vol. 34, no. 7, July 1928, pp. 517-541, 23 figs. Results of co-operative research between University of Minn. and Am. Soc. of Heating and Ventilating Engrs.; flow of heat through building and insulating materials; experiments have been directed to development of apparatus and testing of built-up wall sections and insulating materials; description of test apparatus; hot-plate apparatus and tests; calibrations of apparatus.

WAREHOUSES

TORONTO. Loblaw Warehouse in Toronto Is One of This Year's Notable Structures. Contract Rec. (Toronto), vol. 42, no. 26, June 27, 1928, pp. 679-684, 10 figs. Building covering area of 469 by 300 ft.; model of efficiency in layout; unique loading platform is one feature; four storeys high with full basement, and is of flat-slabbed reinforced concrete with exception of top floor, which is of steel frame construction and has monitor sash; all goods are handled by system of skids and mechanical mules and are assembled for distribution by over 2,000 ft. of electric tram rail.

WASTE HEAT RECOVERY

MAIN ASPECTS. Waste-Heat Recovery, W. Gregson. Iron and Steel of Canada (Gardenvale, Que.), vol. 11, no. 7, July 1928, p. 207. Main aspects of recovery of waste heat by steam raising in steel and carbonization industries are discussed; subject one of important factors that make for economic production based on post-war requirements. Paper read before Instn. Mech. Engrs.

WATER CHLORINATION

TORONTO, ONTARIO. Superchlorination of Toronto Water, N. J. Howard. Can. Engr. (Toronto), vol. 54, no. 26, June 26, 1928, pp. 645-646; and Contract Rec. (Toronto), vol. 54, no. 26, June 27, pp. 645-646. Discussion of paper by L. H. Enslow; superchlorination is laboratory controlled and not continuous; during 334-day period treatment used on whole or part of 167 days; raw-water turbidity less than 5 on 200 days in year; plans for new 100,000,000-gal. mechanical plant for Toronto make full provision for treatment. Paper presented at Am. Water Works Assn.

WATER DISTRIBUTION

DATA SUMMARIZED. A.W.W.A. Questionnaire Data Summarized. Can. Engr. (Toronto), vol. 54, no. 24, June 12, 1928, pp. 610-612. Summary of replies to questionnaire tabulated for discussion at Superintendents' Round Table Meetings at annual convention of Am. Water Works Assn., San Francisco; large percentage of cities submit data.

WATER FILTRATION

ELEMENTS. Elements of Successful Water Filtration, H. N. Jenks. Can. Engr. (Toronto), vol. 54, no. 25, June 19, 1928, pp. 630-632. Coagulation and filtration are chief factors in successful water purification; design factors and operating methods; chemical feed apparatus; coagulant dosing lines; design of mixing devices; mechanical mixing; design of underdrain system; size and depth of sand; filter-control equipment; application of coagulant; preservation of flow; washing of filter. Abstract of paper read before Iowa Water Works Conference.

Successful Water Filter Operation, H. N. Jenks. Contract Rec. (Toronto), vol. 42, no. 24, June 13, 1928, pp. 639-642. Satisfactory filtration is dependent on adequate coagulation; how suitable pretreatment of water can be obtained; influence of plant design and operating methods; design features as related to coagulation; design of mixing devices; compromise between gravity mixing and mechanical mixing; influence of plant design on filtration; underdrain system; size and depth of sand; filter-control equipment; preservation of flow; filtration as affected by operating methods.

WATER FILTRATION PLANTS

CALIFORNIA. Unusual Filtration and Aeration Plant Completed by City of Beverly Hills, R. L. Derby. Hydraulic Eng., vol. 4, no. 6, June 1928, pp. 354, 378 and 380, 3 figs. Difficult problem of water purification involving hydrogen-sulphide water solved after several years' intensive experimentation; first municipal rapid-sand filtration plant in state of California in which water softening as well as filtration is undertaken; process finally worked out; description of equipment; air blowers; head house; chlorination.

WATER METERS

LIFE OF. Life of Water Meters Largely Dependent Upon Construction Materials, T. C. Brownell. Hydraulic Eng., vol. 4, no. 6, June 1928, p. 388, 1 fig. Galvanic action of stray electric currents often destroys meters made of inferior materials; electrochemical action.

WATER PIPE

COPPER. Copper Water Service Pipe Connections, R. B. Morse. Can. Engr. (Toronto), vol. 54, no. 26, June 26, 1928, pp. 639-640. Practice of Washington Suburban Sanitary District in use of copper tubing for service pipes of smaller diameters and reasons for adoption; district water supply; all services are metered; installing service pipe; flexibility of tubing; comparative cost of services.

WATER PIPE LINES

ARC WELDING. Long Welded Pipe Line, V. R. Young. Can. Engr. (Toronto), vol. 55, no. 2, July 10, 1928, p. 32, 3 figs. Carries water distance of seven miles to city, passing under Connecticut River; 54-in. and 48-in. diam. pipe; plates are bent into half cylinders and automatically arc welded together in shop.

CLEANING. Periodical Cleaning of Water Mains Greatly Decreases City Distribution Expense, W. H. Grotz. Hydraulic Eng., vol. 4, no. 6, June 1928, pp. 356, 370, 372 and 373. Experience has shown that low-pressure mains often become so badly silted as to reduce capacity by nearly half; mains which had been in ground 25 years and longer were badly silted; cleans approximately six mi. of mains; improvement after cleaning; 100 per cent increase; description of process; time required.

CLEANING, BUFFALO. Experiences at Buffalo, N.Y., in Cleaning Water Mains, W. H. Grotz. Mun. News, vol. 74, no. 5, May 1928, pp. 125-126. Distribution system; mains in ground 24 years and longer were badly silted; work done under first contract gave excellent results; procedure in cleaning water main; cleaning device; cost; benefits. Abstract of paper presented before Can. Section, Am. Water Works Assn.

CONCRETE. New Concrete Pipe Line Carries Water Supply to Birmingham, W. R. Brend. Concrete Products, vol. 34, no. 6, June 1928, pp. 51-53, 4 figs. Concrete pipe lines more than 9 miles in total length; composed of 42-in. and 36-in. pipe; all pipe are of lock-joint type, with steel cylinder imbedded in concrete and bar reinforcement so designed to carry up to 300-ft. head of water.

New Soft Water Supply for Santa Maria, California, H. L. Neel, Jr. West. Constr. News, vol. 3, no. 11, June 10, 1928, pp. 354-355. Installation of 18-in. concrete pipe line from Orcutt to Santa Maria; pipe having 2½-in. wall stands hydrostatic pressure test of 120 lb.; pipe lengths 3 ft.; total cost of 5½-mi. pipe line was $65,000.

CROSS CONNECTIONS. Report of Committee on Cross-Connections. New England Water Works Assn.—Jl., vol. 42, no. 2, June 1928, pp. 191-219. Definitions; demand for cross-connection; fire protection; cross-connection and public health; position of public-health authorities; importance of inspection; examples of common cross-connections to potable water supplies; partial list of epidemics caused by polluted water entering drinking-water systems through cross-connections.

DEAD ENDS. Dead End in Water Works Systems, S. B. Morris. Can. Engr. (Toronto), vol. 55, no. 1, July 3, 1928, pp. 107-108. Disadvantages in employment of dead ends in water mains discussed; their effect on hydraulic capacity of main and quality of water; briefly analyzes and weighs several problems pertaining to dead ends in water mains and sealed services; effect upon corrosion; effect of electrolysis. Paper presented at Am. Water Works Assn.

WATER PURIFICATION

PROTECTION. Protection and Purification of Supplies and Methods of Analysis. Eng. News-Rec., vol. 100, no. 26, June 28, 1928, pp. 1012-1015. Abstracts of papers read before annual convention of Am. Water Works Assn. on pollution diversion, protection of water supply of Wichita Falls, Tex., from salt water; recreational use of reservoirs; prechlorination; super- and de-chlorination; algae and crenothrix control; plankton in reservoirs; hydrogen-sulphide removal; tastes from creosoted wood-stave pipe; filter-plant operation; chemical and bacteriolocal practice.

WATER SOFTENING

ZEOLITE PROCESS. Softening Water by Use of Zeolite, J. T. Campbell and D. E. Davis. Can. Engr. (Toronto), vol. 55, no. 5, July 31, 1928, pp. 178-182. Experience with zeolite process on treatment of municipal water supplies in two towns on Ohio River; comparative annual cost estimate for lime-soda vs. zeolite softening; size of softening units; experiences at Sewickley. Paper presented at Am. Water Works Assn.

WATER TREATMENT

DOMESTIC PURPOSES. The Filtration and Treatment of Water for Domestic Purposes, A. C. Houston and H. E. Stilgoe. Engineering (Lond.), vol. 125, no. 3258, June 22, 1928, pp. 787-788, and (discussion) 760, 2 figs. Metropolitan water supply of London is given as example of what can be done to purify waters which in their origin are not free from contamination; examples of nearly every known method of purification are to be seen at works of Board. Abstract of paper read before Instn. Civil Engrs. See also Engineer (Lond.), vol. 145, no. 3780, June 22, 1928, p. 681; and Surveyor (Lond.), vol. 73, no. 1899, June 15, pp. 625-626, 1 fig.

NEW YORK CITY. Taking Corrosion Out of Catskill Water, W. W. Brush. Water Works Eng., vol. 81, no. 13, June 20, 1928, pp. 913-914, 2 figs. Experiments of New York Water Department to effect result; water now especially corrosive to cast-iron hot-water pipes; most desirable treatment; cost of treatment; experiments to determine material.

WATER WORKS

PUMPAGE METERING. Does It Pay to Meter Waterworks Pumpage? C. W. Parsons. Contract Rec. (Toronto), vol. 42, no. 28, July 11, 1928, pp. 732-734. Cases of two cities, one small and one large with different problems, cited as indication of value of installing flow meters; reasons for metering; effect of metering large mains; metering at filtration plants; improvement of operating conditions; why metering pumpage pays.

WELDING

BIBLIOGRAPHY. Current Welding Literature. Am. Welding Soc.—Jl., vol. 7, no. 6, June 1928, pp. 61-63. Bibliography covering American and foreign periodicals.

WELDING PRACTICE

GENERAL THOUGHTS. Some General Thoughts on Fusion Welding, S. W. Miller. Am. Soc. Steel Treating—Trans., vol. 14, no. 1, July 1928, pp. 61-65 and (discussion) 65-66. Comparison is made between different methods of welding, showing need in all of them for protection of metal from oxidation; explanation of action of fluxes and of advantages of making rods for fusion welding of proper chemical composition so that resultant welds will be free from oxides.

WIND TUNNELS

AIR FLOW. On Improvement of Air Flow in Wind Tunnels, C. Wieselsberger. Nat. Advisory Committee for Aeronautics—Tech. Memo., no. 470, July 1928, 9 pp., 7 figs. Analysis of Gottingen type of wind tunnel; application of Gottingen principle to other wind tunnels, such as Nat. Physics Laboratory or Eiffel type, by replacing customary exit cone with different one; requirements of air stream employed in aerodynamic investigations of aircraft models or of individual parts. From Jl. of Soc. Mech. Engrs. of Japan, vol. 28, no. 98, June 1925.

WINDOWS, METAL

AIR INFILTRATION. Air Leakage Through a Pivoted Metal Window, F. C. Houghten and M. E. O'Connell. Am. Soc. Heat. and Vent. Engrs.—Jl., vol. 34, no. 7, July 1928, pp. 549-553, 5 figs. Study of air leakage through pivoted window in Grand Central Palace Bldg., New York City, during Power Show; description of building; test procedure and results.

WIRE

STEEL, HEAT TREATMENT. The Heat Treatment of Drawn Wire for Bridges, A. V. de Forest. Wire, vol. 3, no. 7, July 1928, pp. 236-237, 1 fig. Better knowledge of better strength steels points to prospect of longer and lighter bridges; paper was written as part of symposium on subject of bridge steels; use of heat treated steel; instead of wire hardened by cold working, fully heat-treated steel was used in quenched and tempered state; future of bridge wire; reprinted from Am. Soc. Steel Treating—Trans.

TESTING MACHINES. The Mechanical Testing of Wire, J. D. Brunton. Wire, vol. 3, no. 7, July 1928, pp. 224-226 and 241-244, 6 figs. Variety of machines makes it possible to maintain high-quality production by frequent, rapid and accurate tests; gives outline of these tests and their meaning and describes apparatus that is most commonly used to perform them; 10,000-lb. capacity; 60,000-lb. capacity; 200-lb. machines; testing grips important.

WOOD PULP

TESTING. Chemical Wood Pulp Quality Evaluation, J. L. A. Macdonald and G. A. Cramond. Paper Trade Jl., vol. 87, no. 5, Aug. 2, 1928, pp. 51-53. More than little doubt as to whether tear of sheet pulp is truly indicative of strength characteristic of pulp when converted into sheet of paper; numerical data; deals with problem of testing of chemical wood pulps for strength; test results.

Testing Wood Pulp for Strength. Paper Mill, vol. 51, no. 28, July 14, 1928, pp. 20, 22, 24 and 36. Abstract of contribution to discussion on Evaluation of Chemical Wood Pulps by J. L. A. MacDonald and G. A. Cramond at meeting of South of Scotland Technical Section of British Paper Makers' Assn.; dealing with problem of testing of chemical wood pulps for strength; meaning of strength; only practical method of testing pulps for strength is in form of sheets; evaluation of chemical wood-pulp strength testing; direct mill application.

Z

ZINC PLATING

GALVANIC. Electroplating Zinc. Metal Industry (Lond.), vol. 32, no. 25, June 22, 1928, p. 620. Paweck and Seihoer, of Vienna Electrochemical Institute, have devised galvanic zinc-plating process, which greatly reduces time factors in that operation.

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A

AERIAL PHOTOGRAPHY

Canada. The Airplane in Canadian Exploration, A. M. Narraway. Soc. Automotive Engrs.—Jl., vol. 23, no. 3, Sept. 1928, pp. 229-234, 4 figs. Use of aerial surveying in investigation and development of Canada's vast undeveloped areas; descriptions are given of method of taking photographs, which differs from other photographic mapping methods, of plotting data on map, and of preparing type maps showing condition of lumber resources of region; application of photography to investigation of water-power resources; problem of indexing photographs.

Geological Survey. Application of Commercial Aviation to a Geological Survey, C. M. Wagner. Oil. Bul., vol. 14, no. 8, Aug. 1928, pp. 807-808. Airplane facilitates field work, but its use cannot replace detailed ground work; in unexplored and unmapped area, aerial observation preceding general reconnassance or detailed work is of great value; cites two-hour flight over territory that would require weeks or months in mere reconnaissance.

Mapping, Canada. Aerial Photography Solves Canadian Surveying Problem. Eng. and Min. Jl., vol. 126, no. 8, Aug. 25, 1928, p. 311, 1 fig. Map and brief description show how proposed route for transmission line of Hudson Bay Mining and Smelting Co. was determined by means of aerial photography; time and expense saved; power plant at Island Falls on Churchill river, near Wasawakasik lake, 80 mi. north of Flin Flon mine.

AERIAL TRANSPORTATION

Mining Exploration, Canada. A Trip Through Northern Manitoba, R. C. Rowe. Can. Min. Jl. (Gardenvale, Que.), vol. 49, no. 33, Aug. 17, 1928, pp. 652-657, 8 figs. Mandy mine on Schist lake; Flin Flon mine, on north shore of bay of Flin Flon lake; description of mine and mill; return to The Pas, finishing round trip in four days; in north-land, big mines are in wireless communication with The Pas and Winnipeg; call plane, just like calling taxi. (Concluded.)

AIRPLANE ENGINES

Lubrication. Development of Aircraft Engine Design and Lubrication. Lubrication, vol. 14, no. 7, July 1928, pp. 73-84, 17 figs.

AIRPLANES

Tail Surfaces, Design. Study of Horizontal Tail Surfaces of Consolidated XPT-3 (NY-1). Air Corps Information Circular, vol. 7, no. 615, Aug. 15, 1928, 8 pp., 7 figs. Study to improve landing characteristics of XPT-3 airplane by re-designing horizontal tail surfaces; desired larger stalling moments obtained by proposed tail are effective only at low speed and do not alter balance with elevators free at 85 mi. per hr.; decreased slope of pitching coefficient improves control throughout entire range of flying; somewhat increased stick forces can be offset by use of balanced elevators.

Wings. Pressure Distribution Over a Rectangular Monoplane Wing Model Up to 90 Deg. Angle of Attack, M. Knight and O. Loeser, Jr. Nat. Advisory Committee for Aeronautics, Report No. 288, 1928, 19 pp., 34 figs. Description of pressure-distribution tests made on wing model in atmospheric wind tunnel of Langley Memorial Aeronautical Laboratory.

16th Wilbur Wright Memorial Lecture, F. H. Handley Page. Roy. Aeronautical Soc.—Jl. (Lond.), vol. 32, no. 212, Aug. 1928, pp. 649-704 and (discussion) 704-705, 62 figs. Wind-tunnel experiments showing how aerodynamic characteristics of wing section are altered by slot, are described, and best application of Handley-Page slotted wing for control purposes is explained; with correctly designed and positioned auxiliary airfoil, opening and closing automatically, very good control at beyond stall can be obtained without added complication of control by forward airfoil.

Slotted Wings and the Automatic Slot, F. H. Page. Engineering (Lond.), vol. 126, no. 3265, Aug. 10, 1928, pp. 180-182, 11 figs.

Tests with New Type of Airplanes (Versuche mit neuartigen Flugzeugtypen), A. Lippisch. Zeit. fuer Flugtechnik u. Motorluft-schiffahrt (Munich), vol. 19, no. 12, June 28, 1928, pp. 274-281, 19 figs.

The Surface Resistance of Airplane Wings (Ueber den Oberflaechenwiderstand bei Flugzeugen), M. Schrenk. Zeit. fuer Flugtechnik u. Motorluftschiffahrt (Munich), vol. 19, no. 9, May 14, 1928, pp. 208-209.

Wing Spread as the Basic Factor in Design (Die Spannweite als grundlegendes Bestimmungsstueck des Flugzeugentwurfs), G. Lachmann. Zeit. fuer Flugtechnik u. Motorluftschiffahrt (Munich), vol. 19, no. 9, May 14, 1928, pp. 198-208, 21 figs.

AIRPORTS

Planning. Airport Planning, G. Hadden. Eng. News-Rec., vol. 101, no. 10, Sept. 6, 1928, pp. 344-345, 2 figs. Brief general discussion of considerations influencing airport design; suggests policy of planning for future developments as nearly as they can be predicted and to build for immediate needs.

Chicago, Ill. Chicago's Municipal Airport An Institution. Airports, vol. 1, no. 3, July 1928, pp. 27 and 38, 1 fig.

ALLOYS

Aluminum. *See Aluminum Alloys.*

Bronze. *See Bronze.*

Chrome-Nickel. *See Chromium-Nickel Alloys.*

Equilibrium Diagrams. Equilibrium Diagrams in Studying Alloys, W. Rosenhain. Heat Treating and Forging, vol. 14, no. 7, July 1928, pp. 734-739, 3 figs. Abstract from presidential address to Institute of Metals.

Heat-Resisting. Heat-Resisting Alloys, T. H. Turner. Am. Metal Market, vol. 35, no. 155, Aug. 14, 1928, pp. 17-20, and 22-23.

Zinc. *See Die Casting.*

ALLOY STEELS

Manufacture. The Manufacture of Alloy Steel, E. C. Smith. Iron and Steel of Can. (Gardenvale, Que.), vol. 11, no. 8, Aug. 1928, pp. 242-244. Inquiry into alloy-practice conditions; control of charge necessary; furnaces and fuels used; many intangibles included in customer's demands; methods of adding alloys; ingot practice must be good; slow rolling in smooth rolls; alloy steels like old branded products; fine alloy steels from basic open hearth. Paper presented to Am. Iron and Steel Inst.

ALUMINUM ALLOYS

Chlorine Treatment. Note on the Treatment of Aluminum and Aluminum Alloys With Chlorine, D. R. Tullis. Inst. of Metals—Advance Paper (Lond.), no. 480, for mtg. Sept. 4-7. 1928, 8 pp.

Fits. How Temperature Affects Fits in Aluminum Alloys. Am. Mach., vol. 69, no. 8, Aug. 23, 1928, p. 311. Builders of automobile engines have experienced difficulty with fit of rods on crankpins in extremes of temperature; customary to allow little more rod clearance in winter than in summer; additional clearance of 0.0004 in. is allowed for new engines that go into service in winter months; experiments with steel reinforced and alloy caps; Franklin and Hupp practice.

Welding. Spot Welding of Aluminum and Its Alloys, W. M. Dunlap. Aviation, vol. 25, no. 9, Aug. 25, 1928, pp. 590-591 and 618-626, 10 figs.

ALUMINUM ALLOY CASTINGS

High Temperature Effects. Mechanical Properties of Aluminum Casting Alloys at Elevated Temperatures, R. L. Templin, C. Graglio and K. Marsh. Iron and Steel A.S.M.E. Trans., vol. 50, no. 16, May-Aug. 1928, pp. 25-36 and (discussion) 36-37, 28 figs. Tensile results obtained from "short-time" high-temperature tests of ten different aluminum casting alloys and very pure cast aluminum, and for various heat treatments; all specimens tested were sand cast; tensile strength, yield point, elongation in 2 in., reduction in area, and Young's modulus values are given for various temperatures throughout range 75-800 deg. fahr.; describes method of measuring specimen temperatures during tensile tests.

ALUMINUM CASTINGS

X-Ray Analysis. Results of X-ray Examinations of Aluminum Pistons and Other Light-Metal Castings (Untersuchungsergebnisse der Roentgendurchleuchtung von Aluminiumkolben und anderen Leichtmetall-Gusstuecken), M. v. Schwarz. Zeit. fuer Flugtechnik u. Motorluftschiffahrt (Munich), vol. 19, no. 14, July 28, 1928, pp. 323-325, 13 figs.

AMMONIA COMPRESSORS

Temperature-Pressure Relations. Temperatures and Pressures in Ammonia Systems, A. G. Solomon. Power Plant Eng., vol. 32, no. 17, Sept. 1, 1928, pp. 941-942, 1 fig.

APARTMENT HOUSES

Reinforced Concrete. Tall Reinforced-Concrete Building Involves Special Design, B. B. Shapiro. Eng. News-Rec., vol. 101, no. 9, Aug. 30, 1928, pp. 315-317, 3 figs. Reinforced-concrete apartment house recently built in Chicago; designed originally for steel framing; 21 storeys high; founded on 60-ft. wood piles; because of unusual irregularity in plan column spacings varied; unusual windbracing; rapid construction; quality control of concrete; economy in concrete framing.

ARCHES

Hinges, Design. Reinforced-Concrete Hinges With Convex and Concave Contact Surfaces (Eisenbeton-Waelzgelenke mit konkaver und konvexer Beruehrungsflaeche), G. Hartschen. Bauingenieur (Berlin), vol. 9, no. 32, Aug. 10, 1928, p. 580, 2 figs. Theoretical, mathematical discussion of principles of design; numerical example.

ASBESTOS INDUSTRY

Canada. Canadian Asbestos, 1927. Can. Min. Jl. (Gardenvale, Que.), vol. 49, no. 35, Aug. 31, 1928, p. 699. Production slightly greater than 1926; higher prices give 5.1 per cent increase in value; tabulated statistics on output, shipments, imports, exports, etc.

ASBESTOS

South Africa. The Nature and Origin of the Amphibole-Asbestos of South Africa, M. A. Peacock. Am. Mineralogist, vol. 13, no. 7, July 1928, pp. 241-286 and 6 figs. on supp. plates.

AUTOMOBILE ENGINES

Connecting Rods, Manufacture. How Citroen Makes Connecting Rods. Am. Mach., vol. 69, no. 9, Aug. 30, 1928, pp. 348-349, 7 figs.

Cylinders, Manufacture. Unique Locating Method Employed in Finishing Cylinder Blocks, K. W. Stillman. Automotive Industries, vol. 59, no. 9, Sept. 1, 1928, pp. 296-298, 6 figs.

Detonation. Influence of Engine Design on Detonation (L'influence du dessin du moteur sur al détonation Ricardo. Technique Automobile et Aérienne (Paris), vol. 19, no. 142, 1928, pp. 75-79. Discussion of detonation, causes, prevention, form of combustion chamber, merits of various forms; influence of cylinder dimensions of detonation.

AUTOMOBILE PLANTS

Heat Treating in. Dodge Electrifies Heat Treatment. Iron Age, vol. 122, no. 7, Aug. 16, 1928, pp. 389-392, 5 figs.

AUTOMOBILES

Bodies, Steel. Sheet Steel for Automobile Bodies. Heat Treating and Forging, vol. 14, no. 8, Aug. 1928, pp. 856-862, 7 figs.

Brakes. A New Vacuum Servo. Automobile Engr. (Lond.), vol. 18, no. 244, Aug. 1928, pp. 289-290, 5 figs.

Frames, Manufacture. Making Automobile Frames Automatically. Iron Trade Rev., vol. 83, no. 8, Aug. 23, 1928, pp. 441-443 and 483, 5 figs. Article deals with automatic production of automobile frames by A. O. Smith Corp., Milwaukee; rates of speed maintained in automatic plant is between 300 and 360 frames per hour; description of equipment and operation.

Front Axles, Manufacture. How Ford Makes Front Axles, F. L. Faurote. Iron Age, vol. 122, no. 8, Aug. 23, 1928, pp. 457-460, 7 figs.

Springs, Standardization. Leaf-Spring Standards. Soc. Automotive Engrs.—Jl., vol. 23, no. 3, Sept. 1928, pp. 321-322, 3 figs. Present spring and spring parts specifications, as revised and consolidated by Subdivision of Passenger Car Division, are given and include leaf springs, leaf-spring steel, leaf-spring tests, and tests for parallelism of spring eyes.

Transmissions. The Lescarts Variable-Speed Transmission Gear (Appareil de transmission à vitesse variable système Lescarts), A. Dumont. Genie Civil (Paris), vol. 93, no. 4, July 28, 1928, pp. 93-95, 4 figs.

AUTOMOTIVE FUELS

Anti-Knock Compounds. Iron Carbonyl: The German Anti-Knock Compound. Petroleum Times (Lond.), vol. 20, no. 497, July 21, 1928, p. 108. Researches have proved that crude benzol can be refined into high-grade motor fuel when used alone; supplies are too limited for general use; Benzol-Verband has found blends of benzol or alcohol with petroleum fuel satisfactory; most important anti-knock fuel in Germany is "Motalin," which is doped petroleum motor fuel in which added chemical is iron carbonyl Fe (CO) 5; said to be non-poisonous; 0.1 per cent sufficient.

Detonation. Spectroscopic Study of Fuels and Analysis of Detonation Theories, G. L. Clark. Soc. Automotive Engrs.—Jl., vol. 23, no. 2, Aug. 1928, pp. 167-173, 1 fig

B

BEAMS, REINFORCED CONCRETE

Stresses. Web Stresses in Reinforced Concrete Beams. Contract Rec. (Toronto), vol. 42, no. 33, Aug. 15, 1928, pp. 845-847. Action of web reinforcement in overhanging or restrained beams in which there are both positive and negative bending moments; purposes of tests; how tests were made; conclusions as result of tests. From University of Illinois Engineering Experiment Station—Bul.

BLOWERS

Forced-Draft. Westinghouse Forced-Draft Blower of the Schmidt Propeller Type, J. B. Lincoln and B. F. Treat. Am. Soc. Naval Engrs.—Jl., vol. 40, no. 3, Aug. 1928, pp. 424-437, 9 figs. Article describes and gives results of tests made at U. S. Naval Eng. Experiment Station on Schmidt vertical blower manufactured by Westinghouse Electric & Mfg. Co.; tests cover performance of fan at various speeds and capacities and performance of combined unit; description of blower.

BLOWING ENGINES

Gas, Testing. Industrial Tests Made on Gas Blowing Engine, Cockerill No. 2, at Central Gas Blowing Plant of Belval Works of Societé Métallurgique des Terres Rouges (Essais industriels effectués sur le groupe soufflet-moteur à gaz Cockerill No. 2, etc.), Stefffes and A. Graff. Chaleur et Industrie (Paris), vol. 9, no. 99, July 1928, pp. 391-410, 21 figs.

BOILER FEEDWATER

Treatment. A Non-Chemical Method for the Prevention of Scale Accumulation in Boilers, Diesel-Jackets, and Water-Circulating Systems in General, A. T. Ridout. Inst. Mar. Engrs.—Trans. (Lond.). vol. 40, July 1928, pp. 333-340 and (discussion) 340-350.

BOILER FURNACES

Design. Some Fundamental Considerations in the Design of Boiler Furnaces, W. J. Wohlenberg and F. W. Brooks. Fuels and Steam Power (A.S.M.E. Trans.), vol. 50, no. 15, May-Aug. 1928, pp. 141-155 and (discussion) 155-158, 22 figs.

Pulverized Coal. Some Operating Data of Large Steam Generating Units, H. Kreisinger and T. E. Purcell. Fuels and Steam Power (A.S.M.E. Trans.), vol. 50, no. 15, May-Aug. 1928, pp. 83-94 and (discussion) 94-101, 23 figs.

Pulverized Coal and Gas Firing. Combination Firing of Blast-Furnace Gas and Pulverized Coal, F. G. Cutler. Fuels and Steam Power (A.S.M.E. Trans.), vol. 50, no. 15, May-Aug. 1928, pp. 102-105 and (discussion) 105-106, 8 figs. Ensley blast-furnace plant of Tennessee Coal, Iron and Railroad Co., consisting of six blast furnaces, has been operating for about five years; boiler plant using pulverized coal to supplement blast-furnace-gas firing, and some results obtained from this installation are given.

Pulverized Coal. Experiences in Changing to Pulverized Coal, M. J. Gearing. Power Plant Eng., vol. 32, no. 17, Sept. 1, 1928, pp. 914-918, 3 figs. Changing from stokers to pulverized-coal equipment necessitated some experimenting at Diamond Crystal Salt Co. plant.

Regulation. Automatic Regulation of Boiler Furnaces (Selbsttaetige Reglung von Feuerungen fuer Dampfkessel), H. Treitel. Archiv fuer Waermewirtschaft (Berlin), vol. 9, no. 8, Aug. 1928, pp. 249-255, 11 figs.

BOILER SCALE

Formation of. Theoretical and Experimental Study of the Formation of Scale in Boilers (Etudes théoriques et expérimentales sur la formation des incrustations de chaudières), R. Stumper. Chimie et Industrie (Paris), vol. 20, no. 1, July 1928, pp. 10-20, 5 figs.

BOILERS

Corrosion Prevention. Corrosion of Boilers Checked by Electrochemical System, O. W. Garrick. Eng. News-Rec., vol. 101, no. 6, Aug. 9, 1928, p. 209.

High Pressure. High-Pressure Steam Boilers, G. A. Orrok. Fuels and Steam Power (A.S.M.E. Trans.), vol. 50, no. 15, May-Aug. 1928, pp. 47-57 and (discussion) 57-67, 17 figs. Paper previously indexed from Mech. Eng., June 1928.

High-Pressure, Manufacture. Construction of High-Pressure Boiler Drums (La construction des corps de chaudières à haute pression). Génie Civil (Paris), vol. 92, no. 16, Apr. 21, 1928, pp. 392-393, 2 figs. Method employed by firm of Thyssen (Mulheim) is described; rolling mill capable of dealing with 30-ton ingots is used to produce plates of 16 to 18 tons; after trimming plates and beveling two edges in preparation for lap welding, drum about 4 ft. in diameter can be formed with single longitudinal seam; welded drum is heated to 900 deg. cent. in order to remove all internal stresses.

Pulverized-Fuel Firing. Latest Developments in Pulverized Fuel Firing. Iron and Coal Trades Rev. (Lond.), vol. 117, no. 3153, Aug. 3, 1928, p. 157, 2 figs.

Waste-Heat. Steel Plant Waste Heat Boilers, R. H. Stevens. Blast Furnace and Steel Plant, vol. 16, nos. 7 and 8, July and Aug. 1928, pp. 931-935 and 1050-1053, 5 figs. Paper delivered before Am. Iron and Steel Inst.

BRAKES

Internal Expanding. Differential Internal Expanding Band Coupling or Brake with Linked Bands (Differential-Innenband-Kuppling Oder Bremse mit Verketteten Baendern), P. Kaeppler. Werkstattstechnik (Berlin), vol. 22, no. 15, Aug. 1, 1928, pp. 435-436, 5 figs. Details of patented Kaeppler coupling, its application in construction of internal bands expanding by centrifugal force; results of tests.

BRIDGES

Arch, Concrete. Arch Bridge Unusual in Design and Construction, W. L. Scott. Eng. News-Rec., vol. 101, no. 9, Aug. 30, 1928, pp. 325-327, 3 figs. Pont de la Caille on road between Annecy and Geneva in France is 450-ft. single-arch bridge of reinforced concrete spanning gorge 480 ft. deep.

Cantilever, Highway, Carquinez Strait. The Design of the Carquinez Strait Bridge, D. B. Steinman. West. Soc. Engrs.—Jl., vol. 33, no. 8, Aug. 1928, pp. 389-400, 7 figs.

Highway, Approach Slabs. Reinforced Approach Slabs for Highway Bridges, W. H. Rabe. Eng. News-Rec., vol. 101, no. 10, Sept. 6, 1928, pp. 352-354, 2 figs.

Highway, England. The Valley Bridge, Scarborough. Engineer (Lond.), vol. 146, no. 3786, Aug. 3, 1928, p. 109, 2 figs. Notes on reconstruction of bridge originally completed in 1865; new bridge consists of 4 spans of 150 ft. each and provides roadway 40 ft. wide with two footwalks each 12 ft. 3 in. wide; details of construction work.

Highway, Foundations. Investigation of Foundations in Highway Bridge Surveys, C. B. McCullough. Roads and Streets, vol. 68, no. 8, Aug. 1928, pp. 385-391, 4 figs. Extracted from Tech. Bul. by author in coöperation with U. S. Bur. Pub. Roads, issued by U. S. Dept. of Agriculture.

Highway, Surveys. Highway Bridge Surveys, C. B. McCollough. Contract Rec. (Toronto), vol. 42, nos. 34 and 35, Aug. 22 and 29, 1928, pp. 860-865 and 921-926, 8 figs. Value of obtaining comprehensive and accurate preliminary information; method of reporting data; scope of survey; waterway, foundation and traffic factors; maps and profiles; factors that affect run-off; determination of channel movement and of current velocity. (To be continued.)

Masonry, Arch. The English Bridge and Its Predecessors Over the Severn at Shrewsbury, A. W. Ward. Instn. Mun. and County Engrs.—Jl. (Lond.), vol. 55, no. 3, Aug. 7, 1928, pp. 241-246, 2 figs.

Masonry, Widening, Italy. Widening the Railroad Bridge Over Quadronna Creek (L' allargamento del viadotto sul torrente Quadronna), D. L. de Veali. Rivista Tecnica delle Ferrovie Italiane (Rome), vol. 34, no. 1, July 15, 1928, pp. 13-28, 11 figs. and 1 supp. sheet. Design and construction of duplicate masonry bridge adjoining one built in 1893, on Milan-Laveno line between Saronno and Varese, to make room for extra tracks; both bridges are carried on six semi-circular arches, 12 m. span, and are tied together at tops of piers by arch work giving 11.61 m. total width instead of original width of 4.12 m.; details of loading tests of new construction.

Piers, Construction. Piers in Deep Water for Highway Bridges, P. R. Johnson. Constr. Methods, vol. 10, no. 9, Sept. 1928, pp. 6-9, 7 figs.

Selection. What is the Best Kind of Bridge to Build? J. A. L. Waddell. Contract Rec. (Toronto), vol. 42, no. 34, Aug. 22, 1928, pp. 866-869. Author discusses suitability of various types of bridges for different conditions encountered at crossings; enumerates many factors that must be considered in selecting design of bridge; reinforced-concrete versus steel bridges; methods of pier sinking; concrete versus timber piles; plate-girder bridges; cantilever bridges. (To be continued.)

Steel, Construction. Floating a 300-ft. Bridge Span Into Position, J. F. Jackson. Eng. News-Rec., vol. 101, no. 9, Aug. 30, 1928, pp. 310-311, 2 figs. Flood conditions in Atchafalya river in spring of 1928 necessitated special methods in placing last span of combined bridge built for Louisiana Railway and Navigation Co. at Simmesport, La.

Steel, Highway. Rolled Structural Sections Used in Rio Grande Highway Bridge, P. B. Tartt. Eng. News-Rec., vol. 101, no. 8, Aug. 23, 1928, p. 274, 1 fig. New Rio Grande toll bridge to be built between Del Rio, Tex., and Villa Acunya, Coah., Mexico, will consist of four 150-ft. Pratt truss spans; all main members of bridge, with exception of interior verticals, are rolled H-sections with web horizontal in every case; slight excess metal is more than compensated for in saving in inert material of lacing that would have been required in built-up sections; saving in shop work and number of rivets eliminated is enormous.

Suspension, Steubenville, Ohio. Ohio River Suspension Bridge at Steubenville, Ohio, G. F. Wolfe. Eng. News-Rec., vol. 101, no. 9, Aug. 30, 1928, pp. 304-309, 8 figs. Fort Steuben structure with 689-ft. centre span presents new practices in suspension-bridge engineering, namely: in use of rolled steel sections for main towers and web members of stiffening trusses; cable spinning on land; method of strand transfer; use of 150-ft. tower boat for erecting main towers and use of standard derrick boat equipped with special 130-ft. boom for erecting stiffening trusses and floor system of main span and West Virginia side span.

Trestle, Construction. Building a Pile Trestle Bridge Across a Swamp, F. M. Garnett. Contractors and Engrs. Monthly, vol. 17, no. 1, July 1928, pp. 23-25, 5 figs. Millen-Statesboro highway crosses Ogeechee river in Georgia; and swamp over newly constructed causeway and bridge; grading work by dragline; construction of bridge; piling driven from ground by special rig; handling and placing timbers; placing Kyrock bridge mat; force and equipment used.

BRONZE

Hardness Testing. The Hardness Value for Standard Tin Bronzes, Red Brass Alloys, and Lead-Tin Bronzes in Cast State (Zur Kenntnis der Haertwerte der genormten Zinn-Bronzen, Rotguss-Legierungen und Blei-Zinn-Bronzen in gegossenem Zustande), W. Claus, H. Goeke and F. Goederitz. Giesserei (Duesseldorf), vol. 15, no. 31, Aug. 3. 1928, pp. 763-772, 19 figs. Results of Brinell hardness testing; regulations for different alloys.

High-Strength. Notes on High-Strength Bronzes (Notes sur les bronzes à hautes résistances), Duranton. Fonderie Moderne (Paris), vol. 22, Aug. 10, 1928, pp. 301-302. Composition of bronzes used in France; 10 kinds of ordinary and 4 kinds of high-strength bronzes; aluminum bronzes of high strength.

BUILDINGS

CONCRETE CONSTRUCTION. Concrete Building Construction, T. Crane and T. Nolan. Engineering (Lond.), vol. 126, no. 3265, Aug. 10, 1928, pp. 155-156.

SPHERICAL, GERMANY. World's First Spherical Building. Eng. News-Rec., vol. 101, no. 9, Aug. 30, 1928, p. 331, 1 fig. Building erected for Dresden Exposition "Die Technische Stadt," diameter 82 ft., five storeys (98½ ft.) high, contains about 268,000 cu. ft. and is completely equipped as office building with cafe on top floor.

C

CABLEWAYS

LUMBER TRANSPORTER. Mammoth Tramway to Span Western Canyon. Gen. Elec. Rev., vol. 31, no. 9, Sept. 1928, p. 475. Recently erected by Michigan-California Lumber Co. at Camino, Calif.; single tram carrier carries rail car loaded with maximum of 24,000 lb. of sawed lumber; distance between terminals is approximately 2,700 ft.; maximum speed of operation will be 1,800 ft. per min.; four steel cables, each 2 in. in diam., support tram carrier which runs on 32 wheels; traction rope endless and one inch in diameter.

CANALS

HEAD WORKS. The Head-Works of the Imperial Canal, C. E. Grunsky. Am. Soc. Civil Engrs.—Proc., vol. 54, no. 7, Sept. 1928, pp. 2102-2105. Discussion by E. S. Lindley of paper published in Nov. 1927, issue of Proceedings indexed in Eng. Index 1927, p. 139.

CARS

STREET RAILROAD, BEARINGS. Use of Ball and Roller Bearings on Street Cars (Kugle og rullelejers anvendclighed i sporvogne), J. V. Balslev. Teknisk Tidskrift (Stockholm), vol. 58, no. 33, Aug. 18, 1928 (Mekanik), pp. 106-112, 5 figs.

CAR RETARDERS

RECENT DEVELOPMENT. Car Retarders, a Recent Development in Railway-Yard Operation, L. Richardson. Am. Soc. Mech. Engrs.—Advance Paper for mtg. Oct. 1 to 3, 1928, 8 pp., 11 figs.

CASE HARDENING

CARBURIZING COMPOUNDS. Carburizing and Case Hardening. Heat Treating and Forging, vol. 14, no. 7, July 1928, pp. 757-761, 1 fig. Carburizing compounds used and containers employed with proper directions given for packing parts; cyanide and gas carburizing; lead and furnace treatments. From Driver-Harris Co. booklet on Nichrome Castings.

CAST IRON

"GUNITE." "Gunite"—Its Properties and Applications. Machy. (N.Y.), vol. 35, no. 1, Sept. 1928, pp. 61-62, 3 figs. New metal known as Gunite recently announced by Gunite Corp. of Rockford, Ill., is discussed.

PEARLITIC. High-Grade Cast Iron (Hochwertiges Gusseisen), H. Jungbluth. Maschinenbau (Berlin), vol. 7, no. 16, Aug. 16, 1928, pp. 766-770, 3 figs. Compilation based on recent papers in German and in English, by Piwowarsky, Kerpely, Young, and others; improvement of cast iron by addition of other metals, production of pearlitic mass, reduction in graphite content, etc.

CEMENT

ALUMINA. High-Alumina Slags for Alumina Cement. Iron and Steel of Can. (Gardenvale, Que.), vol. 11, no. 8, Aug. 1928, pp. 251-252. Production in blast furnace of high alumina slags for manufacture of alumina cement, investigated by U. S. Bureau of Mines, at North Central Experimental Station, Minneapolis, Minn.

DISINTEGRATION IN SALT WATER. Sea Water-Resistant Cements, G. J. Fertig. Concrete, vol. 33, no. 3, Sept. 1928 (Mill Sec.), pp. 105-110, 6 figs.

CEMENT KILNS, ROTARY

HEAT BALANCE. Heat Balance in Rotary Cement Kilns, H. Pooley. Engineering (Lond.), vol. 126, no. 3267, Aug. 24, 1928, pp. 219-220. Table is presented which serves as example of type of heat balance wheel which might be expected in connection with average wet-process, uninsulated cement kiln; author indicates methods which can be used to obtain better fuel consumption and stresses importance of accurate and continuous records, which items are frequently neglected.

CEMENT MORTAR

STEAM TREATMENT. Effect of Steam Treatment of Portland Cement Mortars on Their Resistance to Sulphate Action, T. Thorvaldson and V. A. Vigfusson. Eng. Jl. (Montreal), vol. 11, no. 9, Sept. 1928, pp. 493-499, 2 figs. Discussion of paper previously indexed from Mar. 1928 issue of same journal.

CHROMIUM-NICKEL ALLOYS

HIGH TEMPERATURE. Laboratory Experiments on High-Temperature Resistance Alloys, C. J. Smithells, S. V. Williams and J. W. Avery. Inst. of Metals—Advance Paper (Lond.), no. 466, for mtg. Sept. 4-7, 1928, 22 pp., 17 figs.

CITIES AND TOWNS

PLANNING. Imagination in City Planning, S. Child. Am. Soc. Civil Engrs.—Proc., vol. 54, no. 7, Sept. 1928, pp. 2147-2149. Discussion by W. W. Crosby and A. A. Shurtleff of paper published in Apr. 1928 issue of Proceedings.

PLANNING, BUILDING DESIGN. Development of City Property for Industrial Purposes, W. W. Hay. Contract Rec. (Toronto), vol. 42, nos. 35 and 36, Aug. 29 and Sept. 5, 1928, pp. 928-929 and 946-948, 5 figs.

COAL

CARBONIZATION, LOW-TEMPERATURE. The "Plassmann" Process of Low Temperature Carbonization, D. Brownlie. Gas Age-Rec., vol. 62, no. 7, Aug. 18, 1928, pp. 196-198, 3 figs.

The K.S.G. Process of Low-Temperature Carbonization, W. Runge. Fuels and Steam Power (A.S.M.E. Trans.), vol. 50, no. 15, May-Aug. 1928, pp. 17-23 and (discussion) 24-27, 2 figs. Paper deals with development of Kohlenscheidungs Gesellschaft process; principle of operation and field of application; constructional details of retorts are described, as are also method of heating, fuel handling, gas and tar recovery, and types of coals suitable for process; yields of products per ton of coal of given analysis are tabulated; by-products; economic phases of process.

COMBUSTION PROPERTIES. Burning Characteristics of Different Coals, H. Kreisinger and B. J. Cross. Am. Soc. Mech. Engrs.—Advance Paper for mtg. Sept. 17-20, 1928, 10 pp., 10 figs.

SPONTANEOUS COMBUSTION, TESTING. Spontaneous Heating of Coal in Storage. Iron and Steel of Can. (Gardenvale, Que.), vol. 11, no. 8, Aug. 1928, pp. 254-255. General review of results of chemical and physical research relative to causes and prevention of spontaneous heating of coal in storage, published by U.S. Bur. of Mines, as Tech. Paper no. 409. See also Power Plant Eng., vol. 32, no. 17, Sept. 1, 1928, p. 946.

COAL HANDLING

BELT CONVEYORS. Caterpillar Coal Face Conveyor, G. F. Zimmer. Indus. Mgmt. (Lond.), vol. 15, no. 8, Aug. 1928, pp. 264-265, 4 figs.

GRAB BUCKETS. New Type of Segmental Grabs (Ein neuer Segmentgreifer), C. Huetter. Gas und Wasserfach (Munich), vol. 71, no. 30, July 28, 1928, pp. 734-735, 2 figs.

EQUIPMENT. Modern Mechanical Coal Handling Plant. Colliery Guardian (Lond.), vol. 137, no. 3530, Aug. 24, 1928, pp. 729-731, 5 figs. Describes items of coal-handling equipment manufactured and sold by Underfeed Stoker Co.; known as Beaumont specialties and include automatic skip hoist, cable drag scraper conveyors, bucket elevators and conveyors, steel bunkers, and rubber belt conveyors; applicable also to handling of coke, ash, sand, cement, limestone, ores, etc.

COAL MINES AND MINING

BLASTING. Increasing Lump Coal by Shooting Explosives in Self-Tamping Recoverable Steel Barrels, S. S. Lanier Jr. Explosives Engr., vol. 6, no. 8, Aug. 1928, pp. 294-295, 2 figs.

CONVEYOR. Standard Equipment Slightly Modified Interlocks 4½ Mile Conveyor, F. R. Grant. Coal Age, vol. 33, no. 8, Aug. 1928, pp. 477-478 and 481, 4 figs.

EXPLOSIVES. Approved List of Permissible Explosives. Coal Age, vol. 33, no. 8, Aug. 1928, pp. 490-491. Abstract of U.S. Bur. of Mines—Reports of Investigations, serial no. 2879, 1928, previously indexed.

Necessity for the Use of Short-Flame Explosives, T. E. Jenkins. Min. Congress Jl., vol. 14, no. 8, Aug. 1928, p. 611, 1 fig.

LOADERS. Rock Work With Mechanical Loaders, T. F. McCarthy. Coal Mine Mgmt., vol. 7, no. 7, Aug. 1928, pp. 28-31 and 40. Paper previously indexed from Min. Congress Jl., June 1928.

Mechanical Loading with A.C. Power Meets Test at Francisco, J. Mosbey. Coal Age, vol. 33, no. 8, Aug. 1928, pp. 470-472, 6 figs. Describes tests with a.c. power at Francisco Mining Co.'s No. 2 mine, 7 mi. east of Princeton, Ind.; time studies; cost of coal delivered to parting is 25 per cent less than with hand loading.

OPEN PIT, INDIANA. All Equipment New and Completely Standardized at Indiana Strip Mine, C. C. Balzer. Coal Age, vol. 33, no. 8, Aug. 1928, pp. 482-484, 7 figs. Describes equipment and operations at strip mine of Electric Shovel Coal Corp. near Clinton, Ind.; about 1,200 acres with maximum cover 52 ft., average 40 ft.; seam is 52 in. of low-ash coal and 20 in. top coal with 20 per cent ash; average production 40,000 tons per month with 102 men; total electric power cost is 13 to 15 cents per ton of coal.

SCRAPERS. Scrapers in Entries and Long Faces, W. H. Smitherman. Coal Mine Mgmt., vol. 7, no. 7, Aug. 1928, pp. 32-35, 4 figs. Paper previously indexed from Min. Congress Jl., June 1928.

SIGNAL SYSTEMS. Automatic Block Signals for Mine Haulage Systems, C. E. Watts. Min. Congress Jl., vol. 14, no. 8, Aug. 1928, pp. 608-610, 5 figs.

SIGNAL SYSTEMS, GREAT BRITAIN. Signaling in British Coal Mines, L. Fokes. Coal Age, vol. 33, no. 8, Aug. 1928, pp. 485-486 and 488, 4 figs. Coal Mines Act of 1911 specified maximum of 25 volts for signaling; later order required bells modified to render them incapable of igniting gaseous mixture; practice of designing underground signaling gear in flameproof enclosures; describes types of signaling equipment, with particular reference to lowering and hoisting of men in coal-mine shafts.

STEEL SUPPORTS. The Use of Steel in Coal Mining, L. Frost. Iron and Steel of Can. (Gardenvale, Que.), vol. 11, no. 8, Aug. 1928, pp. 238-239. Use of steel arches in supporting underground roadways on coal mines.

STEEP SEAMS. An Experience of Machine-Mining in a Highly-Inclined Seam, J. M. Williamson and J. Bilsland. Instn. Min. Engrs.—Trans. (Lond.), vol. 75, part 4, July 1928, pp. 327-334, 5 figs. Paper previously read before Min. Inst. of Scotland, Dunfermline, and indexed from Colliery Guardian, June 29, 1928.

COAL WASHING PLANTS

WEST VIRGINIA. Ashland Coal and Coke Company Tipple and Washer, H. D. Smith. Min. Congress Jl., vol. 14, no. 8, Aug. 1928, pp. 602-607, 15 figs. Ashland plant in Pocahontas coal field, about 20 mi. from Bluefield, W. Va.; five sizes of coal made and cleaned at this plant; complete description of plant and equipment; results entirely satisfactory and product meets exacting demands of present market.

COKE PLANTS

CANADA. The Plant of the Montreal Coke and Manufacturing Company, D. G. Munroe. Gas Age-Rec., vol. 62, no. 8, Aug. 25, 1928, pp. 225-226, 233-234, 5 figs.

ENGLAND. A Modern Coke Oven Plant. Engineer (Lond.), vol. 146, nos. 3788 and 3789, Aug. 17 and 24, 1928, pp. 168-172 and 190-195, 22 figs. Details of plant of South Yorkshire Chemical Works of Parkgate; comprises battery of 60 Semet Solvay ovens, capable of carbonizing 6,000 tons of coal a week, with elaborate coal and coke-handling machinery, complete by-products recovery plant and power house.

MONTREAL. New Plant of Montreal Coke and Manufacturing Company, D. G. Munroe. Iron and Steel of Can. (Gardenvale, Que.), vol. 11, no. 8, Aug. 1928, pp. 228-230.

COLUMNS

DESIGN. Moments of Inertia of Uniform Octagonal Cross-Sections (Traegheitsmomente von bewehrten, regelmaessigen Achteckquerschnitten), W. Fiedler. Beton u. Eisen (Berlin), vol. 27, no. 15, Aug. 5, 1928, p. 291, 1 fig. Fundamental formulas and table of values of moments of inertia, for use in design of columns in mushroom systems of roof construction.

CONCRETE

ELASTICITY. Extensibility of High Quality Concrete. Pit and Quarry, vol. 16, no. 11, Aug. 29, 1928, pp. 85-86, 3 figs. Experiments were made with standard test pieces of concrete such as are usually made in testing tensile and compressive strengths; extensibility was determined, or really elasticity. Brief abstract translated from Zement, July 26, 1928.

PERMEABILITY. The Permeability of Concrete, I. L. Collier. Contract Rec. (Toronto), vol. 42, no. 34, Aug. 22, 1928, pp. 870 and 911-912, 4 figs. Paper presented before Am. Soc. for Testing Matls., previously indexed from Concrete, Aug. 1928.

PROPORTIONING. An Exact Basis of Proportioning, J. A. Kitts. Concrete, vol. 33, no. 3, Sept. 1928, pp. 13-14.

PROPORTIONING PLANTS. Proportioning Plant and Transit Mixers, W. A. Scott. Eng. World, vol. 33, no. 2, Aug. 1928, pp. 65-67, 2 figs. Central proportioning plant and transit mixing units recently put in operation at Portland, Ore., for concrete paving and other forms of concrete work; results in undeviating uniformity of mixture for all batches of concrete delivered at same job.

STRENGTH. Equation for Predicting Strength of Concrete, F. N. Wray. Eng. News-Rec., vol. 101, no. 8, Aug. 23, 1928, pp. 291-292. Equation developed from data published by Portland Cement Assn. and based on compression tests of 6 by 12-in. cylinders, makes it possible to predict strength of concrete at any age between seven days and five years, when strength at any other age between those same limits is given.

CONCRETE AGGREGATES

SAWDUST. Sawdust as a Concrete Aggregate. Contract Rec. (Toronto), vol. 42, no. 33, Aug. 15, 1928, pp. 850-851 and 855. It is possible to make light-weight partition or backing-up block with sawdust, sand and portland cement; mineralized sawdust is used to counteract shrinkage and render material incombustible; Columbia University tests.

CONCRETE CONSTRUCTION

DEVELOPMENTS. Development in Use of Concrete, F. E. Wentworth-Sheilds. Can. Engr. (Toronto), vol. 55, no. 7, Aug. 14, 1928, pp. 230-231. Paper presented before Instn. of Civil Engrs.

WINTER. Unusual Inclosure for Winter Building Construction. Eng. News-Rec., vol. 101, no. 8, Aug. 23, 1928, p. 292, 1 fig. In constructing Belmont Hotel at Madison, Wis., in winter of 1927-28, all floors were concreted in canvas inclosures moved up as work progressed; canvas inclosure was heated by coke salamanders; after lower stories were concreted wooden housing was constructed to protect stone cutting and interior finishing operations.

WINTER, COST. Unit Costs of Winter Concreting on Two St. Louis Buildings. Eng. News-Rec., vol. 101, no. 8, Aug. 23, 1928, p. 290, 1 fig.

CONCRETE

REINFORCED, CALCULATION CHARTS. Calculation of the Bending and Compression Parts of Reinforced Concrete (Le Calcul des pieces flechies et comprimées en beton arme), H. Ravize. Génie Civil (Paris), vol. 93, no. 6, Aug. 11, 1928, pp. 135-138, 3 figs.

RETEMPERING. Retempering Concrete. Good Roads, vol. 71, no. 8, Aug. 1928, p. 452, 1 fig. Results of recent group of tests made in Research Laboratory of Portland Cement Association to determine effect of retempering and delayed placing on strength and workability of concrete.

CONCRETE STONE

SPECIFICATIONS. Specifications for Concrete Stone, C. Van de Bogart. Can. Engr. (Toronto), vol. 55, no. 8, Aug. 21, 1928, pp. 249-250. Paper presented before Am. Concrete Inst., previously indexed from advance paper for mtg. Feb. 28, 1928.

COOLING TOWERS

CONCRETE, HYPERBOLIC. The Hyperbolic Reinforced-Concrete Cooling Tower, J. H. D. Blanke. Nat. Engr., vol. 32, no. 5, May 1928, pp. 209-213, 5 figs.

COPPER EXTRACTION

IODINE PROCESS. Amenabar's Wet, Iodine Process of Copper Extraction (Die Aussichten des Amenabar-Verfahrens zur Gewinnung von Kupfer mittels Jod auf nassem Wege), E. Hentze. Metall und Erz (Halle, Germany), vol. 25, no. 15, Aug. 1, 1928, pp. 370-372. Critical review and appraisal of commercial future of iodine method of copper extraction patented by A. Amenabar Ossa, of Chile; comparison with Claudet's iodine process of extracting gold and silver from Henderson lyes.

COPPER-MAGNESIUM ALLOYS

TESTS. The Copper-Magnesium Alloys, W. R. D. Jones. Inst. of Metals—Advance Paper (Lond.), no. 469, for mtg. Sept. 4-7, 1928, 11 pp., 5 figs.

COPPER MINES AND MINING

AFRICAN COPPER DEPOSITS. C. B. Lakenan Favorably Impressed With African Copper Deposits, A. B. Parsons. Eng. and Min. Jl., vol. 126, no. 7, Aug. 18, 1928, pp. 244-245 and 260. Interview with engineer; world demand for copper will bring price near 20 cents; copper-mining regions of Chile, Belgian Congo, and Rhodesia; present problem in Congo is lack of sulphide ore to facilitate leaching and smelting; in Rhodesia, first producer will be Roan Antelope, then N'Kana and N'Changa; immense tonnages of 3 per cent ores; Africa should be investigated by American copper interests.

ACCIDENT PREVENTION. Promotion of Safety at the Ray Plant Nevada Consolidated Copper Co., M. Brown. Min. Congress Jl., vol. 14, no. 9, Sept. 1928, pp. 659-660, 1 fig.

ARIZONA. The Mining Operations of the Cornelia Copper Company, G. R. Ingham. Min. Congress Jl., vol. 14, no. 8, Aug. 1928, pp. 623-627, 10 figs.

QUEBEC. The Noranda Enterprise, A. H. Hubbell. Eng. and Min. Jl., vol. 126, no. 9, Sept. 1, 1928, pp. 330-334, 8 figs. Mine and smelter of Horne Copper Corp. near Rouyn, Quebec; 1,198,375 tons above 300 level, average 6.73 per cent copper and $5.44 gold per ton; irregular lenses of pyrrhotite, chalcopyrite, and pyrite among rhyolite lavas, agglomerates and andesites; geology and development; lenses mined by inclined branch raises, slashed to full width after reaching level above; intervening benches removed by combined underhand and overhand stoping. (To be continued.)

COPPER-NICKEL CASTINGS

SPECIFICATIONS. Proposed Master Specifications for Copper-Nickel Alloy Castings. Foundry, vol. 56, nos. 15 and 16, Aug. 1 and 15, 1928, supp. sheets nos. 727, 728, and 729, 1 fig. Aug.: United States Government general specification for metals, Federal Specifications Board Specification No. 339, in effect on date of invitation for bids, forms part of this specification; general and detail requirements of material and method of inspection and tests given. Aug. 15: Inspection; packing and marking of shipment.

COPPER ORE TREATMENT

ARIZONA. The Old Dominion Company, E. H. Robie. Eng. and Min. Jl., vol. 126, no. 7, Aug. 18, 1928, p. 259. Brief account of visit to plant at Globe that treats ore from Old Dominion and Arizona Commercial mines.

FLOTATION, ARIZONA. The Morenci Concentrator of the Phelps Dodge Corporation, E. H. Robie. Eng. and Min. Jl., vol. 126, no. 8, Aug. 25, 1928, pp. 290-294, 3 figs.

CRANES

RUNWAYS. Reinforcing Craneways in a Big Shop. Am. Mach., vol. 69, no. 10, Sept. 6, 1928, pp. 398-400, 6 figs. Describes work in Schenectady plant of General Electric Co.

CULVERTS

DESIGN. The Design of Box Culverts, A. C. Hughes and C. S. Gray. Surveyor (Lond.), vol. 74, no. 1909, Aug. 24, 1928, pp. 165-167, 4 figs.

CYLINDERS

METAL, STRESSES IN. Internal Stresses in Metallic Cylinders (Sur la détermination des efforts internes dans les cylindres métalliques), Portevin. Académie des Sciences—Comptes Rendus (Paris), vol. 186, no. 14, Apr. 2, 1928, pp. 939-941, 1 fig.

D

DAMS

UNUSUAL DESIGN. Arch Dam of Unusual Design. Eng. News-Rec., vol. 101, no. 9, Aug. 30, 1928, p. 311, 1 fig. Novel types of dam consisting of series of light arch walls decreasing in height, in downstream order; light construction made possible by intermediate pools, which provide balanced load on lower downstream section of each wall and lower effective water pressure; this reduces amount of material in structure and prevents scour below dam at times of overflow; tests were made on plaster models of contemplated dam on Upper Dordogne using mercury in place of water, showed factor of safety between four and five.

DESIGN. Recent Progress in Construction of Dams (Les derniers progrès dans la construction des digues et barrages). Revue Générale de l'Electricité (Paris), vol. 24, no. 6, Aug. 11, 1928, pp. 204-210. Report by A. Forti on dams of masonry, gravity and arch types, and construction methods for masonry dams; other types of dams; reservoir-dam studies in France; calculation and construction of large dams; state of dam construction in Italy. Paper presented before Congrès le Paris de l'Union Internationale des Producteurs et Distributeurs d'Energie Electrique.

ARCH, CANEADEA, N.Y. Caneadea Dam One of Uncommon Form, A. S. Taylor. Compressed Air Mag., vol. 33, no. 9, Sept. 1928, pp. 2513-2516, 12 figs. Structure in Northwestern New York is first constant-angle arch type of dam to be built in eastern part of United States; crest of dam has total length of 600 ft.; 45 ft. through at base; arch section is made up of eleven 40-ft. segments.

ARCH, DESIGN. Local Distribution in High Arch Dams, R. A. Sutherland. Am. Soc. Civil Engrs.—Proc., vol. 54, no. 7, Sept. 1928, pp. 2151-2156. Discussion by W. Cain and B. F. Jakobsen of paper published in Apr. 1928 issue of Proceedings.

EARTH. Lafayette Rolled Earth-Fill Dam, P. Schuyler. West. Constr. News, vol. 3, no. 16, Aug. 25, 1928, pp. 529-531, 7 figs. Earth-fill dam for Mokelumne water-supply project of East Bay municipal utility district, will be 160 ft. high (maximum centre height), 1,850 ft. long on crest, and will contain 1,800,000 cu. yd. of earth; construction progress; centre portion varies in clay content from 60 to 90 per cent; upstream facing consists of 6-in. reinforced-concrete pavement laid on 9 in. of gravel.

EARTH, CONSTRUCTION. South Carolina's Big Dam, F. J. Messick. Du Pont Mag., vol. 22, no. 8, Aug. 1928, pp. 11-14, 7 figs. Brief description of construction work on largest earth dam in world on Saluda river, S.C., to back up 750 billion gallons of water for hydro-electric power development.

FAILURES. Extremely Thin Dam Fails. Eng. News-Rec., vol. 101, no. 9, Aug. 30, 1928, p. 318, 3 figs. Unreported failure of dam on Prosser Creek about 5 mi. below Truckee, Nevada; built of unreinforced concrete, thickness at top only 18 in. and at bottom not more than 36 in.; height 35 ft. and top length 100 ft.; portion 60 ft. long at top, 30 ft. long at bottom and 20 ft. high was carried away, bottom of break being at construction joint at which apparently no attempt had been made to bond concrete.

GRAVITY, CONCRETE, IDAHO. The Black Canyon Diversion Dam, Boise Project, Idaho, I. E. Houk. New Reclamation Era, vol. 19, no. 8, Aug. 1928, pp. 125-127, 1 fig.

MULTIPLE DOME, COOLIDGE, ARIZ. Coolidge Dam—A New Type of Construction, E. Sickler. Excavating Engr., vol. 22, no. 8, Aug. 1928, pp. 291-293 and 307, 8 figs. Multiple-dome dam being built by U.S. Indian Irrigation Service on Gila river at San Carlos, Ariz.; consists of three egg-shaped domes supported by canyon walls, and by intermediate buttresses, with smaller end of dome resting on foundation and larger end forming part of crest and serving as support for bridge for trans-continental highway.

SLAB (AMBURSEN). Stony Gorge Dam, J. L. Savage and H. J. Gault. West. Constr. News, vol. 3, no. 15, Aug. 10, 1928, pp. 490-501, 11 figs. For supplemental storage, Orland project, California, U.S. Bureau of Reclamation; details of design and construction; fault line is determining factor in selection of Ambursen type of dam; selection, location and dimensions of Ambursen type; design data and details; special features; foundations; concrete aggregates; detail cost analysis.

DESUPERHEATERS

SATURATORS AND. Desuperheaters and Steam Saturators (Desurchauffeurs et saturateurs de vapeur), P. Coulon. Société Alsacienne de Constructions Mécaniques—Bul. (Belfort, France), vol. 6, no. 23, July 1928, pp. 80-84, 4 figs.

DIE CASTING

ALUMINUM ALLOYS. Properties and Production of Aluminum Alloy Die-Castings, S. L. Archblutt, J. D. Grogan and J. W. Jenkin. Inst. of Metals—Advance Paper (Lond.), no. 477, for mtg. Sept. 4-7, 1928, 19 pp., 19 figs.

COPPER ALLOYS. Die-Casting of Copper-Rich Alloys, R. Genders, R. C. Reader and V. T. S. Foster. Inst. of Metals—Advance Paper (Lond.), no. 475, for mtg. Sept. 4-7, 1928, 32 pp.

ZINC ALLOYS FOR. Die-Casting Alloys of Low Melting Point, T. F. Russell, W. E. Goodrich, W. Cross, and N. P. Allen. Inst. of Metals—Advance Paper (Lond.), no. 473, for mtg. Sept. 4-7, 1928, 15 pp., 4 figs.

DIESEL ENGINES

COMPRESSORLESS, FUEL PUMPS FOR. Fuel Pumps of Compressorless Diesel Engine (Brennstoffpumpen kompressorloser Dieselmotoren), O. Holm. Archiv fuer Waermewirtschaft (Berlin), vol. 9, no. 8, Aug. 1928, pp. 258-261, 24 figs. Author points out difficulties which have existed so far in production of efficient fuel pumps for compressorless engines; discusses causes of trouble and means for their elimination; advantages and disadvantages of usual types and arrangement of valves, pump chambers, and packing.

MARINE (SULZER-SCHELDE). The Sulzer-Schelde Marine Engines (Sulzer-Schelde Scheepsdieselmotoren), F. C. Martzinger. Schip (Hague), vol. 10, no. 15, July 20, 1928, pp. 195-204, 22 figs. Characteristics and special merits of Dutch adaptation of Sulzer two-cycle and four-cycle marine Diesel engines, for use on Dutch four-screw motor liners.

DIESEL LOCOMOTIVES

SPEED CHANGERS FOR. Universal Transmission for Electric Locomotives, and Speed Changer Operated by Oil Under Pressure for Diesel Locomotives Constructed by the Société de Locomotives de Winterthur (Transmission universelle pour locomotives électriques et changement de vitesse actionné par huile sous pression pour locomotives Diesel, construits par la Société de Locomotives de Winterthur). Revue Générale des Chemins de Fer (Paris), vol. 47, no. 2, Aug. 1928, pp. 258-262, 6 figs. Description of transmission used on electric locomotive and geared speed reducer used on Diesel locomotives.

DRILLS, TWIST

STANDARDIZATION OF. Twist Drills. Automobile Engr. (Lond.), vol. 18, no. 244, Aug. 1928, p. 286, 1 fig. Discussion of new British Engineering Standards Association report dealing with penetration of twist drills; graph shows performance test for twist drills.

E

ECONOMIZERS

DESIGN AND OPERATION. What the Boiler Plant Engineer Should Know of Material, Design and Operation of Exhaust-Gas Feedwater Preheaters (Was der Dampfkessel-Ingenieur von dem Material, dem Bau und dem Betrebe der Abgas-Speisewasser-Verwaermer wissen muss). G. Frantz. Waerme (Berlin), vol. 51, no. 30, July 28, 1928, pp. 527-545, 18 figs.

ELECTRIC CIRCUIT BREAKERS

HIGH-SPEED. High-Speed Circuit Breakers, with Special Reference to A-C Type, J. W. McNairy. Gen. Elec. Rev., vol. 31, no. 9, Sept. 1928, pp. 468-475, 14 figs.

ELECTRIC CONVERTERS

Rotary. The Care of Manually Controlled Rotaries and Auxiliary Equipment, II. W. Smith. Elec. News (Toronto), vol. 37, no. 16, Aug. 15, 1928, pp. 37-38 and 46, 3 figs.

ELECTRIC EQUIPMENT

Grounding. The Earthing of Electrical Equipment. Engineering (Lond.), vol. 126, no. 3267, Aug. 24, 1928, pp. 235-236. Editorial comments in which it is claimed that if plebiscite of electrical industry were taken on this subject, majority in favor of earthing would result; earth wire must be sufficiently large to carry any fault current that may be produced, and care must be taken to protect it against mechanical damage and corrosion.

ELECTRIC FURNACES

Hydrogen-Nitrogen Mixtures. The Application of Oxygen and Hydrogen to Industrial Operation, F. P. Wilson. Gen. Elec. Rev., vol. 31, no. 9, Sept. 1928, pp. 493-495, 1 fig.

Steel-Making. Electric Furnaces, Brown-Boveri System with Hydraulic Regulation of Electrodes (Fours électriques système Brown-Boveri à réglage électro-hydraulique des électrodes), E. de Mulinen. Génie Civil (Paris), vol. 93, no. 6, Aug. 11, 1928, pp. 143-145, 5 figs. Describes electric furnace of 20 tons capacity installed at Aosta; has 3 electrodes of 600 mm. diam. for 15,000-amp. current; how electrodes are regulated.

ELECTRIC LAMPS

Mercury Quartz. New Type of Mercury Quartz Lamp, A. I. Tkhorzhevsky. Electritchestvo (Leningrad), no. 13-14, July 1928, pp. 286-289. 8 figs.

Neon. High-Speed Vision. Power, vol. 68, no. 7, Aug. 14, 1928, p. 290. Neon lamp is capable of being illuminated to its full brilliancy and extinguished almost completely in time interval that is measured in millionths of a second; machines, including Stroborama and other types, are successfully used in mechanical industries, hydraulics, aerodynamics, etc., wherever fast periodic method occurs.

ELECTRIC LINES

Grounding. Protective Grounds, V. E. Johnson. Elec. Jl., vol. 25, no. 9, Sept. 1928, pp. 447-450, 6 figs.

High Tension, Colorado. Transmission Experience of the Public Service Company of Colorado, M. S. Coover and W. D. Hardaway. Am. Inst. of Elec. Engrs.—Jl., vol. 47, no. 9, Sept. 1928, pp. 633-636, 6 figs. 100,000-volt transmission lines completed in 1909 extended from Shoshone hydro plant on Colorado river across Continental Divide to Denver and represented pioneering in high-voltage transmission at high altitudes; paper describes system in general way and outlines some of more salient operating difficulties that have arisen from time to time as well as their remedies; method of load dispatching.

Insulation. Rationalization of Transmission System Insulation Strength, P. Sporm. Am. Inst. of Elec. Engrs.—Jl., vol. 47, no. 9, Sept. 1928, pp. 641-644, 5 figs. It is shown that at present time transmission systems in general are designed without proper consideration of surge voltages which may be imposed upon them; grading scheme proposed is possible although requiring additional operating data; grading should result in less costly designs and installations; net effect will be better performance of transmission system in service.

Relation Between Transmission Line Insulation and Transformer Insulation, W. W. Lewis. Am. Inst. of Elec. Engrs.—Jl., vol. 47, no. 9, Sept. 1928, pp. 637-640, 3 figs. Principles to be followed in transmission-line construction to reduce damage from lightning are recommended; recommendations are as follows: keep transmission conductors low and arrange horizontally; use ground wires; use sufficient insulation but of sufficiently low value near stations to protect apparatus; install lightning arresters at transformers; arguments leading to these recommendations are outlined.

Transmission Line Insulation and Overhead Ground Wires, S. W. Lewis. Iron and Steel Engr., vol. 5, no. 8, Aug. 1928, pp. 354-358, 2 figs.

Loss Calculation. Load Factor-Equivalent Hour Values Compared. H. M. Sayers. Elec. World, vol. 92, no. 8, Aug. 25, 1928, p. 369. Writer refers to article of F. H. Buller and C. A. Woodrow published in July 14th issue of this journal, and presents table of load characteristics for different load diagrams, all giving 25 per cent load factor.

Overhead, Design. Design of Overhead Power-Transmission Lines (Beitrag zur Berechnung von Freileitungen), K. Langhard. Elektrotechnische Zeit. (Berlin), vol. 49, no. 32, Aug. 9, 1928, pp. 1181-1183, 2 figs.

Power Arcs. Study of Transmission Line Power-Arcs, P. Ackerman. Eng. Jl. (Montreal), vol. 11, no. 9, Sept. 1928, p. 504. Discussion of paper previously indexed from May 1928 issue of same journal.

ELECTRIC LOCOMOTIVES

Germany. The Bergmann 2-C-2 Locomotive With a Single Motor (La locomotora Bergmann 2-C-2 de un solo motor). Ingenieria y Construction (Madrid), vol. 6, no. 67, July 1928, pp. 369-370, 3 figs. Brief description and principal specification data on electric locomotive with one 3,200-h.p. motor using alternating current at 15,000 volts.

ELECTRIC MACHINERY

Vibration. Vibration of Frames of Electrical Machines, J. P. Den Hartog. Applied Mechanics (A.S.M.E. Trans.), vol. 50, no. 17, May-Aug. 1928, pp. 1-5 and (discussion) 5-6, 9 figs.

Windings. Induced Voltages in Field Windings, W. F. Sutherland. Power Plant Eng., vol. 32, no. 16, Aug. 15, 1928, pp. 878-879, 2 figs.

ELECTRIC METERS

High Tension. Inexpensive Approximate Metering of a 66-Kv. Line, R. S. Daniels. Elec. World, vol. 92, no. 8, Aug. 25, 1928, pp. 357-358, 1 fig. Account of scheme which has worked successfully during past year for several installations on system of California-Oregon Power Co. at locations where high-tension was required for load-dispatching purposes only.

ELECTRIC MOTOR-GENERATORS

High Frequency. High-Frequency Alternators for Induction Furnaces. English Elec. Jl. (Lond.), vol. 4, no. 4, July 1928, pp. 111-113, 5 figs. Special motor-generator sets have been made in sizes from 150 to 650 kw., operating at frequencies from 500 up to several thousands of cycles per sec.; attention drawn to construction of stator frames of alternator and induction motor of set, which is of welded-steel plate type.

ELECTRIC MOTORS

Starters. Fundamental Principles and Operation of Direct-Current Motor Starters, C. G. Green. Nat. Engr., vol. 32, no. 6, June 1928, pp. 255-259, 12 figs. Effect of resistance in motor field; acceleration period; hand-operated starters; description of manual starter; principal of operation of automatic starter; protection against overload.

Supersynchronous, Brakes. Automatic Brake for Supersynchronous Motors, M. P. Bailey. Elec. World, vol. 92, no. 10, Sept. 8, 1928, p. 455, 2 figs. One of first installations of supersynchronous motors fitted with automatic motor-operated brakes has been put in service at Volunteer Portland Cement Co.'s plant at Knoxville, Tenn.; supersynchronous motor is built in such way that stator frame can revolve; brake is put into operation by push button.

Synchronous. Where Synchronous Motors Are Applied, F. W. Hotchkiss. Power, vol. 68, no. 10, Sept. 4, 1928, pp. 406-409, 4 figs. Author reviews recent improvements made in synchronous motors and their controllers that have made them applicable to practically every constant-speed drive; typical examples of difficult drives are cited and chart given that shows 32 different applications in 50 different industries.

Three-Phase Standards, Germany. Standard Types of Three-Phase Motors (Die Entwicklung der neuen Drehstrommotoren von 5,5 kW bis 100 kW, etc.), O. Zaehringer. Siemens—Zeit. (Berlin), vol. 8, no. 7, July 1928, pp. 367-375 and supp. plate, 31 figs. Recently established German motor standards made it desirable to abandon old designs and develop modern line covering range up to 100 kw.; designers found it possible to reduce frames and bearings to ten sizes; large variety of motors can be assembled from relatively few stock parts to answer practically all demands within this range; chart is included showing by colors how same parts can be utilized in different types of motors.

ELECTRIC NETWORKS

Low-Voltage. Low-Voltage A-C Networks, D. K. Blake. Gen. Elec. Rev., vol. 31, no. 9, Sept. 1928, pp. 470-482, 6 figs.

ELECTRIC TRANSFORMERS

Costs. Relative Costs of Transformers. Elec. World, vol. 92, no. 8, Aug. 25, 1928, pp. 363-364.

Large. Design of Large Transformers (Bau von Grosstransformatoren), G. Stern. Elektrotechnik und Maschinenbau (Vienna), vol. 46, no. 26, June 24, 1928, pp. 685-691, 13 figs. Latest developments in design of large power transformers by German concern; in spite of disastrous failures of others with butt-joint iron cores, author's concern clings to this core construction on account of advantages which it offers when compared with interleaved core; unit, claimed to be largest existing transformer, can be reconnected to give 100,000 kva. single-phase output. See brief translated abstract in Elec. World, vol. 92, no. 8, Aug. 25, 1928, p. 370.

Protection. Network Transformer Protection. Elec. World, vol. 92, no. 9, Sept. 1, 1928, p. 408, 2 figs. In distribution network of Dallas, Tex., Power and Light Co. it was desired that good regulation characteristics of low secondary reactance transformers be had without consequent increased liability to transformer failure or burnt-out underground, short-circuit or other overload conditions; in series with each transformer secondary and grounded neutral is parallel circuit consisting of fuse and reactor.

Testing. Distribution Transformer Tests, D. M. Thomas. Elec. World, vol. 92, no. 8, Aug. 25, 1928, p. 358, 2 figs.

Methods of Testing Electrical Apparatus. Elec. Jl., vol. 25, no. 9, Sept. 1928, pp. 457-461, 8 figs.

Thermal Rating. The Thermal Rating of Transformers, E. T. Norris. Instn. Elec. Engrs. (Lond.), vol. 66, no. 380, Aug. 1928, pp 841-854, 6 figs.

Three-Winding. Three-Winding Transformers with Tap Changing Under Load, K. A. Oplinger. Elec. World, vol. 92, no. 9, Sept. 1, 1928, pp. 410-412, 5 figs.

ELECTRIC TRANSMISSION AND DISTRIBUTION

Annual Report. Annual Report of the Committee on Power Transmission and Distribution, P. Torchio. Am. Inst. Elec. Engrs.—Jl., vol. 47, nó. 9, Sept. 1928, pp. 676-678.

ELECTRIC WELDING

Arc-Welding Steel Structures. Arc-Welding Steel Structures and Machine Parts, A. M. Candy. Machy. (N.Y.), vol. 35, no. 1, Sept. 1928, pp. 51-52, 7 figs.

Resistance Welders. Resistance Welders as Manufacturing Tools. Engineering (Lond.), vol. 126, no. 3265, Aug. 10, 1928, pp. 158-161, 16 figs.

ELECTRICITY SUPPLY

Ontario. "Hydro" Service in Ontario Municipalities. Elec. News (Toronto), vol. 37, no. 16, Aug. 15, 1928, pp. 39-40, 1 fig. It is claimed that more than 80 per cent of domestic energy is sold where average charge is less than 2 cents per kw-hr., and more than 70 per cent of commercial power sold where rate is less than $25 per horsepower year.

ELECTROMAGNETS

Most Powerful. The Most Powerful Electromagnet in the World, the Electromagnet of the Academy of Science (L'électro-aimant le plus puissant du monde l'électro-aimant de L'Académie des Sciences). Nature (Paris), no. 2790, Aug. 1, 1928, pp. 119-123, 6 figs. Description of electromagnet installed at National Research Laboratory at Bellevue near Paris; history of electromagnet; weight 120 tons; electric power 100 kw., diam. of coils, 75 cm.

EMBANKMENTS

Reinforced Concrete. Marine Embankments in Reinforced Concrete, R. N. Stroyer. Concrete and Constr. Eng. (Lond.), vol. 23, no. 8, Aug. 1928, pp. 527-540, 16 figs.

EVAPORATORS

Multiple-Effect. Evaporators for Boiler-Feed Make-Up Water, W. L. Badger. Fuels and Steam Power (A.S.M.E. Trans.), vol. 50, no. 15, May-Aug. 1928, pp. 207-212, 6 figs.

F

FELDSPAR DEPOSITS

Canada. Feldspar in Canada. Can. Min. Jl. (Gardenvale, Que.), vol. 49, no. 31, Aug. 3, 1928, p. 626, 1 fig.

FILTERS

Sludge. Recent Types of Continuous Filters for Sludge-like Masses (Neuere unterbrochen arbeitende filter fuer schlammige massen), K. W. Geisler. V.D.I. Zeit. (Berlin), vol. 72, no. 31, Aug. 4, 1928, pp. 1089-1092, 11 figs. Construction details of suction and other types of filters by Groeppel, Wolf, Polysius and others, also special filter for dehydration of cellulose.

FLOW METERS

Steam. Correction of the Steam-Flow Meter for Change in Size of Orifice, H. Weber. Power, vol. 68, no. 9, Aug. 28, 1928, p. 362, 4 figs. Author shows method by which meter can easily be corrected.

FLOW OF WATER

Concrete Pipe. Determination of Coefficients for Concrete Pipe from Actual Field Measurements, F. C. Scobey. Hydraulic Eng., vol. 4, no. 8, Aug. 1928, pp. 491-493 and 502-503 and 514, 5 figs. Summary of mass of experimental data upon various types of concrete pipe lines, coefficients mentioned for but three formulas, Scobey, Williams-Hazen, and Kutter-Ganguillet. Paper presented before Am. Water Works.

Orifices. Acceleration of Water Flow Through an Orifice, M. F. Sayre. Mech. Eng., vol. 50, no. 9, Sept. 1928, pp. 722-723.

Pipes. Formulæ for Estimating Flow of Water in Various Types of Closed Conduits. Hydraulic Eng., vol. 4, no. 8, Aug. 1928, p. 514.

FORESTRY

British Columbia. Forest Conservation in British Columbia, P. Z. Caverhill. Eng. Jl. (Montreal), vol. 11, no. 9, Sept. 1928, p. 505. Discussion of paper previously indexed from June 1928 issue of same journal.

FORGINGS

BRASS, HEAT TREATMENT OF. The Heat Treatment of Drop Forged Brass, R. Hinzmann. Fuels and Furnaces, vol. 6, no. 8, Aug. 1928, pp. 1047-1050, and 1069-1070, 16 figs.

STEEL, HEAT TREATMENT OF. Determination of the Heating Time for Forgings. Fuels and Furnaces, vol. 6, no. 8, Aug. 1928, pp. 1081-1082, 2 figs.

FOUNDATIONS

COLUMN FOOTINGS, DESIGN. Proposed Method of Design for Continuous Column Footings, N. B. Green. Eng. News-Rec., vol. 101, no. 7, Aug. 16, 1928, pp. 237-238, 3 figs.

SUBAQUEOUS, TESTING. Wash Borings in Tidal Waters with Portable Pump, J. R. Noyes. Eng. News-Rec., vol. 101, no. 8, Aug. 23, 1928, pp. 290-291, 2 figs. Eighty-pound pump, direct-connected to four-cylinder, two-cycle, high-speed gasoline motor, capable of delivering about 40 g.p.m. at pressure of 120 lb. per sq. in., was connected through hose to 1-in. iron jetting pipe; more than 100 borings were taken in 6½ hr.; in 7½ working days 2 mi. of channel was examined to depth of 2 ft. below mean lower low water permitting accurate determination of subsurface conditions across entire bar, in Gastineau Channel, near Juneau, Alaska.

FOUNDRY PRACTICE

OXYACETYLENE WELDING. Oxy-Acetylene Welding in the Foundry, G. F. Wieser. Acetylene Jl., vol. 30, no. 2, Aug. 1928, pp. 59-62. Paper read before Welding Conference.

FURNACES, ANNEALING

NORMALIZING IN. Furnaces and Methods in Normalizing. Heat Treating and Forging, vol. 14, no. 8, Aug. 1928, pp. 915 and 917.

FURNACES, HEAT-TREATING

TYPES. Furnaces for Various Heat Treatments, P. C. Osterman and E. C. Cook. Heat Treating and Forging, vol. 14, nos. 7 and 8, July and Aug. 1928, pp. 781-784 and 903-907, 14 figs. July: Oven semi-muffle furnace is described in connection with treatment of high-speed steel tools; vertical cylindrical type furnaces and salt baths adaptable for certain purposes; electric and gas-fired furnaces compared. Aug.: Case-hardening problems are reviewed and number of installations are described.

G

GARAGES

MECHANICAL HANDLING IN. Garage Has Mechanical Handling for Cars. Eng. News-Rec., vol. 101, no. 10, Sept. 6, 1928, pp. 359-361, 3 figs. Twenty-two storey 66 by 88-ft. garage in 41-storey Pure Oil Building downtown business district of Chicago, which has storage capacity for 572 cars, and in which cars are moved vertically by elevators and horizontally by transfer tables, without use of their own power, is new development toward solving parking problems in congested districts; also providing parking accommodation for tenants in office buildings.

GARBAGE INCINERATORS

INCINERATORS. Incinerators. Domestic Eng. (Chicago), vol. 124, no. 8, Aug. 25, 1928, pp. 23-25 and 47-48 and 51-52, 18 figs.

GAS ENGINES

HEAT LOSSES IN. Losses in Exhaust of Large Gas Engines (Verluste im Auspuff von Grossgas motoren), J. R. Solt. Stahl and Eisen (Duesseldorf), vol. 48, no. 33, Aug. 16, 1928, pp. 1132-1133, 2 figs.

GAS PRODUCERS

MECHANICAL. Gas Producer Arranged for Full Mechanical Operation. Iron Age, vol. 122, no. 8, Aug. 23, 1928, p. 467, 3 figs.

GAS RETORTS

CONTINUOUS VERTICAL. Carbonization in Vertical Retorts, J. L. Hyslop. Gas World, vol. 89, no. 2298, Aug. 18, 1928, pp. 142-146.

GAS TANKS

WATERLESS. The Waterless Holder at Toronto, W. R. Gardner. Gas Engr. (Lond.), vol. 44, no. 628, Aug. 1928, pp. 206 and 209. Digest of paper before Can. Gas Assn., previously indexed from Gas World, July 14, 1928.

GASES

HIGH-PRESSURE RESEARCH. High Pressure Gas Research at the University of Illinois, N. W. Krase. Chem. and Met. Eng., vol. 35, no. 8, Aug. 1928, pp. 463-465, 4 figs.

GAUGES

KRUPP MIKROTAST. Krupp Mikrotast Gauge. Machy. (Lond.), vol. 32, no. 823, July 19, 1928, pp. 510-513, 11 figs. Description of gauge developed by F. Krupp, A.-G., Essen, which consists of two parts, Mikrotast proper which may be used alone, and adapters to suit work to be gauged; Mikrotast can be supplied and with wide range of scale graduations reading in both millimeters and inches, and measurements can be taken to 0.001 mm. or 0.00004 in.; pointer actuating mechanism; gauging cylindrical surfaces; special applications of saddle gauge; internal gauging; thread gauging.

GEARS

DESIGN. The Arc Gear Tooth System, A. Fisher. Machy. (Lond.), vol. 32, no. 826, Aug. 9, 1928, pp. 595-598, 6 figs.

NON-METALLIC, HORSEPOWER OF. Horsepower of Non-Metallic Spur Gears. Machy. (N.Y.), vol. 35, no. 1, Sept. 1928, suppl. sheet no. 137. Method of computing horsepower of spur gears composed of laminated phenolic materials or rawhide, as recommended practice of Am. Gear Mfrs.' Assn.; table of safe working stresses for different speeds.

TOOTH MODIFICATION. Hob Corrections for Gear Tooth Modifications, J. A. Hall. Am. Mach., vol. 69, no. 10, Sept. 6, 1928, pp. 379-382, 4 figs. Paper presented before Am. Gear Mfrs. Assn.

GEOPHYSICAL EXPLORATION

METHOD OF MAPPING. The Seismic Method of Mapping Geologic Structure, D. C. Barton. Min. and Met., vol. 9, no. 261, Sept. 1928, pp. 401-403.

Wireless in Mineral Prospecting, F. J. North. Discovery (Lond.), vol. 9, no. 104, Aug. 1928, pp. 239-243, 6 figs. Considerable success is being obtained with use of wireless for detecting minerals, mainly as result of research in United States; many details have still to be worked out before this new process can be generally employed by surveyors; special study of geophysical methods will be undertaken in Australia.

GOLD MINES AND MINING

NOVA SCOTIA. Gold Mining in Nova Scotia, J. P. Messervy. Can. Min. Jl. (Gardenvale, Que.), vol. 49, no. 31, Aug. 3, 1928, pp. 623-624 and (discussion) 624-626. Interview, reported by S. Mifflen; historical note of first discovery in 1858; causes of decline in activity; recent interest awakened as to rehabilitation; outline map of known gold districts, covering about half of province along Atlantic coast; brief summary as to how developments should be carried out.

GOLD ORE TREATMENT

CYANIDATION. Problem of Cyaniding South Dakota "Blue Ores" Solved, E. S. Leaver and J. A. Woolf. Eng. and Min. Jl., vol. 126, no. 7, Aug. 18, 1928, p. 260. Abstract of Bur. of Mines—Tech. Paper no. 423, "Cyanide Extraction of Gold and Silver Associated with Arsenic and Antimony in Ores, with Especial Reference to Those in Nevada and South Dakota."

GRAIN ELEVATORS

ELECTRIC OPERATION. The Electrical Installation of a Modern Terminal Grain Elevator, A. E. Macdonald. Elec. News (Toronto), vol. 37, no. 16, Aug. 15, 1928, pp. 47-51, 7 figs. New 5,500,000-bushel, reinforced-concrete terminal grain elevator of United Grain Growers, Ltd., Port Arthur, Ont.

GRINDING

PRECISION. Precision Grinding of Small Parts, F. W. Curtis. Am. Mach., vol. 69, no. 9, Aug. 30, 1928, pp. 359-361, 8 figs.

H

HARBOUR IMPROVEMENTS

NEW BRUNSWICK. Important Work in St. John Harbour. Contract Rec. (Toronto), vol. 42, no. 34, Aug. 22, 1928, pp. 857-858, 1 fig. Pier, 800 ft., and 1,500,000-bushel elevator are among projects to be carried out with $5,000,000 loaned by Dominion Government.

HARBOURS

APPROACHES. Harbour and Dock Approaches, C. R. S. Kirkpatrick. Can. Engr. (Toronto), vol. 55, no. 8, Aug. 21, 1928, p. 240. Abstract of paper presented before Instn. Civil Engrs., previously indexed from Engineering (Lond.), June 15, 1928.

HARDNESS

TESTING. Hardness Testing, H. M. German. Am. Soc. Steel Treating—Trans., vol. 14, no. 3, Sept. 1928, pp. 343-354, 13 figs. Paper presents some newer ideas pertaining to Brinell, Rockwell, and scleroscope hardness testing; charts showing comparative hardness values of Brinell with Rockwell C, Rockwell B and scleroscope; brief description of Vickers and monotron hardness testing machines.

HEAT TRANSMISSION

PIPES. Heat Transfer Between Flowing Liquid and Enclosing Pipe Shell (Waermeuebergang stroemender Fluessigkeit in Rohren), L. Schiller and T. Burbach. V.D.I. Zeit. (Berlin), vol. 72, no. 34, Aug. 25, 1928, pp. 1195-1196, 2 figs.

Note on Heat Transmission in Pipes (Bermerkung ueber den Waermeuebergang im Rohr), L. Prandtl. Physikalische Zeit. (Leipzig), vol. 29, no. 14, July 15, 1928, pp. 487-489. Theoretical, mathematical elaboration of older formulas; takes account of phenomena of turbulent flow of liquid in pipes.

WALLS. Thermal Phenomena in Walls of any Form (Waerme und Temperaturverlauf in Waenden von beliebiger Form), K. Laehmann. V.D.I. Zeit. (Berlin), vol. 72, no. 32, Aug. 11, 1928, pp. 1127-1128, 6 figs.

HYDRAULIC DREDGES

DIESEL DRIVEN. Diesel Hydraulic Dredge. Mar. Rev., vol. 58, no. 9, Sept. 1928, pp. 40-41, 2 figs. Hull is 106 ft. long, by 28 ft. beam, by 8 ft. depth; Diesel pump engine is Bessemer 6-cylinder, 4-stroke-cycle, developing 500 hp. at 275 r.p.m., direct-connected through Francke floating-ring type of flexible coupling to 15-in. Morris centrifugal pump; delivering 200 cu. yd. solids per hour against 40-ft. head.

HYDRAULIC TURBINES

OPERATION. Operation of Waterwheels at Small Gate Openings, J. Talla. Power, vol. 68, no. 9, Aug. 28, 1928, p. 360, 1 fig.

HYDRAULICS

STANDING WAVES. The Standing Wave, J. H. Jones. Engineering (Lond.), vol. 126, nos. 3265 and 3266, Aug. 10 and 17, 1928, pp. 172-173 and 193-194, 10 figs. Standing wave may either make or destroy success of otherwise carefully planned water-regulating works, and its analysis throws great light upon other apparently unconnected obscure phenomena; results of author's investigations covering period of eight years; method of analysis adopted is based on law of conservation of momentum; weir discharge. (To be continued.)

HYDRO-ELECTRIC DEVELOPMENTS

BRITISH COLUMBIA. Water-Power Resources of British Columbia. Elec. World, vol. 92, no. 9, Sept. 1, 1928, p. 409, 1 fig. Water-power resources are estimated at 1,930,000 hp. minimum and 5,100,000 hp. for six months, of which 460,562 hp. has already been developed; principal central-station systems in province are those supplying Vancouver, Victoria, and Nelson districts.

CONOWINGO, MD. The Conowingo Hydroelectric Development on the Susquehanna River, A. Wilson. Am. Inst. Elec. Engrs.—Jl., vol. 47, no. 9, Sept. 1928, pp. 655-657. Unusual features of design and construction of dam, power station, and hydraulic equipment, together with general description of entire project are described.

HYDRO-ELECTRIC POWER DEVELOPMENTS

BRITISH COLUMBIA. The Alouette Lakes Development, British Columbia. Engineering (Lond.), vol. 126, no. 3266, Aug. 17, 1928, pp. 185-191, 23 figs.

CANADA. Hydro-Electric Development in Canada. Can. Engr. (Toronto), vol. 55, no. 8, Aug. 21, 1928, pp. 235-237, 6 figs. Review of present and prospective hydro-electric power-plant construction in Canada; estimated that about 550,000 hp. will be installed this year; numerous undertakings also in initial stages of construction; developments in various provinces.

ONTARIO. Ontario Hydro's New 54,000 hp. Nipigon River Development. Elec. News (Toronto), vol. 37, no. 18, Sept. 15, 1928, pp. 33-34, 3 figs.

QUEBEC. Montreal Island Power Development Is in Full Swing. Elec. News (Toronto), vol. 37, no. 18, Sept. 15, 1928, pp. 34-35, 2 figs. Description of power development on Riviere des Prairies at Black river; ultimate installation will consist of ten units of 12,000 hp. maximum capacity, with total of 90,000 hp. under normal conditions; location of plant is shown by map accompanying article; 800 men are at present employed on job and work is progressing very satisfactorily.

HYDROGRAPHIC SURVEYING

POSITION FINDING. Radio Acoustic Position Finding in Hydrography, J. H. Service. Am. Inst. Elec. Engrs.—Jl., vol. 47, no. 9, Sept. 1928, pp. 670-674, 4 figs. Temporary shore stations are set up, equipped with microphone placed in water and connected with amplifier ashore through cable; amplifier is connected through relay to automatic key driven by clockwork, which causes radio transmitter to send out characteristic signal whenever microphones is disturbed; ship obtains time of travel of sound in water from her position to shore-station microphones; speed of sound in seawater being known, ship's position is thus fixed; method has been used in U.S. Coast and Geodetic Survey. Bibliography.

I

ICE PLANTS

PHILADELPHIA. Tacony Plant of Kensington Hygeia Ice Co., Philadelphia, Pa. Ice and Refrig., vol. 75, no. 2, Aug. 1928, pp. 93-95, 6 figs.

INDUSTRIAL LIGHTING

VIBRATIONS EFFECT. Vibration As Related to Industrial Lighting, A. J. Thompson. Iron and Steel Engr., vol. 5, no. 8, Aug. 1928, pp. 390-391.

INSULATING MATERIALS (ELECTRIC)

TESTING. A Modern Industrial High-Pressure Laboratory, A. Imhof. Elec. Rev. (Lond.), vol. 103, no. 2647, Aug. 17, 1928, pp. 267-269, 6 figs. Account of equipment used for testing insulating materials; high-tension works laboratory must serve two purposes: insulators must be expeditiously and yet thoroughly examined for quality and size; accurate research is absolutely necessary in connection with improvement of quality and study of convenient dimensions and construction details; test room must be spacious; good ventilation and illumination by adjustable reflectors must be provided; description of one of latest and largest industrial test laboratories in German porcelain factory.

INSULATORS

ELECTRIC. Hardware and Insulators, D. C. Hopper. Iron and Steel Engr., vol. 5, no. 8, Aug. 1928, pp. 350-352.

[*See also Airplane Engines; Automobile Engines; Diesel Engines; Oil Engines.*]

IRON AND STEEL PLANTS

NOVA SCOTIA. Plant of Dominion Iron & Steel Company at Sydney, N.S. Iron and Steel of Can. (Gardenvale, Que.), vol. 11, no. 8, Aug. 1928, pp. 231-232. Description of small improvements made to plant which have effected important economies; all production records in all departments have been broken in past year.

IRON CASTINGS

GRAY. Way to Improve Gray-Iron Castings, R. Moldenke. Iron and Steel of Can. (Gardenvale, Que.), vol. 11, no. 8, Aug. 1928, pp. 240-242. Abstracts of paper presented at European Foundrymen's Congress, Barcelona, Spain.

IRON FOUNDRIES

CASTING PRACTICE. Casting Technique (Die Giesstechnik fuer Gusseisen), J. Petin. Giesserei (Duesseldorf), vol. 15, no. 31, Aug. 3, 1928, pp. 749-757, 15 figs.

GRAY-IRON. Completes New Foundry for Compressor and Engine Gray-Iron Castings. Iron Age, vol. 122, no. 8, Aug. 23, 1928, pp. 461-462, 2 figs. Chicago Pneumatic Tool Co. has completed new foundry at Franklin, Pa.; building is 130 ft. wide and 220 ft. long; buildings and foundry equipment represents investment of more than $400,000; 225 men will be employed; equipment includes two cupolas, one of 16 and one of 8 tons per hour capacity.

IRON MINES AND MINING

PUMPS, ELECTRIC. Two Deep-Level Pumping Plants in the Lake Superior Iron Country, W. M. Hoen. Eng. and Min. Jl., vol. 126, no. 10, Sept. 8, 1928, pp. 364-369, 6 figs. Castile Mining Co. and Montreal Mining Co. on Gogebic range; water is accumulated at about 2,000 ft.; new pumps replace older and less efficient units; Castile has 3 geared 5¼ by 18-in. Prescott horizontal duplex; 200-hp. squirrel-cage motors, 2,200 volts; Montreal has 2 geared 6¾ by 24-in. Worthington horizontal duplex 450-hp. synchronous motors, 2,200 volts; at both plants, motors connected to pinion shaft through Falk-Bibby coupling.

IRRIGATED LANDS

DRAINAGE. Report of the Committee of the Irrigation Division on Drainage of Irrigated Lands. Am. Soc. Civil Engrs.—Proc., vol. 54, Mar. 3, 1928, pp. 131-152. See discussion in no. 7, Sept. 1928, pp. 2203-2205, 1 fig.

IRRIGATION

WATER RECOVERY. Return Water and Drainage Recovery From Irrigation. Am. Soc. Civil Engrs.—Proc., vol. 54, no. 7, Sept. 1928, pp. 2178-2194, 3 figs. Discussion by R. I. Meeker and F. H. Tibbetts on symposium, presented at meeting of Irrigation Division, Denver, Colo., July 14, 1927, and published in Apr. 1928 issue of Proceedings.

L

LEAD-ZINC MINES AND MINING

AUSTRALIA. Mining Ore at the Broken Hill Proprietary, E. J. Horwood. Eng. and Min. Jl., vol. 126, no. 8, Aug. 25, 1928, pp. 295-297, 3 figs.

LOCOMOTIVE REPAIR SHOPS

WABASH RY. CO. Wabash Shops Are Enlarged to Meet Repair Demands, F. W. Curtis. Am. Mach., vol. 69, no. 8, Aug. 23, 1928, pp. 315-317, 4 figs.

LOCOMOTIVES

DESIGN. British Influence on American Locomotive Design. Modern Transport (Lond.), vol. 9, no. 491, Aug. 11, 1928, pp. 3-4, 7 figs. New Pacific-type locomotive built at Mt. Clare shops of Baltimore and Ohio Railroad, design of which is said to be strongly influenced by British design.

DIESEL. *See Diesel Locomotives.*

ELECTRIC. *See Electric Locomotives.*

FRAMES. Graphical Analysis of Rigid Beams on Elastic Supports (Zeichnerische Untersuchungen fuer den starren Traeger auf Elastischen Stuetzen), E. Pawelka. Organ fuer die Fortschritte des Eisenbahnwesens (Berlin), vol. 83, no. 15, Aug. 1, 1928, pp. 289-292, 8 figs. Author develops graphical method of analysis of stresses in beam members of locomotive frames resting on springs.

HIGH-PRESSURE, SWITZERLAND. High-Pressure Locomotives of the Swiss Locomotive Works of Winterthur (Hochdrucklokomotive 60 Atm. der Schweizerischen Lokomotiv-und Maschinenfabrik Winterthur), H. Brown. Zeit. des Oesterr. Ingenieur u. Architekten-Vereines (Vienna), vol. 80, no. 31/32, Aug. 3, 1928, pp. 279-285, 15 figs.

OIL-ELECTRIC. A 660-Hp., 87-Ton Oil-Electric Switcher for the Long Island Railroad, J. H. Harvey. Ry. and Locomotive Eng., vol. 41, no. 6, June 1928, pp. 162-165, 5 figs.

PULVERIZED-COAL. The AEG Pulverized Fuel Locomotive, W. Kleinow. Fuel (Lond.), vol. 7, no. 8, Aug. 1928, pp. 345-363, 23 figs. Development of use of pulverized fuel; development of A.E.G. system of pulverized-fuel combustion for locomotives; A.E.G. pulverized-fuel tender; trial of locomotive on road.

STEAM-TURBINE. The Super-High-Pressure Turbine Locomotive of the J. A. Maffei A. G. Eng. Progress (Berlin), vol. 9, no. 8, Aug. 1928, pp. 218-219. German State Railways Co. have placed order with Locomotive Works of J. A. Maffei, of Munich, for locomotive with super-high-pressure boiler and turbine drive; locomotive will be express train engine of 4-6-2 type, of 2,500 hp. maximum capacity, and will have maximum speed of 110 km., 68 m. per hour; boiler as Benson type.

THREE-CYLINDER. Some Experimental Results from a Three-Cylinder Compound Locomotive, L. H. Fry. Instn. Mech. Engrs.—Proc. (Lond.), no. 4, 1927, pp. 923-954 and (discussion) 955-1024, 30 figs.

WHEEL LOADING. Dynamic Loading on Locomotive Wheels, G. Lomonossoff. Engineer (Lond.), vol. 146, nos. 3784 and 3785, July 20 and 27, 1928, pp. 58-59 and 83-85, 4 figs.

LOOMS, COTTON

POWER REQUIREMENTS. Theoretical Expressions for the Power Required to Drive Plain Cotton Looms, R. H. Wilmot. Metropolitan Vickers Gaz. (Manchester, Eng.), vol. 11, no. 184, July 1928, pp. 18-20.

LUMBER HANDLING

PRINCIPAL CLASSIFICATIONS. Mechanical Handling of Lumber, C. M. Bigelow and T. D. Perry. Am. Soc. Mech. Engrs.—Advance Paper for mctg. Oct. 1 to 3, 1928, 7 pp., 18 figs. Problem may be divided into three principal classifications: handling of lumber for kiln drying; handling of relatively moderate sizes of dimension lumber for erection and equipment of houses and small industrial structures; handling of large-size structures, ships, etc.

M

MACHINE TOOLS

BALL BEARINGS. Ball Bearings for Main Spindles, H. W. Holdsworth. Machy. (N.Y.), vol. 35, no. 1, Sept. 1928, pp. 11-16, 8 figs.

ELECTRIC DRIVE. Electric Drivers for Machine Tools, A. Fox and A. J. Whitcomb. Machy. (N.Y.), vol. 35, no. 1, Sept. 1928, pp. 33-36, 5 figs.

MACHINERY

POWER REQUIREMENTS. Power Required to Drive Machinery, J. W. Brassington. Nat. Engr., vol. 32, no. 4, Apr. 1928, pp. 155-158, 3 figs.

TORSION RESISTANCE. Resisting Torsional Strains in Machinery Bases. Am. Mach., vol. 69, no. 9, Aug. 30, 1928, p. 342, 4 figs. Illustrations of use of butt-welded tubes for resisting effects of torsion; examples of tests carried out by Lincoln Electric Co. on tubular cross-members for base on gasoline-driven hoist.

MANGANESE STEEL

MANUFACTURE BY ELECTRIC PROCESS. Making Electric Manganese Steel, J. H. Hruska. Iron Age, vol. 122, no. 8, Aug. 23, 1928, pp. 455-456, 2 figs.

MATERIALS HANDLING

GRAB BUCKETS. Grabs, E. G. Fiegehen. Engineering (Lond.), vol. 126, no. 3267, Aug. 24, 1928, pp. 224-225, 4 figs. Grabs for transporters and telphers; automatic coiling drums.

IRON AND STEEL PLANTS. Clamshell Buckets in the Steel Industry, E. L. Harrington. Blast Furnace and Steel Plant, vol. 16, no. 8, Aug. 1928, pp. 1076 and 1075, 1 fig.

METAL CUTTING

TEMPERATURE EFFECTS. Cutting Tools Research Committee Report on Cutting Temperatures: Their Effect on Tools and on Materials Subjected to Work, E. G. Herbert. Instn. Mech. Engrs.—Proc. (Lond.), no. 4, 1927, pp. 863-892 and (discussion) 893-908, 21 figs.

METAL MINES AND MINING

BRITISH COLUMBIA. The Central British Columbia Mining District, R. C. Rowe. Can. Min. Jl. (Gardenvale, Que.), vol. 49, no. 35, Aug. 31, 1928, pp. 692-695, 6 figs. Outline of geology and description of some individual mines in area about 250 mi. in length, from Terrace to Endago on Edmonton-Prince Rupert line of Canadian Northern Ry.; deposits mainly of silver-lead or silver-lead zinc type and some occurrences of gold-copper ore.

EXPLOSIVES. Reducing Metal Mining Costs by Using Stemming, O. N. Wampler. Explosives Engr., vol. 6, no. 8, Aug. 1928, pp. 303-305, 4 figs. Tests conducted on lead blocks showed 90 per cent gain in explosive energy from use of stemming; various percentages of saving in quantity of explosives required to produce given results in certain mines; reduces number of boulders in stope shots; further advantages to be expected as men become adept with its use and become convinced of its advantages.

FIRE PREVENTION. How to Prevent Mine Fires, E. D. Gardner and D. J. Parker. Eng. and Min. Jl., vol. 126, no. 8, Aug. 25, 1928, p. 300. Abstract of U.S. Bureau of Mines—Reports of Investigations; no. 2882, previously indexed.

STOPING. Stope Control, Dilution, and Recovery with the Caving Methods, C. A. Mitke. Eng. and Min. Jl., vol. 126, no. 7, Aug. 18, 1928, pp. 246-252, 14 figs. Purpose of boundary shrinkage stopes is to isolate, from main mass, block of ore being undercut and drawn; mechanics of ground movement; piping caused by uneven drawings; cross currents proved by tests with wooden cubes placed in ore blocks about to be caved; high recovery dependent on close spacing of draw holes, as well as on "stope control"; examples of tonnages and grades at Miami, Morenci, and other mines. (Concluded.)

METALS

FATIGUE. What is Fatigue (Was ist Ermuedung)? K. Laute and G. Sachs. V.D.I. Zeit. (Berlin), vol. 72, no. 34, Aug. 25, 1928, pp. 1188-1189, 2 figs. Report from government testing laboratory and Kaiser Wilhelm Institute for metal research at Berlin-Dahlem; review of fatigue of metals studies by Gough, Ludwik, Moore and Kommers, and others; new experiments by authors showing weakening effect of heat treatment on nickel bars subjected to vibrations repeated millions of times.

HEAT CONDUCTIVITY. Heat Conductivity of Metals as Factor in Heat Transfer, R. Worthington. Chem. and Met. Eng., vol. 35, no. 8, Aug. 1928, pp. 481-482.

NOTCHED-BAR TESTS. The Fracture of Notched Tensile Test Pieces (Der Bruch gekerbter Zugproben), W. Kuntze. Archiv. fuer das Eisenhuettenwesen (Duesseldorf), vol. 2, no. 2, Aug. 1928, pp. 109-117, 11 figs.

WEAR TESTING. The Wear of Metals and Its Determination. Engineering (Lond.), vol. 126, no. 3267, Aug. 24, 1928, p. 237.

MINERAL DEPOSITS

CANADA. Apatite, Graphite, and Mica in Canada. Can. Min. Jl. (Gardenvale, Que.), vol. 49, no. 34, Aug. 24, 1928, pp. 675-676. Much apatite produced as by-product of mica mining; these minerals and graphite occur in and near Grenville-Hastings group of sedimentary rocks, in parts of Ontario and Quebec, south and north of Ottawa; general outline of characteristics of deposits, with some production data.

MINES AND MINING

CANADA. Canadian Mining Industries. Engineer (Lond.), vol. 146, no. 3788, Aug. 17, 1928, pp. 177-178, 7 figs. partly on p. 174. Vast coal fields of Nova Scotia, Alberta, and British Columbia, gold ores of Porcupine and Kirkland lake in Ontario, nickel-copper deposits of Sudbury, silver-cobalt ores of Cobalt, all have been important factors in opening up new sections of country and in establishing permanent civilization; mining activities in Canada furnish employment for appreciable percentage of population; development facilitated by plentiful supply of cheap hydro-electric power; transportation; aviation.

CAVING. Comparison of Branch Raise and Combined Shrinkage and Caving Methods, C. A. Mitke. Min. and Met., vol. 9, no. 261, Sept. 1928, p. 411. (Abstract.)

LIQUID FIRE. Mining By Fire. Can. Min. Jl. (Gardenvale, Que.), vol. 49, no. 35, Aug. 31, 1928, pp. 700-701. Article previously indexed from Min. and Indus. Mag. of S. Africa, Mar. 21, 1928.

PUMPS, HYDRAULIC. P. Mengin Pump, Hydraulically Operated, for Deep-Water Pumping (Pompe P. Mengin à Commande hydraulique, pour le puisage des eaux profondes). Génie Civil (Paris), vol. 93, no. 6, Aug. 11, 1928, p. 146.

Rock Pressure. Nature of Rock Pressure and Its Utilization in Working of Mansfeld Mines (Das Wesen des Gebirgsdruckes und dessen Ausnutzung beim Abbaubetriebe des Mansfelder Bergbaus), G. Gillitzer. Glueckauf (Berlin), vol. 64, nos. 29 and 30, July 21 and 28, 1928, pp. 977-987 and 1009-1016, 15 figs.

O

OIL ENGINES

Airless Injection, Testing. Experiments on Solid-Injection Engine, G. F. Mucklow. Automobile Engr. (Lond.), vol. 18, no. 244, Aug. 1928, pp. 306-310, 13 figs. Experiments carried out in engineering laboratories of University of Manchester on Crossley single-cylinder solid-injection heavy-oil engine Type 0123 which was so arranged that timing of fuel injection could be varied; normal injection timing of 348.5 deg. gives best results in case of particular engine under test.

Power Measurement. Exhaust Temperature as Load Index for Oil Engines, E. C. Magdeburger. Am. Soc. Naval Engrs.—Jl., vol. 40, no. 3, Aug. 1928, pp. 496-500. 1 fig. See article by Heidelberg in V.D.I. Beit. (Berlin), Dec. 24, 1927.

Power-Plants. An 11,700 B.H.P. Oil Engine for Power Station Work. Engineer (Lond.), vol. 146, no. 3786, Aug. 3, 1928, p. 128, 1 fig.

OIL SHALE

Canada. Oil Shale Developments in Canada, A. A. Swinnerton. Petroleum World (Lond.), vol. 9, no. 335, Aug. 1928, pp. 309-314. Paper presented at Dominion Chemical Convention, previously indexed from Petroleum Times (Lond.), July 28, 1928.

OPEN-HEARTH FURNACES

Design. Improvements in Open Hearth Furnaces with Moll-Type Head (Neuerungen an Siemens-Martin-Oefen mit Moll-Kopf), K. H. Moll. Stahl u. Eisen (Duesseldorf), vol. 48, no. 34, Aug. 23, 1928, pp. 1160-1165, 6 figs. Report no. 146 of Steel Works Committee of Verein deutscher Eisenhuettenleute.

ORE DEPOSITS

Theory. Diffusion in Ore Genesis, A. R. Whitman. Economic Geology, vol. 23, no. 5, Aug. 1928, pp. 473-488, 5 figs. Describes quantitative experiment to establish rate of diffusion of metallic solutions in rock; author argues that diffusion process functions as principal agent of mobility in facilitating metasomatism.

ORE DRESSING

Experimental Plant. The Experimental Plant, H. F. Lunt. Colo. School of Mines Mag., vol. 18, no. 1, May 1928, pp. 15-17, 6 figs. Accurate results from pilot mill made possible by special equipment, devised principally by A. J. Weinig; rock saw; reagent feeder; table for determining quantities of reagents required. (Continuation of serial.)

ORE TREATMENT

Flotation. Preparation and Modification of Ore Pulps for Flotation Grinding, H. S. Martin. Min. Congress Jl., vol. 14, no. 9, Sept. 1928, pp. 716-718, 1 fig.

ORE TREATMENT, FLOTATION PLANTS

Payments. Analyzing Complex-Ore Settlements Graphically, H. L. Johnson. Eng. and Min. Jl., vol. 126, no. 7, Aug. 18, 1928, pp. 256-258.

P

PAVEMENTS

Brick, Wear. Wear of Brick Pavement Under Heavy City Traffic, P. L. Brockway. Eng. News-Rec., vol. 101, no. 8, Aug. 23, 1928, pp. 286-287. At Wichita, Kan., traffic of 3,000,000 tons per foot of width reduces thickness one inch; Arlington test by Bureau of Public Roads misleading; traffic wears out pavement in direct ratio to volume and in increasing ratio with density.

Concrete, Felt Base. Sealed Felt Base for Concrete Pavement. Roads and Streets, vol. 68, no. 8, Aug. 1928, p. 415.

Concrete, Specifications. The Effect of the Length of the Mixing Period on the Quality of the Concrete Mixed in Standard Pavers, J. L. Harrison. Pub. Roads, vol. 9, no. 5, July 1928, pp. 93-111, 9 figs. Results of study of specifications governing mixing of concrete for highway pavements made by U.S. Bur. of Public Roads; with coöperation of state highway departments; reports of records of some 1,500 broken cylinders are given.

Testing, Germany. Dynamic Testing of Street Pavements and Its Results (Dynamische Strassenwertung und Ihre Ergebnisse), P. Langer and W. Thome. Beton-Strasse (Berlin), vol. 3, no. 8, Aug. 1, 1928, pp. 199-208, 17 figs. Authors describe instruments and methods used in testing street and highway pavements by acceleration and impact effects; results of tests on Brunswick experimental highway; effect of vehicle springs; graphs of pavement conditions.

PETROLEUM PRODUCTION

Canada. Progress in Western Canada Fields, V. Lauriston. Oil and Gas Jl., vol. 27, no. 10, July 26, 1928, pp. 145, 156, 159-160.

PHOTOELASTICITY

Theory and Practice. Use of Oblique Double Refraction in Study of Strain Distribution in Stressed Bodies (Ueber die Anwendung der akzidentellen Doppelbrechung zum Studium der Spannungsverteilung in beanspruchten Koerpern), M. Waechtler. Physikalische Zeit. (Leipzig), vol. 29, no. 15, Aug. 1, 1928, pp. 497-534, 39 figs. Extensive review of theory and practice of photoelasticity; theoretical and practical studies by Coker, Filon, Mesnager, Koenig, Asch, author, and others; international bibliographic list of 102 references.

PIPE LINES

Welding. Welding as Applied to Steam and Water Piping, J. H. Zink. Heat. and Vent. Mag., vol. 25, no. 8, Aug. 1928, pp. 80-82, 5 figs.

PIPING (POWER PLANTS)

Welding. The Welding of Power-Plant Piping, A. W. Moulder. Fuels and Steam Power (A.S.M.E. Trans.), vol. 50, no. 15, May-Aug. 1928, pp. 235-240, 17 figs.

POWER PLANTS

Electric, Substations. Safe, Underground Transmission of Electrical Energy, H. Milliken. Elec. News (Toronto), vol. 37, no. 17, Sept. 1, 1928, pp. 31-37, 15 figs. Montreal Light, Heat and Power Consolidated has completed 4,000-volt distribution substation where density of load is such as to require ultimate station capacity of approximately 90,000 kva. two-hour rating; station is known as Vallee Street Substation; description of 66-kv. cable installation connecting substation to overload system, 4,000 ft. away.

Electrical Features of the Conowingo Generating Station and the Receiving Stations in Philadelphia, R. A. Hentz. Am. Inst. Elec. Engrs.—Jl., vol. 47, no. 9, Sept. 1928, pp. 649-654, 13 figs. Paper outlines principal electrical features of Conowingo development; including main units and their connections, station auxiliary supply, and 220,000-volt substation built on roof of power plant; 220,000-volt substation at Plymouth meeting Philadelphia terminus of Conowingo lines at lines of Pennsylvania-New Jersey interconnection; Westmoreland substation where 66-kv. lines from Plymouth meeting tie in with 66-kv. backbone of Philadelphia Electric System.

What Size Substations? L. G. Smith. Elec. World, vol. 92, no. 10, Sept. 8, 1928, pp. 459-461, 4 figs. Factors to be considered in determining economic size; practices of utilities; method of analysis developed upon basis of interrelation of system elements. Based on material compiled by substation subcommittee of electrical apparatus committee, N.E.L.A.

Electric, Substations, Remote Control. The Economics of Supervisory Control, R. J. Wensley. Elec. News (Toronto), vol. 37, no. 16, Aug. 15, 1928, pp. 34-36.

Electric, Transformer Stations. Extra-high Pressure Step-down Transformer Station. Engineer (Lond.), vol. 146, no. 3789, Aug. 24, 1928, p. 198. First 220,000-volt step-down transformer station to be built in Canada is being erected by Ontario Hydro-Electric Power Commission in Leaside, Ont.; 220,000-volt lines terminate on bush and may be disconnected from it by means of large oil circuit breakers and disconnecting switches; each circuit breaker is 22 ft. high to top of bushing, and occupies area of 25 ft. by 10 ft.; 110,000-volt windings of transformers provide means of inter-connection whereby Gatineau power may be taken directly and absorbed into 110,000-volt Niagara system.

POWER PLANTS, HYDRO-ELECTRIC

Automatic. Largest Automatically Controlled Generating Station, C. W. Colvin. Contract Rec. (Toronto), vol. 42, no. 32, Aug. 8, 1928, pp. 815-818, 4 figs. Description of 10,000-kva. unit in British Columbia Electric Railway Co.'s Alouette plant controlled from Stave Falls, 10 miles distant; spare turbine-driven exciter installed; station building is of reinforced-concrete construction; hydraulic, electric, and auxiliary apparatus; governing system.

British Columbia. Largest Automatically Controlled Generating Station, C. W. Colvin. Elec. News (Toronto), vol. 37, no. 16, Aug. 15, 1928, pp. 29-30 and 51, 3 figs. Control equipment of Alouette station is designed to perform automatically and in proper sequence all of operations of starting, running, and shutting down ordinarily performed by operations and floor men in manually operated stations; protective features. (Concluded.)

Automatic, Switzerland. Automatic Generating Plants Installed in Switzerland (Les usines génératrices à fonctionnement automatique installées en Suisse), J. Kloninger. Revue Générale de l'Electricité (Paris), vol. 24, no. 5, Aug. 4, 1928, pp. 189-195, 6 figs.

Gates. Roller and Sector Gates on Hydro Plants, O. Reed. Eng. News-Rec., vol. 101, no. 10, Sept. 6, 1928, pp. 346-349, 7 figs. General review of hydro-electric development in Norway; special problems; regulation of forebay ponds by sector and roller gates at Raanaasfos, Solbergfos, and Vamma; Raanaasfos dam spillway has capacity of 141,000 sec.-ft. and is regulated by two sector gates and one roller weir, 164 ft. long with regulating height of 12.3 ft.; reliability of these gates proved by thorough operating experience; electric heating of roller gates; objection to use of sector gates is wide masonry base which is required.

Ice Control. Electric Heating Protects Sluice Gates and Intakes Against Ice, J. H. D. Blanke. Nat. Engr., vol. 32, no. 7, July 1928, pp. 315-316. How number of hydro-electric plants are warding off ice troubles quite effectively by means of electric heating systems installed by Siemens-Schuckert-Werke; at Gratwein paper mill transformer of 95-kva. capacity and output voltage of 110 is employed for screenheating system.

Water Flow. Water-Flow Prediction for Hydraulic Power Stations (Wassermengenvorhersage im Kraftwerksbetrieb), A. Kvetensky. Elektrotechnik u. Maschinenbau (Vienna), vol. 46, no. 17, Apr. 22, 1928, pp. 375-377, 2 figs.

POWER PLANTS, STEAM

Design. Some Economic Factors in Power-Station Design, H. B. Brydon. Fuels and Steam Power (A.S.M.E. Trans.), vol. 50, no. 15, May-Aug. 1928, pp. 159-168 and (discussion) 168-181, 17 figs. Paper previously indexed from Mech. Eng., May 1928.

High Pressure. High Pressure Steam at Edgar Station, I. E. Moultrop and E. W. Norris. Fuels and Steam Power (A.S.M.E. Trans.), vol. 50, no. 15, May-Aug. 1928, pp. 32-36 and (discussion) 36-40. Authors describe design of generating plant for Edison Electric Illuminating Co. using steam at 1,200 lb.; this plant was first in country to use pressures of this magnitude; equipment of original plant is described and operating difficulties and results are discussed; comparison of space requirements of high- and low-pressure equipment.

Economies of Higher Pressures Substantiated. Power Plant Eng., vol. 32, no. 17, Sept. 1, 1928, pp. 918-919, 1 fig.

POWER PLANTS, STEAM-ELECTRIC

Detroit. What is in Detroit's Morrell Street Plan—And What It Cost. Power, vol. 68, no. 10, Sept. 4. 1928, pp. 402-404, 2 figs.

One-Man Operation. One-Man Operation for Avon Park Station, R. D. Stauffer and J. P. Garvin. Elec. World, vol. 92, no. 8, Aug. 25, 1928, pp. 349-357, 8 figs.

PRESSURE VESSELS

Fusion Welding. Fusion Welds on Heavy Plate, R. W. Miller. Iron Age, vol. 122, no. 10, Sept. 6, 1928, pp. 567-570, 6 figs.

Welded Joints. Maximum Allowable Unit Working Stresses for Fusion-Welded Joints. Acetylene Jl., vol. 30, no. 2, Aug. 1928, pp. 70-71.

PUMPING STATIONS

Equipment, Economics. The Merits of Seven Kinds of Pumping Equipment Compared, P. Hansen. Eng. News-Rec., vol. 101, no. 11, Sept. 13, 1928, pp. 386-388, 2 figs. In connection with new pumping station at Highland Park, Ill., seven types or combinations were considered, which are enumerated; study of local governing conditions indicates preference for electrically driven centrifugal pumps using purchased energy. See also editorial comment on p. 377.

England. The Prestwood Pumping Station of the South Staffordshire Waterworks Company. Engineering (Lond.), vol. 126, nos. 3263 and 3266, July 27 and Aug. 17, 1928, pp. 102-104 and 211-212, 13 figs., 4 on p. 202.

PUMPS, CENTRIFUGAL

Design. Some Unusual Pumping Services. W. A. T. Gilmour. Can. Engr. (Ontario), vol. 55, no. 7, Aug. 14, 1928, pp. 225-226, 5 figs. Design of centrifugal pumps for sewerage, drainage, dredging, abattoir, quarry, dairy, salt manufacture, and other special purposes.

Fluids Other Than Water. Characteristic Laws for a Centrifugal Pump With Fluids Other Than Water, H. Mawson. Instn. Mech. Engrs.—Proc. (Lond.), no. 4, 1927, pp. 1037-1045, 5 figs.

Petroleum Pipe Lines. Big Development in Centrifugal Pumps, A. H. Borchardt. Oil and Gas Jl., vol. 27, no. 15, Aug. 30, 1928, p. T-176, 2 figs. Research work has resulted in widespread use of this type of machinery in pumping of crude oil.

Piping. Centrifugal Pumps, E. W. Sargeant. Mech. World (Lond.), vol. 84, nos. 2167 and 2171, July 13 and Aug. 10, 1928, pp. 28-29 and 124-126, 9 figs.

PUMPS, SELECTION

To Fit Service Conditions. Selection of Pumps to Fit Service Conditions, F. G. Cunningham. Am. Water Works Assn.—Jl., vol. 20, no. 2, Aug. 1928, pp. 171-182. See also Water Works Eng., vol. 81, no. 17, Aug. 15, 1928, pp. 1183-1184 and 1187.

PUMPS, RECIPROCATING

Petroleum Pipe Lines. Air Chambers for Reciprocating Pumps, W. D. Pomeroy. Oil and Gas Jl., vol. 27, no. 15, Aug. 30, 1928, pp. T-112-113, T-116, T-118, T-119, T-122 and T-124, 27 figs.

PUMPS, ROTARY

Multi-Disk. The Hollko Multi-disk Rotary Pump (Die Hollko Waelzkolbenpumpe) Jentsch. V.D.I. Zeit. (Berlin), vol. 72, no. 33, Aug. 18, 1928, pp. 1158-1160, 13 figs. Construction details of new type of rotary pump (Mocigemba design) consisting of two shafts carrying six rotary disks each, manufactured by Hollunder and Co. of Essen for heads of 50 to 200 m. and up to 1,900 r.p.m.; tests by author at Duisburg School of Mechanical and Mining Engineering indicate efficiency of 35 per cent.

PYRITE DEPOSITS

Canada. A General Summary of Observations on the Sulphide Deposits of Northern Quebec, H. C. Cooke and W. F. James. Can. Min. Jl. (Gardenvale, Que.), vol. 49, nos. 34 and 35, Aug. 24 and 31, 1928, pp. 670-674 and 696-698, 7 figs.

PYROMETERS

Surface-Temperature. Pyrometers for Surface Temperature Measurements. Foundry Trade Jl. (Lond.), vol. 39, no. 624, Aug. 2, 1928, pp. 79-80, 4 figs. Description of new form of pyrometer, produced by Cambridge Instrument Co., which enables temperatures of hot metal surfaces to be measured with ease and rapidity hitherto impossible; overcoming contact difficulties; modifications for industrial utility; nonferrous applications.

R

RADIO BEACONS

Rotating. A Rotating Radio Beacon, R. L. Smith-Rose and S. R. Chapman. Engineering (Lond.), vol. 126, no. 3264, Aug. 3, 1928, pp. 130-131. Ordinary open aerial of wireless installation is replaced in beacon by vertical rotating frame aerial consisting essentially of vertical oblong flat coil; coil in beacon rotates at uniform rate round vertical axis and listener at each receiving station therefore gets zero, or minimum, signal twice in each revolution; accuracy of observations made in this way depends essentially on uniformity with which beacon revolves and is synchronized with stopwatch. Abstract of report by Committee on Directional Wireless.

RADIO RECTIFIERS

Metal. Metal Rectifiers. Wireless World (Lond.), vol. 23, no. 8, Aug. 22, 1928, pp. 223-226, 6 figs.

RAILROADS

Coal Storage. The Storage of Railway Coal, E. McAuliffe. Ry. Age, vol. 85, no. 8, Aug. 25, 1928, pp. 361-363, 1 fig. Union Pacific has successfully stored Rock Springs lump, without loss of fuel value after four years in pile; Union Pacific System rules governing storage of coal are set forth.

Grading, Costs. Cost Data on a Railroad Grading Job. Contractors and Engrs. Monthly, vol. 17, no. 1, July 1928, pp. 10-11, 2 figs.

Los Angeles Harbour. Belt-Line Railroad Agreement for Los Angeles Harbour. Eng. News-Rec., vol. 101, no. 8, Aug. 23, 1928, p. 282. After three years of preliminary work, agreement turning all port rail trackage over to harbour belt-line railway to be operated as separate corporation signed by Los Angeles Board of Harbour Commissioners and by four railroads that reach harbour; track mileage 122.7, valuation $57,927,732; after five years any party to agreement may withdraw upon two years' written notice.

Signals and Signaling. Speed Signal Aspects, C. W. Prescott. Int. Ry. Congress Assn.—Bul. (Lond.), vol. 10, no. 7, July 1928, pp. 594-597.

Signals and Signaling, Interlocking. Electric Interlocking System, R. J. Cullen. Am. Soc. Mech. Engrs.—Advance Paper for metg. Oct. 1 to 3, 1928, 5 pp., 9 figs. Installation by Boston and Albany Railroad at its new station in Springfield, Mass., centralizes control of all switches and signals; details of interlocking machine, switches, signal, track circuits, track and signal indicator, telephone service, and power supply.

Signals and Signaling, Power Supply. Power Supply for Railway Signals and Automatic Train Control, C. F. King Jr. Am. Inst. Elec. Engrs.—Jl., vol. 47, no. 9, Sept. 1928, pp. 658-661, 1 fig. Paper deals with several systems of automatic block signaling, particularly a.c. system, and apparatus commonly used to insure continuity of power supply; within past three years number of frequency-converting automatic substations has been installed by railway companies; class of apparatus used in these stations is discussed, including details of installations on Pennsylvania and Long Island Railroads.

Tracks, Curve Reduction. Ironing Out a Mountain Railway. Ry. Age, vol. 85, no. 9, Sept. 1, 1928, pp. 403-410, 13 figs. Denver and Rio Grande Western eliminates more than ten complete circles of curvature and reduces maximum curves from 12 degrees to 6; expenditures for improvements amount to $26,863,147; roadbed was widened; treated ties and heavier rails are used; data on heavy locomotives on D. & R.G.W.

Tracks, Widening. Novel Methods Used in Widening Narrow Gauge Line. Ry. Age, vol. 85, no. 10, Sept. 8, 1928, pp. 453-454, 4 figs. Southern Pacific departs from usual prrctices in modernizing Nevada-California-Oregon; new rails were laid on each side of old track; description of track work carried out.

RAILS

Bonds, Arc Welding. Arc-Weld Rail Bonds. Gen. Elec. Rev., vol. 31, no. 9, Sept. 1928, pp. 510-511, 8 figs.

Curve Resistance. Freight Train Curve Resistance. Elec. Traction, vol. 24, no. 8, Aug. 1928, p. 402, 2 figs. Tests made by University of Illinois to determine resistance of cars and rails at different speeds and curvature; results obtained from 101 tests made with five freight trains.

RAILWAY ELECTRIFICATION

Cleveland. Cleveland Terminal To Be Electrified. Ry. Age, vol. 85, no. 8, Aug. 25, 1928, p. 345.

RAILWAY MOTOR CARS

Gasoline-Electric. A Solution of the Branch Line Problem, L. C. Paul. Ry. and Locomotive Eng., vol. 41, no. 6, June 1928, pp. 155-158, 2 figs.

REFRIGERATION

Research Laboratories. The New Refrigeration of the German Institute of Engineering Physics (Das neue Kaeltelaboratorium der Physikalisch. Technischen Reichsanstalt), W. Meissner. V.D.I. Zeit. (Berlin), vol. 72, no. 31, Aug. 4, 1928, pp. 1069-1076, 9 figs. Financing of new laboratory of government institute; general plan of buildings and general equipment; details of special apparatus for liquefaction of nitrogen (20 liters per hour), oxygen (7 1/hr.), hydrogen (10 1/hr.) and helium (2.5 1/hr.); apparatus for separation of neon from helium and for purification of helium.

REFUSE INCINERATORS

Chicago. Chicago Builds $600,000 Garbage-Incinerating Plant. Eng. News-Rec., vol. 101, no. 8, Aug. 23, 1928, pp. 287-288, 2 figs. Six furnaces of Goose Island incinerator give capacity of 600 tons of refuse daily; cranes carry materials from pit to charging hoppers.

RESERVOIRS

Gate Valves, Setting. Placing Gate Valves Under Water in Reservoir, C. B. Burdick. Eng. News-Rec., vol. 101, no. 11, Sept. 13, 1928, pp. 389-391, 3 figs. Divers set frames for valves over openings in cross-walls and suction pipes at Louisville, Ky.

Reinforced Concrete, Covered. Covered Reservoir Combines Precast and Poured Concrete, G. D. Reichert. Eng. News-Rec., vol. 101, no. 11, Sept. 13, 1928, pp. 380-385, 11 figs. Appreciable saving made in constructing Stacy Park covered reservoir for St. Louis water works by combining precast concrete with concrete poured in place; reservoir, 806 ft. long and 603 ft. wide, has reinforced-concrete roof, supported by 1,724 precast concrete columns spaced 16½ ft. on centres and tied together in groups of fours by precast struts at about mid-height; column casting yard at central mixing plant; construction plant for wall footings; belt conveyor backfilling walls; roof forms carried by precast columns. See also editorial comment on p. 379.

Reinforced-Concrete, England. Reinforced-Concrete Service Reservoir at Stafford. Concrete and Constr. Eng. (Lond.), vol. 23, no. 8, Aug. 1928, pp. 559-563, 4 figs. Town has total consumption of 850,000 gal. per day; form and main dimensions of new reservoir are shown; inside dimensions are 107 by 90 ft., with 17 ft. of water at stated capacity; side walls are 15 in. thick, and division wall 17 in., main reinforcement being ¾-in. diam., bars at 4½-in. centres; roof slab of reservoir is 4½ in. thick, reinforced.

RESINS

Synthetic, Properties of. Elasticity and Mechanical Properties of Resinoids as a Function on Their Preparation, O. Manfred and J. Obrist. Plastics, vol. 4, no. 7, July 1928, pp. 371-372 and 374, 1 fig.

ROADS

Concrete. Portland Cement Concrete Roads for May 1928 Surpass All Previous High Marks. Good Roads, vol. 71, no. 7, July 1928, p. 420, 1 fig. Trend of concrete road construction; presents table of yardage awards of portland-cement concrete for May 1928.

Concrete, England. A Few Descriptive Notes on Concrete Roads in Survey, W. P. Robinson. Instn. Mun. and County Engrs.—Jl. (Lond.), vol. 55, no. 3, Aug. 7, 1928, pp. 229-235, 4 figs. Kingston by-pass road and Merton connections; by-pass road is 8½ mi. in length; width of road is 100 ft.; carriage-way 30 ft. in width; Reigate to Dorking main road, 4.88 mi. in length, minimum width of 60 ft.; concrete-surfaced carriage-way 30 ft. in width; Sutton by-pass road 4¾ mi. in length, 80 ft. in width, carriage-way 30 ft. in width.

Concrete, Ontario. Concrete Pavement at Cornwall, J. M. Breen. Can. Engr. (Toronto), vol. 55, no. 8, Aug. 21, 1928, p. 245, 3 figs. Cornwall, Ont., last year embarked on five-year programme of permanent road improvement; plan consists of paving about 1½ mi. of streets each year; township also laying concrete pavements; method of carrying out work. From Mun. Improvements.

Construction, Canada. Reconstruction of the Old Cariboo Road in Canada, P. Philip. Roads and Streets, vol. 68, no. 8, Aug. 1928, pp. 406-410, 7 figs. Unit prices on contract work; tunnel work on Section 2; difficult rock work; bridge work; Boothroyd-Lytton 24-mi. section; Lytton-Spences bridge; 100 mi. of Cariboo road, when completed in fall of 1928, will cost approximately $2,500,000.

Construction, Scotland. Road Maintenance and Construction, Past and Present, with Notes on Road Works in Galashiels, J. Watson. Instn. Mun. and County Engrs.—Jl. (Lond.), vol. 55, no. 1, July 10, 1928, pp. 80-88, 4 figs.

Design. Roads 1888-1928, A. W. Cross. Instn. Mun. and County Engrs.—Jl. (Lond.), vol. 55, no. 26, June 26, 1928, pp. 1559-1569 and (discussion) 1570-1573. Foundations; curbing, channeling and draining; surfacing; pros and cons of various surfacings mentioned; tarred macadam; asphalts; wood blocks; granite and other stone set pavements; concrete surfaces; blue-brick paving. Paper prepared for meeting of West Midland District of Instn. of Min. and County Engrs.

Gravel, Construction. Utah Now Using California Type Oiled Gravel Road. Eng. News-Rec., vol. 101, no. 8, Aug. 23, 1928, p. 291, 1 fig. On relocation of main highway east from Salt Lake City, by way of Parleys Canyon, California type of mulched oiled gravel is being tried; grader mixes asphaltic oil with gravel, throws material in ridges, then spreads it.

Reconstruction, Oregon. Reconstruction of Canyon Road, Oregon, W. A. Scott. Highway Engr. and Contractor, vol. 19, no. 3, Sept. 1928, pp. 24-27, 7 figs.

Surface Treatment. "Arcite," the New French Aqueous Pitch Emulsion for Road Finishing, W. Maclaren. Colliery Guardian (Lond.), vol. 137, no. 3530, Aug. 24, 1928, pp. 733-735, 5 figs.

Surface Treatment, Europe. Methods of Resurfacing With Emulsified Asphalt Penetration Macadam in European Countries, C. L. McKesson. Roads and Streets, vol. 68, no. 8, Aug. 1928, pp. 393-395, 9 figs. Notes on practice in England, France, and Germany; construction methods similar to American; penetration resurface over old macadam; German resurface job; penetration macadam on German race course, in military road, and over old stone-block pavement.

Surface Treatment, Testing. Results of Tests of Road Surface Treatment (Ergebnisse von Fahrbahnoberflaechenbehandlungen), Nack. Bautechnik (Berlin), vol. 6, no. 34, Aug. 10, 1928, pp. 485-489. Author tabulates observations on condition of 37 experimental sections in streets of Essen, treated with various patented commercial compounds; details of construction and state of weather during and about period of construction in fall of 1927; general condition in Apr. 1928.

ROCKETS

Laws of Flight. Mechanics of Interplanetary Rockets (Zur Mechanik der Weltraumraketen), H. A. Senftleben. Zeit. fuer Flugtechnik u. Motorluftschiffahrt (Munich), vol. 19, no. 14, July 1928, pp. 319-323, 4 figs.

Rocket Engines. The Problem of Rocket Vehicles (Zur Frage der Raketenfahrzeuge), R. Conrad. Motorwagen (Berlin), vol. 31, no. 19, July 10, 1928, pp. 440-441.

S

SAND AND GRAVEL PLANTS

Complete Unit. A Complete Sand and Gravel Unit. Pit and Quarry, vol. 16, no. 11, Aug. 29, 1928, pp. 43-48, 10 figs. Description of plant of Kenosha Sand and Gravel Co., Kenosha, Wis.

SAND, BITUMINOUS

Canada. Alberta Tar Sands to Be Used. Oil and Gas Jl., vol. 27, no. 16, Sept. 6, 1928, p. 140. Brief news item from Chatham, Ont., states that extensive use of Fort McMurray tar sands of northern Alberta, for paving purposes throughout West, will be undertaken in 1929; large plant will probably be constructed at Edmonton or Calgary for necessary refining operation; government appropriation to enable S. C. Ells to work out new processes.

SEWAGE CHLORINATION

DEMONSTRATION. A Demonstration of Color-Reaction in the Test for Free Chlorine as Applied to Sewage, C. M. Nicholas. New Jersey Sewage Works Assn.—Proc., Mar. 23, 1928, pp. 12-13 and (discussion) 13-14. Paper covers general range of application of chlorine to settled sewage of 5, 10, 15 and 20 p.p.m.; free chlorine test on sewage leaving chlorine contact tank (generally point of discharge in steam) instead of immediately after chlorine is added; delayed color reaction; proper length of contact period; starch iodine vs. orthotolidin.

SEWAGE DISPOSAL

FILTERS. Filtering Materials for Sewage Works, N. T. Veach, Jr. Mun. News, vol. 75, no. 2, Aug. 1928, pp. 91-92, 1 fig. Paper presented at Texas Water Works Short School.

SEPARATE SLUDGE DIGESTION. Separate Sludge Digestion in Primary and Secondary Tanks, F. P. Sissons. Eng. News-Rec., vol. 101, no. 11, Sept. 13, 1928, p. 402. Abstract of previously indexed paper by F. P. Sissons, read before Association of Managers of Sewage Works and printed in Surveyor (Lond.), July 13, 1928; separate sludge digestion reduced; weight of sludge sent to drying beds by 46 per cent.

TUCSON, ARIZ. "Sewer Farm" at Tucson, Arizona, To Be Irrigated With Settled Sewage, F. M. Veatch. West. Constr. News, vol. 3, no. 16, Aug. 25, 1928, pp. 525-528, 2 figs. Sewer farm consists of 750 acres; comparative costs of sewage-disposal plants at Tucson, Ariz.; sewage-flow and land required for broad irrigation at Tucson; treatment plant.

SEWAGE DISPOSAL PLANTS

FILTERING MATERIALS. Progress Report of the Committee of the Sanitary Engineering Division of Filtering Materials for Water and Sewage Works. Am. Soc. Civil Engrs.—Proc., vol. 54, no. 4, Apr. 1928, pp. 243-280, 3 figs. See also discussion in no. 7, Sept. 1928, pp. 2213-2218.

SEWAGE PUMPING STATION

AUTOMATIC. Automatic Control of Pumping Equipment, as Installed at Springfield, Mass., J. F. Kovalsky. Hydraulic Eng., vol. 4, no. 8, Aug. 1928, pp. 512 and 530, 3 figs.

SEWAGE TREATMENT

FAILURES. Why Sewage Treatment Plants Fail to Function Properly, C. A. Smith. West. Constr. News, vol. 3, no. 15, Aug. 10, 1928, pp. 503-506, 4 figs.

SEWAGE TREATMENT PLANTS

DEWATERING. Dewatering the Site of North Toronto Sewage Treatment Plant Without Sheet Piling. Contract Rec. (Toronto). vol. 42, no. 33, Aug. 15, 1928, pp. 837-838, 4 figs. Moretrench Wellpoint system used at North Toronto sewage-treatment plant with marked success; automatic method that kept excavation dry; area to be dewatered is 45,050 sq. ft., and is largest in Canada to be dewatered by this system; description of operation of system.

FLINT, MICH. Sewage-Works Designed to Meet Needs of Automobile Town, W. R. Drury. Eng. News-Rec., vol. 101, no. 10, Sept. 6, 1928, pp. 357-358, 1 fig. In Flint, Mich., strong domestic sewage plus trade wastes will have complete treatment in which unique Imhoff tank plays part; general layout of sewage works; four radial-flow Imhoff tanks; each tank consists of 18 hexagonal cells with outside ring of cells acting as structural frame; sludge beds, 24 x 125 ft. in plan, 40 in number are built with tile underdrains covered with gravel and sand, with division walls of cypress planks held by means of precast slotted concrete posts.

HOLLAND, MICH. The Holland, Mich., Sewage Treatment Plant, P. Hansen and K. V. Hill. Contractors and Engrs. Monthly, vol. 17, no. 1, July 1928, pp. 1-5, 13 figs.

SHAFT SINKING

EUREKA, UTAH. The North Lily Shaft at Eureka, Utah, J. S. Finlay. Min. Congress Jl., vol. 14, no. 9, Sept. 1928, pp. 698 and 708, 1 fig.

SILK, ARTIFICIAL

PLANTS, ELECTRIC EQUIPMENT. Electrical Practice in a Large New Quebec Artificial Silk Plant, C. E. Olive. Elec. News (Toronto), vol. 37, no. 17, Sept. 1, 1928, pp. 43-45, 4 figs.

SILOS

DESIGN. Load Stresses on Oblique Walls and Bottoms of Bunkers (Die Belastung schraeger Bunkerwaende und Boeden), W. Kunze. Bauingenieur (Berlin), vol. 9, no. 35, Aug. 31, 1928, pp. 632-635, 10 figs. Author points out inconsistencies in usual methods of analysis of stresses in oblique walls and bottoms of large bunkers and compartment silos.

SLABS, REINFORCED CONCRETE

DESIGN. Design Tables for Reinforced-Concrete Slabs Carrying Concentrated Loads (Eisenbetonplatten mit Einzellasten, Hilfswere zu ihrer Berechnung), R. Roll. Bauingenieur (Berlin), vol. 9, no. 34, Aug. 24, 1928. pp. 615-618, 3 figs.

SLIDE RULES

VECTORS. Slide Rule Calculation of Vectors, E. G. Allen. Elec. World, vol. 92, no. 8, Aug. 25, 1928, p. 362. Reference is made to new form of slide rule which, among other uses, facilitates conversion of one form to other; ordinary polyphase duplex slide rule can be similarly used for this purpose in manner described.

SLUDGE TANKS

CAPACITY. Capacity of Sludge Digestion Tanks, K. Imhoff. Can. Engr. (Toronto), vol. 55, no. 8, Aug. 21, 1928, pp. 239-240, 1 fig. Description of types of digestion in different tanks and temperature of sewage in some large disposal plants. Article previously indexed from Am. City, May 1928, from paper presented at Tenth Annual Texas Short School.

SMOKE ABATEMENT

DAMAGE. Damage Due to Smoke, H. B. Meller. Am. Soc. Mech. Engrs.—Advance Paper for mtg. Sept. 17-20, 1928, 6 pp. Paper is based mainly upon publications of smoke investigation conducted by Mellon Inst. of Industrial Research of Pittsburgh, introducing such additional observations and data as have seemed necessary or desirable for correlation, or to indicate results of studies made since 1913; composition of soot; meteorological aspects; products of combustion injurious to stone; effects on metals; effects on outside painting and interior of buildings; effects on vegetation and influence on health.

SNOW REMOVAL

ROADS, NEW YORK. Snow Handling in Onondaga County, R. B. Traver. Pub. Works, vol. 59, no. 8, Aug. 1928, pp. 295-296, 1 fig.

STREET, ALBANY. Fighting Snow in Albany, L. W. Herzog. Pub. Works, vol. 59, no. 8, Aug. 1928, pp. 296-299, 3 figs.

STREETS, TORONTO. Snow Removal in Toronto, G. W. Dies. Pub. Works, vol. 59, no. 8, Aug. 1928, pp. 294-295. Abstract of 192 report of street commissioner of Toronto, Ont.

SOLDERS

PROPERTIES. The Strength of a Cadmium-Zinc and of a Tin-Lead Alloy Solder, C. H. M. Jenkins. Inst. Metals—Advance Paper (Lond.), no. 479, for mtg. Sept. 4-7, 1928, 19 pp., 11 figs.

SPRINGS

TESTING. Tests on Belleville Springs by the Ordnance Department U.S. Army, D. A. Gurney. Am. Soc. Mech. Engrs.—Advance Paper for mtg. Oct. 1-3, 1928, 5 pp., 11 figs. Belleville springs are dish-shaped and used where relatively large load capacity, small deflection, and limited closed height are necessitated by other controlling features of design; recent demands for larger Belleville springs disclose absence of reliable data; investigation at Rock Island Arsenal was undertaken to supply this lack of information; material used was chrome-vanadium sheet steel SAE 6145, containing carbon, 0.43; manganese, 0.62; chromium, 1.10, and vanadium, 0.18.

STEAM

HIGH PRESSURE. Higher Steam Pressures, N. E. Funk. Fuels and Steam Power (A.S.M.E. Trans.), vol. 50, no. 15, May-Aug. 1928, pp. 28-31, 8 figs.

HIGH-PRESSURE, UTILIZATION OF. High-Pressure Steam; Opportunity for Its Use in Industry (La vapeur à haute pression), V. Kammerer. Société Industrielle de Mulhouse—Bul. (Mulhouse), vol. 94, no. 6, June-Aug. 1928, pp. 385-432, 15 figs.

High-Pressure Steam Usage, C. S. Darling. Mech. World (Lond.), vol. 84, no. 2168, July 20, 1928, pp. 52-53, 2 figs.

STEAM CONDENSERS

TUBES, CORROSION OF. The Corrosion of Condenser Tubes. "Impingement Attack"; Its Causes, and Some Methods of Prevention, R. May. Inst. of Metals—Advance Paper (Lond.), no. 471, for mtg. Sept. 4-7, 1928, 35 pp., 8 figs.

STEAM ENGINES

VIBRATION PREVENTION IN. Stopping Building Vibrations Due to Unbalanced Engines, C. H. Bigelow. Power, vol. 68, no. 11, Sept. 11, 1928, pp. 450-451, 2 figs.

STEAM PIPE

BENDS, STRESSES. Stresses and Reactions in Expansion Pipe Bends, A. M. Wahl. Fuels and Steam Power (A.S.M.E. Trans.), vol. 50, no. 15, May-Aug. 1928, pp. 241-255 and (discussion) 255-262, 43 figs.

STEAM TURBINES

BLADES. Detailed Numerical Calculation of Multiple-Action Blading (Calcul numerique détaillé d'un ailettage multiple à action), C. Colombi. Technique Moderne (Paris), vol. 20, no. 15, Aug. 1, 1928, pp. 519-525, 7 figs.

DESIGN. The General Trend of Modern Development in Steam-Turbine Practice, H. L. Guy. Power, vol. 68, no. 6, Aug. 7, 1928, pp. 250-251, 2 figs. Author presents results of important studies and sets forth British point of view. Paper presented before Instn. Civil Engrs., previously indexed.

TESTING. Steam-Combustion Tests of Three-Cylinder 16,000-Kw. Brown Boveri Steam Turbine in Rotterdam (Dampfverbrauchs-Messungen an einer dreigehaeusigen 16,000 kw. Brown Boveri Dampf-Turbine in Rotterdam), D. Dresden. Schweizerische Bauzeitung (Zurich), vol. 92, no. 5, Aug. 4, 1928, pp. 57-59, 2 figs. Descriptive and test data on 16,000-kw., 3,000-r.p.m., 12-atmos. pressure, Brown Boveri, two-stage turbine of Schiaven power plant of Rotterdam municipal electric system; steam consumption 4.50 to 4.88 kg. per kw-hr.

STEEL

COLD DRAWING. Study of Cold Drawing of Soft Steel (Contribution à l'étude de l'étirage à froid de l'acier doux), R. Giraud. Revue de Métallurgie (Paris), vol. 25, no. 6, June 1928, pp. 347-354, 4 figs. Measure of work absorbed by metal under form of potential energy; method of testing and table of tests with results of cold drawing.

HEAT TREATMENT OF. Facts and Principles Concerning Steel and Heat Treatment, H. B. Knowlton. Am. Soc. Steel Treating—Trans., vol. 14, no. 3, Sept. 1928, pp. 415-434.

Heating of Steel By the Controlled Temperature Method, G. W. Hegel. Am. Soc. Steel Treating—Trans., vol. 14, no. 3, Sept. 1928, pp. 377-384, 7 figs. Author demonstrates effect of rate of heating through critical range on temperature distribution in piece of steel; he shows how best results can be obtained by controlling maximum temperature.

MANGANESE. *See Manganese Steel.*

SPRING, TESTING. Researches on Springs—Torsional Fatigue Tests on Spring Steels, G. A. Hankins. Dept. of Sci. and Indus. Research—Eng. Research (Lond.), Special Report No. 9, 1928, 24 pp., 8 figs. partly on supp. plates. Investigation by National Physical Laboratory as part of systematic study undertaken by Springs Research Committee.

STRUCTURAL ARC WELDING. Arc Welding of Structural Steel (Lichtbogenschweissung von Eisenkonstruktionen), K. Bung. V.D.I. Zeit. (Berlin), vol. 72, no. 32, Aug. 11, 1928, pp. 1105-1111, 54 figs. Report from committee on Welding, of Verein Deutscher Ingenieure, on details of welded seams and joints and methods of making them; tensile tests of welded seams and joints; tests of comparative strength of welded and riveted joints; arc welding of pipes, tubes and structural shapes; practical examples of welded steel trusses, tanks, etc.; cost data.

TOOL. *See Tool Steel.*

STEEL CASTINGS

ALLOY-STEEL. Steel Castings Withstand Severe Operating Conditions, J. H. Hall. Foundry, vol. 56, nos. 16 and 17, Aug. 15 and Sept. 1, 1928, pp. 655-656 and 702-704. Abstract of paper presented in behalf of Am. Foundrymen's Assn. before Inst. of Brit. Foundrymen.

STREAM POLLUTION

PREVENTION. Engineering Methods Economically Combat Stream Pollution, W. L. Sullivan. Chem. and Met. Eng., vol. 35, no. 8, Aug. 1928, pp. 483-485, 3 figs. Account of work of Passaic Valley Sewerage Commission appointed with authority to take whatever action was necessary to bring about regeneration of lower Passaic river; Commission's interpretation of what constitutes polluting matter is given.

STREET CLEANING

ORGANIZATION. Street Cleaning and Waste Disposal, E. C. Goodwin. Can. Engr. (Toronto), vol. 55, no. 6, Aug. 7, 1928, pp. 200-202.

STREET LIGHTING

DESCRIPTION. Kansas City Brightway Has 963 Lumens per Foot, R. A. Graves. Elec. World, vol. 92, no. 10, Sept. 8, 1928, pp. 470-471, 4 figs. Equipment gives six times former intensity; first section involves eighty 1,500-cp. lamps within five-block area with rated outputs of 15,000 lumens per lamp; this is only beginning of extensive whiteway which will in time, it is hoped, extend across entire city.

Modern Street Lighting, C. E. Schwenger. Elec. News (Toronto), vol. 37, no. 16, Aug. 15, 1928, pp. 31-33. Comparison of systems and intensities in use with recommendations for good modern practice; flexibility of multiple system increases its popularity; Illuminating Engineering Society recommendations as presented by Committee on Street Lighting 1927, to which other engineering bodies have agreed.

STREET RAILROADS

TRACKS, DESIGN. Divergence of Special Trackwork Design Hinders Standardization, W. J. Nixon. Elec. Ry. Jl., vol. 72, no. 8, Aug. 25, 1928, pp. 292-294, 5 figs.

STRUCTURAL STEEL

CONCRETE ENCASEMENT. Gunite and Concrete Encasement to Increase the Strength of Structural Steel, C. T. Morris and J. R. Shank. Ohio State University Studies—Eng. Experiment Station, no. 37, 1928, 72 pp., 63 figs. Experiments made in England and Canada have indicated that within reasonable limits, concrete encasement will act as unit with member in supporting loads; tests at Engineering Experiment Station of Ohio State University have borne out these conclusions; at North High Street viaduct in Columbus, Ohio, restoration of reduced steel girders by reinforcing steel and gunite has received practical test and has been found satisfactory, results of which are given in full.

SWIMMING POOLS

WATER CHLORINATION. Chlorination of Swimming Pool Water, R. F. Heath. Can. Engr. (Toronto), vol. 55, no. 9, Aug. 28, 1928, pp. 257-262. Brief bibliography.

T

TANKS

DESIGN. Design of Cylindrical Vessels Having Walls of Variable Thickness (Beitrag zur Berechnung des zylindrischen Behaelters mit veraenderlicher Wandstaerke), E. Steuermann. Beton u. Eisen (Berlin), vol. 27, no. 15, Aug. 5, 1928, pp. 286-288, 1 fig.

TEMPERATURE MEASUREMENT

THERMOELECTRIC. Thermoelectric Measurement of Temperatures Above 1,500 Deg. Cent., H. L. Watson and H. Abrams. Am. Electrochem Soc.—Advance Paper for mtg. Sept. 20-22, 1928, pp. 29-41, 6 figs.

TORQUE RECORDERS

VIBRATIONS. Records Transient Vibrations, C. Schwager. Elec. World, vol. 92, no. 8, Aug. 25, 1928, pp. 361-362, 4 figs. Torque recorder described was designed for measuring rapidly varying torques and can be mounted on any shaft; it is application of electrical telemeter described in Technologic paper no. 247, Bur. of Standards.

TIDAL POWER

UTILIZATION. Tidal Power and Turbines Suitable for Its Utilization, A. H. Gibson. Water and Water Eng. (Lond.), vol. 30, no. 356, Aug. 20, 1928, pp. 374-375. Abstract of paper read before Instn. Mech. Engrs., previously indexed.

TOLERANCES

SELECTION. Selecting the Tolerances, J. F. Hardecker. Am. Mach., vol. 69, no. 9, Aug. 30, 1928, p. 341. Entire successful functioning of elaborate mechanism may rest upon successful choice of tolerances; in most instances, tolerances have to go through a period of development design similar to that which idea itself had to go through before it became proven idea.

TOOL STEEL

PROPERTIES. On the Nature and Applications of the Principal Types of Tool Steel, W. H. Wills. Am. Soc. Steel Treating—Trans., vol. 14, no. 3, Sept. 1928, pp. 363-376, 2 figs.

TRACTORS

AGRICULTURAL DRAWBAR PULL. Effect of Drawbar Pull Upon the Effective Weight on Front and Rear Wheels of Farm Tractors, E. G. McKibben. Agric. Eng., vol. 9, no. 8, Aug. 1928, pp. 243-245, 7 figs. Development of simplified formulas to show effect of drawbar pull.

TUBES

MANUFACTURE. Manufacture of Tubes (La fabrication des tubes), G. de Lattre. Technique Moderne (Paris), vol. 20, no. 16, Aug. 15, 1928, pp. 537-545, 17 figs. Evolution and critical study of processes of manufacture of rough materials; ingots and billets; Mannesmann process of rolling tubes and Mannesmann mill layout are described.

TURBO-GENERATORS

COOLING. Ventilating Methods and Equipment for Modern Turbo-Generators, C. L. Hubbard. Nat. Engr., vol. 32, no. 5, May 1928, pp. 203-208, 9 figs. Factors affecting amount of heat generated; limiting temperatures; removal of heat from generators; computing air requirements; cooling and purifying air; removing foreign matter; self-cleaning filter; relation between air temperature and load; humidity; direct or open system of ventilation; indirect or closed system; surface air cooler; fire control; use of inert gases.

TESTING, GERMANY. Acceptance Tests of an 80,000 Kw. Turbo-Generator for the Klingenberg Power Plant (Abnahmeversuche an einer 80,000 Kw-Turbodynamo des Grosskraftwerkes Klingenberg), W. E. Wellmann. V.D.I. Zeit. (Berlin), vol. 72, no. 31, Aug. 4, 1928, pp. 1077-1081, 5 figs. Details of apparatus and methods employed in testing efficiency of largest turbo-generator of continent of Europe, manufactured by A.E.G.; tests by staff of 30, most of them of faculty of Berlin Institute of Technology, showed guarantees exceeded by 2.45 per cent.

V

VENTURI METERS

COEFFICIENTS. Coefficients of Venturi Meters and Reynolds' Criterion, W. S. Pardoe. Eng. News-Rec., vol. 101, no. 8, Aug. 23, 1928, pp. 281-282, 2 figs. In writer's belief coefficients of Venturi meters cannot be plotted against Reynolds' criterion and give any satisfactory result above critical velocity; tested 3.981 by 1.631-in. Venturi meter up to throat velocity of 110 ft. per sec.; both theory and experiment indicate that Reynolds' criterion can be used advantageously below critical velocity or for streamline flow.

VOLTAGE REGULATORS

DEVELOPMENT. The Development of the Feeder Voltage Regulator, E. R. Wolfert. Elec. Jl., vol. 25, no. 9, Sept. 1928, pp. 441-446, 11 figs. Feeder-voltage regulator was developed for purpose of increasing or decreasing outgoing feeder voltage so as to compensate for variable line drop or variable bus voltage, maintaining constant voltage at centre of distribution or load centre; they are divided into two general classes: one in which voltage is varied in steps, and other in which voltage can be changed gradually, or in infinite number of steps, termed induction type; details of both types.

INDUCTION. Induction Voltage Regulators for Power Transmission. World Power (Lond.), vol. 10, no. 56, Aug. 1928, pp. 169-172, 6 figs. English Electric Co. has developed series of induction regulators which are usually oil-immersed and either self-cooled or water-cooled.

W

WATER CHLORINATION

DEVELOPMENTS. Recent Developments in Application of Chlorine in Water Purification, L. H. Enslow. Mun. News, vol. 75, no. 2, Aug. 1928, pp. 71-79, 6 figs.

Removing Tastes of Chlorine. Can. Engr. (Toronto), vol. 55, no. 8, Aug. 21, 1928, p. 242. Remedial measures adopted by New York State Department of Health; three methods are available: (1) "super-chlorination"; (2) destruction of phenolic wastes by use of potassium permanganate; (3) addition of ammonia in small quantities to water just previous to addition of chlorine dose. From Am. City.

WATER FILTRATION PLANTS

MENASHA, WIS. A Modern 4,000,000-Gallon Purification Plant, J. H. Kuester. Am. City, vol. 39, no. 3, Sept. 1928, pp. 87-89, 3 figs. Public water supply of Menasha became contaminated with heavy vegetable growths, making it undesirable for use between June and November; pumping plant was entirely renovated in 1924 and so arranged that water-purification plant could be conveniently connected with very few changes and comparatively small expense; in 1927, funds secured to build new 4,000,000-gal. plant; pumps and aerators; settling basins; pipe gallery; chemical feed and chlorination; filters.

OVERLOADING. Filter Operation at Variable Rates, H. N. Jenks. Am. Water Works Assn.—Jl., vol. 20, no. 2, Aug. 1928, pp. 214-219.

WATER PIPE LINES

CLEANING. Cleaning of Water Mains, W. H. Grotz. Am. Water Works Assn.—Jl., vol. 20, no. 2, Aug. 1928, pp. 199-204 and (discussion) 204-207. Buffalo's water distribution system; thick mud from mains; method of operating machine; amount and cost of water-main cleaning in Buffalo; benefits to community.

LAYING, COSTS. Man-Hour Costs of Water-Main Trenching and Pipelaying, A. E. Walden and A. F. Di Domenico. Eng. News-Rec., vol. 101, no. 11, Sept. 13, 1928, pp. 392-395. Summaries of seven years' work in Baltimore County, Md., given in pounds per man-hour as well as in linear feet; comparative costs of hauling to job, jointing (including leadite and lead) and laying sand-cast and sand-spun pipe; also editorial comment on p. 377.

RUST REMOVAL. Method Used to Remove Rust From Office Building Mains, F. N. Speller, E. L. Chappel and R. P. Russell. Water Works Eng., vol. 81, no. 18, Aug. 29, 1928, pp. 1247-1248. Not necessary to disturb piping by this plan; in one building more than $100,000 was saved; tuberculation removed by acid solution; method described for removing rust tuberculation used in 35-storey office building located in down-town section of New York; general plan of cleaning operation; treatments and difficulties encountered. Abstract of paper presented before Am. Inst. Chem. Engrs.

WATER SOFTENING

ZEOLITE PROCESS. Experiences in Softening With Zeolite, J. T. Campbell and D. E. Davis. Water Works Eng., vol. 81, no. 17, Aug. 15, 1928, pp. 1165-1166 and 1199, 3 figs. How system has served in two plants; good results accomplished; cost of construction and operation. See also Mun. News and Water Works, vol. 75, no. 2, Aug. 1928, pp. 111-116, 2 figs. Paper read before Am. Water Works Assn.

WATER TREATMENT

ALGAE CONTROL. Algae Control in Uncovered Distribution Reservoir By Chlorinating, L. B. Mangun. Mun. News, vol. 75, no. 2, Aug. 1928, pp. 103-104. Abstract of paper presented before Am. Water Works Assn.

WATERWAYS

ENGINEERING PROGRESS. Advances in Waterways Engineering During a Half Century, W. M. Black. Am. Soc. Civil Engrs.—Proc., part 1, vol. 54, no. 7, Sept. 1928, pp. 2101-2102. Discussion of paper, continued from Feb. 1928 issue of Proceedings.

WATER WORKS

DESIGN. Water-Supply Struggles of a Small City, P. P. Phillips. Eng. News-Rec., vol. 101, no. 10, Sept. 6, 1928, pp. 361-363, 4 figs. Mount Airy, N.C., water supply; divert water averted from natural flow of Lovill's Creek through gravity supply main to water treatment and pumping plant designed to supply 1.5 m.g.d. which would give 200 gal. per capita daily to present estimated population of 7,500; clear-water storage; wash-water tank; details of water filtration and pumping plants.

STUART, FLA. Stuart, Florida, Iron Removal and Pumping Station, P. P. De Moya. Am. Water Works Assn.—Jl., vol. 20, no. 2, Aug. 1928, pp. 244-252, 3 figs.

WEIRS, CIRCULAR

FLOW COEFFICIENTS. Summary of Experimental Data Obtained From Use of Circular Weirs, M. P. O'Brien. Hydraulic Eng., vol. 4, no. 8, Aug. 1928, pp. 494-495 and 531, 5 figs.

WELDED JOINTS

EFFECT OF SHAPE ON STRENGTH. Influence of the Shape of Ends of Parts of Certain Welded Joints on the Value of Breaking Load and Deformation (Influence de la forme des abouts des éléments de certains assemblages soudes sur la valeur de la charge de rupture et sur la déformation), D. Lagrange and D. Rosenthal. Académié des Sciences—Comptes Rendus (Paris), vol. 187, no. 5, July 30, 1928, pp. 277-279, 1 fig. Discussion of effect of butt-joint ends on strength of joint. See also Génie Civil, vol. 93, no. 7, Aug. 18, 1928, p. 171, 2 figs.

WELDING

ELECTRIC. *See Electric Welding.*

OXYACETYLENE. *See Foundry Practice.*

WOOD PRESERVATION

STATISTICS, UNITED STATES. Wood Preservation in 1927 Shows High Records. Eng. News-Rec., vol. 101, no. 9, Aug. 30, 1928, p. 314. In 1927, according to annual statistics prepared for U. S. Forest Service in coöperation with American Preservers' Assn., there were 187 treating plants in operation, as against 180 in 1926 and 127 in 1925; 10 new plants were constructed as against 14 in 1926; quantity of wood treated was 345,685,804 cu. ft., or 56,363,725 cu. ft. more than in 1926.

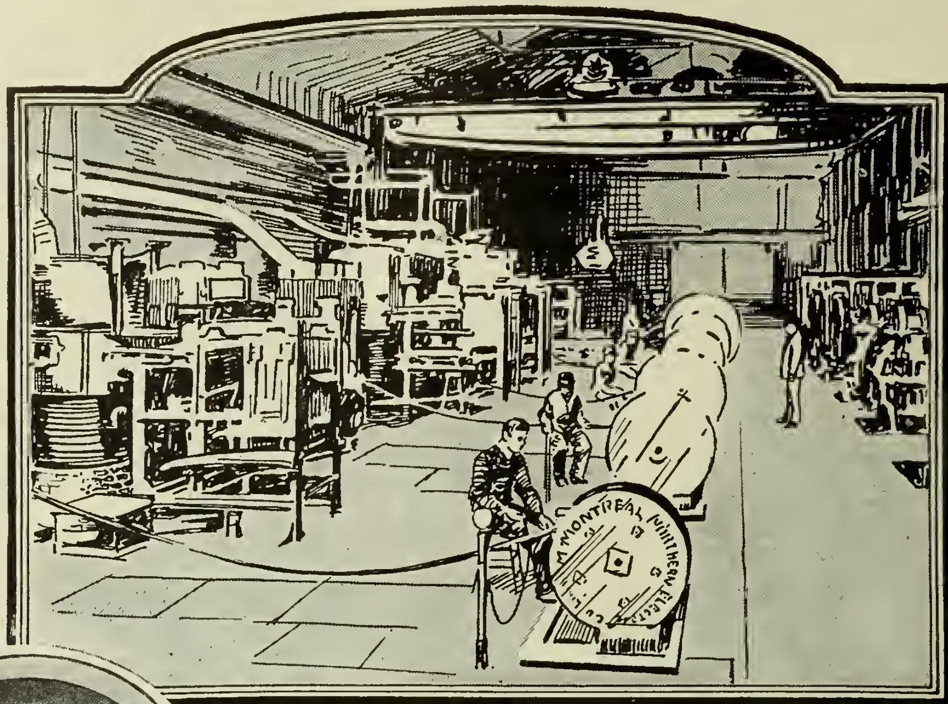
Z

ZINC MINES AND MINING

QUEBEC. Mining and Milling at the Tetreault Mine. Am. Zinc Inst.—Bul., vol. 11, nos. 7-8, July, Aug. 1928, pp. 30-39. Operations and production of mine operated by British Metal Corp. which in 1927 produced 13 per cent of zinc output of Canada in addition to valuable production of lead, silver, and gold.

ZINC ORE TREATMENT

FLOTATION. Flotation Practice at the Sullivan Mill, C. T. Oughtred. Am. Zinc Inst.—Bul., vol. 11, nos. 7-8, July, Aug. 1928, pp. 22-29. Purport of this paper is to review briefly flotation practice at Sullivan concentrator, laying particular stress upon such phases as appear to be departure from what is generally conceded to be standard practice.



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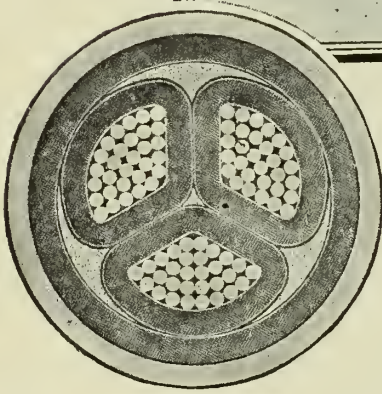

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A

AERONAUTICS

ALBERTA, CANADA. Alberta Awakens to Possibilities of Civil and Commercial Aviation. Can. Aviation (Toronto), vol. 1, no. 3, Sept. 1928, pp. 14 and 46.

DEVELOPMENT, CANADA. Aeronautical Development in Canada, A. O. Adams. Can. Aviation (Toronto), vol 1, no. 3, Sept. 1928, pp. 28 and 30. Perils of early days of flying; technical developments after war; eight aircraft types already designed and built in Canada include four boat seaplanes and four convertible to twin-float seaplanes, landplanes or ski-equipped aircraft; two British and American types in production in Canada are Fairchild F.C.-2 and Avro; details of Vanessa, patrol aircraft Vista and photographic sesquiplane Velos; metal plays important part. (To be continued.)

AIR COMPRESSORS

ROTARY AND TURBO. Rotary and Turbo Compressors. Engineer (Lond.), vol. 146, nos. 3789 and 3790, Aug. 24 and 31, 1928, pp. 206-208 and 233-234, 15 figs.

AIR CONDITIONING

OVERCOMING OBSTACLES. How to Overcome Obstacles to Good Ventilation, C. L. Hubbard. Plumbers Trade Jl., vol. 85, no. 6, Sept. 15, 1928, pp. 546 and 548-549, 552 and 608, 12 figs.

DEHUMIDIFICATION. Dehumidification of Air, C. S. Keevil and W. K. Lewis. Indus. and Eng. Chem., vol. 20, no. 10, Oct. 1928, pp. 1058-1060, 3 figs.

DUST DETERMINATION. A Study of Dust Determinators, F. B. Rowley and J. Beal. Am. Soc. Heat. and Vent. Engrs.—Jl., vol. 34, no. 10, Oct. 1928, pp. 741-750 and (discussion) 750-754, 7 figs. Results of co-operative research between Am. Soc. Heat. and Vent. Engrs. and Univ. of Minn.

REFRIGERATION IN. Refrigeration as Applied to Industrial Air Conditioning, R. W. Waterfill. Heat. and Vent. Mag., vol. 25, no. 9, Sept. 1928, pp. 75-78, 5 figs.

AIRCRAFT ENGINES

AIR COOLING OF. Air Cooling of Aircraft Engines (Luftkuehlung bei Flugmotoren), F. Gosslau. V.D.I. Zeit. (Berlin), vol. 72, no. 38, Sept. 22, 1928, pp. 1335-1340, 26 figs. Paper read at 1928 annual meeting of Society of German Engineers (V.D.I.), reporting experiments made at Siemens and Halske laboratories; obtained quantitative relationship between wind velocity, cylinder-wall temperature and construction-type and dimensions of cylinders, aiding in design of air-cooling system for engines; critical review of various types of cylinder construction.

OIL. The Oil Engine and Aeronautics, E. E. Wilson. Aeronautics (A.S.M.E. Trans.), vol. 50, no. 20, May-Aug. 1928, pp. 65-67 and (discussion) 67-68.
Oil Engines for Aircraft and Railways, A. E. L. Chorlton. Engineering (Lond.), vol. 126, no. 3271, Sept. 21, 1928, pp. 375-378 and (discussion) 369, 10 figs. Paper read before Brit. Assn.

AIRCRAFT PROPELLERS

EFFICIENCY. Considerations on Propeller Efficiency, A. Betz. Nat. Advisory Committee for Aeronautics—Tech. Memorandum, no. 481, Sept. 1928, 20 pp., 12 figs. Translated from Zeit. fuer Flugtechnik u. Motorluftschiffahrt, Apr. 28, 1928.

LIFT CURVES. Preliminary Report on the Flat-Top Lift Curve as a Factor in Control at Low Speed, M. Knight and M. J. Bamber. Nat. Advisory Committee for Aeronautics—Tech. Notes, no. 297, Sept. 1928, 10 pp., 5 figs.

AIRPLANES

BIPLANES, LIFT CALCULATION. On the Lift of Biplanes, T. Moriya. Tokyo Imperial University—Jl. (Tokyo), vol. 17, no. 10, Aug. 1928, pp. 191-200, 12 figs.

MANEUVERABILITY. The Span as a Fundamental Factor in Airplane Design, G. Lachmann. Nat. Advisory Committee for Aeronautics—Tech. Memorandum, no. 479, Sept. 1928, 40 pp., 21 figs. Bibliography. Translated from Zeit. fuer Flugtechnik u. Motorluftschiffahrt, May 14, 1928.

METAL, MANUFACTURE OF. Problems of Metal Construction. Soc. Automotive Engrs.—Jl., vol. 23, no. 4, Oct. 1928, pp. 342-344. Review of Production Session of Los Angeles meeting, with brief abstracts of paper.

AIRPORTS

CANADA. List of Canadian Fields Is Issued. Aviation, vol. 25, no. 14, Sept. 29, 1928, p. 1032. List of 39 landing stations in Canada for airplanes, seaplanes and airships is given, with location, description and owners, in report issued by Assistant Trade Commissioner Thiemann at Ottawa.

ALLOYS

ELECTRIC RESISTANCE. The Electrical Resistance of Alloys Under Pressure, C. W. Ufford. Phys. Rev., vol. 32, no. 3, Sept. 1928, pp. 505-507.

HEAT-RESISTING. Heat-Resisting Alloys, T. H. Turner. Am. Metal Market, vol. 35, no. 179, Sept. 18, 1928, pp. 12-14, 4 figs.

See also Aluminum Alloys; Aluminum Brass; Bearing Metals; Copper Alloys.

ALUMINUM ALLOYS

CASTINGS, TESTING OF. Stability of Aluminum and Magnesium Casting Alloys, A. J. Lyon. Am. Inst. Min. and Met. Engrs.—Tech. Publication, no. 133, Sept. 1928, 15 pp., 5 figs.

ELASTIC LIMIT. The Elastic Limit and Figure of Merit of Light Alloys (Guetezahlen und Elastizitaetsgrenzen bei Leichtmetallen), A. Schroeder. Zeit. fuer Flugtechnik u. Motorluftschiffahrt (Munich), vol. 19, no. 5, Mar. 14, 1928, pp. 105-106. Custom of comparing performance of light alloys on basis of saving in weight for same tensile strength is fallacious, since no consideration for safety is given; what is required is not comparison of ultimate tensile but infinite life under reversal of stress; point is closely related with elastic limit of material; elastic limit has to be determined with great accuracy in order to render comparison of value.

PROPERTIES. Aluminum Alloys (Ueber Aluminium-Legierungen), A. Merz. Giesserei (Duesseldorf), vol. 15, no. 34, Aug. 24, 1928, pp. 836-840, 3 figs. Properties and improvement of best known aluminum alloys are discussed, including duralumin, aldur, skleron, aeron, konstruktal, montegal, lautal, silumin, alneon and neonalium.

CASTINGS. New Aluminum Alloys of High Elastic Limit Which Improve With Age (Neue selbstveredlnde Aluminium-Gusslegierungen mit hoher Elastizitaetsgrenze), M. v. Schwarz. Zeit. fuer Flugtechnik un Motorluftschiffahrt (Muenchen), vol. 19, no. 16, Aug. 28, 1928, pp. 361-364, 18 figs.

ALUMINUM BRASS

PROPERTIES. Aluminum Brasses, E. R. Thews. Can. Chem. and Met. (Toronto), vol. 12, no. 9, Sept. 1928, pp. 246-248. Discussion of metallurgical properties which have a bearing on difficulties met with frequently in manufacturing practice; aluminum and hot rolling of brass; metallurgical considerations; applications of aluminum brasses.

AMMONIA COMPRESSORS

LARGE. The Largest Refrigerating Compressor in the World (Der groesste Kaeltekompressor der Welt). Eis- u. Kaelte-Industrie (Berlin), vol. 21, no. 8, Aug. 1928, pp. 86-88, 2 figs. Descriptive note on 4,000,000-calories two-stage ammonia compressor manufactured by Gebrueder Sulzer A.-G. of Winterthur, Switzerland, for German chemical plant; compressor is direct-connected with 1,200 h.p. steam engine; vaporization temperature is minus 5 deg. Cent., liquefaction temperature is plus 30 deg. Cent.

APARTMENT HOUSES

GERMANY. The Apartment-House Group on the Hallgartenstrasse in Frankfurt a.M. (Der Wohnhausblock in der Hallgartenstrasse Frankfurt a.M.), M. Nowotny. Gesundheits-Ingenieur (Munich), vol. 51, no. 10, Mar. 10, 1928, pp. 145-150, 4 figs.

AQUEDUCTS

ITALY. The Apulian Aqueduct. Engineering (Lond.), vol. 126, no. 3267, Aug. 24, 1928, pp. 220-224 and 234, 30 figs. on supp. plates.

ASBESTOS

MILLING, CANADA. Milling and Dressing Asbestos, E. Larochelle. South African Min. and Eng. Jl. (Johannesburg), vol. 39, nos. 1924 and 1926, Aug. 11 and 25, 1928, pp. 671-673 and 741-743, 3 figs. Article previously indexed from Can. Min. and Met. Bul., June 1928.

SOUTH AFRICA. Asbestos in the Malipsdrift Area. S. Africa Min. and Eng. Jl. (Johannesburg), vol. 39, no. 1923, Aug. 4, 1928, pp. 639-641, 4 figs.

AUDITORIUMS

ERECTION, ATLANTIC CITY. Largest Proscenium Arch for Auditorium. Am. Contractor, vol. 49, no. 35, Aug. 25, 1928, pp. 18-19, 4 figs. Erect truss in sections; structure to be world's greatest convention hall; truss of proscenium arch across main hall of auditorium clear truss span of 350 ft.; truss was fabricated in sections; structure will seat 41,000 people in main auditorium.

AUTOMOBILE ENGINES

CRANKSHAFTS, MANUFACTURE OF. Continental Crankshaft Practice, C. O. Herb. Machy. (N.Y.), vol. 35, no. 2, Oct. 1928, pp. 103-109, 19 figs. Methods recently adopted by Continental Motors Corp. for making crankshaft of well-known 6-cylinder automobile.

DESIGN. How Motion of a Mechanism May Be Analyzed Geometrically, W. Samuels. Automotive Industries, vol. 59, nos. 11 and 12, Sept. 15 and 22, 1928, pp. 366-369 and 406-408 and 417, 3 figs. Sept. 15: Method by which motion of mechanism can be analyzed completely from its geometry, and automotive applications given; differential calculus involved is explained to make method accessible to every engineer; distances, angles, times and speeds dealt with; application to driven end of crank train. Sept. 22: Application to engine valve cams; cam with outline composed of circular arcs and contacting with flat plate on rocker arm; value of sliding reduction.

IGNITION, TESTING OF. The Effect of Hydrocarbon Vapour on the Contact-Points of Ignition Apparatus, E. A. Watson. Automobile Engr. (Lond.), vol. 18, no. 245, Sept. 1928, pp. 347-350.

AUTOMOBILES

Gears and Gearing, Manufacture of. Gear Blanks With Minimum Waste, C. A. McGroder. Iron Age, vol. 122, no. 14, Oct. 4, 1928, pp. 815-817, 5 figs. Uniformity of grain structure where it is most needed and minimized waste of material are outstanding improvements effected by new method of manufacturing bevel ring gear blanks, as developed and perfected by forge department of Dodge Brothers Corp., Detroit; using 4½-in. chrome-vanadium steel bar stock; this new process, through novel heading operation, turns outside surface of bar out and away from its centre, until it lies at right angles to original bar.

Parts, Heat-Treatment of. Willys-Overland Heat-Treating Methods, F. W. Manker. Machy. (N.Y.), vol. 35, no. 2, Oct. 1928, pp. 131-133, 5 figs. Normalizing, hardening and tempering operations performed by automatically carrying work through furnace arranged in tandem; hardening and tempering crankshafts; heat-treating miscellaneous parts; three furnaces used in heat-treating rear-axle shafts; annealing operations performed in pusher-type furnaces.

Transmissions, Design of. Gear Box Design. Motor Transport (Lond.), vol. 47, no. 1224, Aug. 27, 1928, p. 254, 1 fig. Design of gear box introduced by J. M. Hargreaves is discussed; three forward speeds and reverse; gears are in constant mesh; speed changes affected by four cone clutches.

Transmission, Heat Treatment of. Precision Heat Treatment for Gears. Iron Age, vol. 122, no. 13, Sept. 27, 1928, pp. 761-764, 4 figs. Heat-treating operations on automobile transmission and ring gears at plant of Dodge Bros.; six-zone annealing, controlled to 7 deg., necessary for maximum machinability; oil for quenching presses held to 3 deg., plus or minus.

AUTOMOTIVE FUELS

Combustion. Combustion in Automobile Engines (Die Verbrennung im Kraftwagenmotor, ihre Gefahren und ihre Unwirtschaftlichkeit), Sass. Automobil-Rundschau (Berlin-, vol. 30, nos. 12 and 14, June 15 and July 15, 1928, pp. 285-289 and 368-370, 16 figs.

Detonation. Anti-Detonants, C. Moureau and C. Dufraisse. Automobile Engr. (Lond.), vol. 18, no. 245, Sept. 1928, p. 320. From Chem. and Industry, vol. 47, no. 33, p. 848.

Anti-Knock Fuels, G. Edgar. Chem. and Industry (Lond.), vol. 47, no. 34, Aug. 24, 1928, pp. 230T-232T.

Flame Characteristics. Some Flame Characteristics of Motor Fuels, G. B. Maxwell and R. V. Wheeler. Indus. and Eng. Chem., vol. 20, no. 10, Oct. 1928, pp. 1041-1044, 6 figs. In order to obtain some information as to cause of "pink" or knock of motor fuels, photographic study has been made of movement of flames, simultaneously with measurements of development of pressure, during explosion of charge in engine cylinder; suggestions are made for suppression of pinking, and on basis of these studies differences between pinking and non-pinking explosions are pointed out.

Gas. Replacing Liquid Motor Fuels with Gas Fuel, F. Lommatsch. Petroleum Times (Lond.), vol. 20, no. 501, Aug. 18, 1928, p. 280. Discusses lighter-than-air flying craft; in United States military airships, loss of weight by consumption of fuel is compensated by passing gases through condenser; latest Zeppelin LZ 127 to be tested in Aug. 1928 with gas fuel; is of about same specific gravity as air; its consumption does not change weight of airship; said to increase action radius 30 per cent. Abstract translated from Allgem. Oesterr. Chem. u. Tech. Zeit.

Testing. The Influence of Fuel Characteristics on Engine Acceleration, D. B. Brooks. Soc. Automotive Engrs.—Jl., vol. 23, no. 3, Sept. 1928, pp. 235-248 and (discussion) 248, 38 figs. Method for approximately deriving effective air-fuel ratio delivered to cylinders during acceleration described; effect of fuel volatility on engine acceleration was studied using six fuels; it is shown that relative values of these fuels for acceleration depend upon amount of vaporization in manifold.

B

BALANCING

Methods of. Static and Dynamic Methods of Balancing (Statische und dynamische Auswuchtung), D. Hofmann. Maschinenbau (Berlin), vol. 17, no. 7, Sept. 6, 1928, pp. 814-817, 11 figs. Description of Hofmann-Kunze dynamic method of balancing, also of "Universal," "Punga" and other balancing machines; vibration-measuring instruments.

BEAMS, REINFORCED CONCRETE

Design. Nomogram for Determination of Moment of Inertia of Rectangular and T-beams (Nomogramm zur Bestimmung der Tragmomente von Rechteck und Plattenbalken). P. Deutsch. Beton u. Eisen (Berlin), vol. 27, no. 17, Sept. 5, 1928, pp. 317-321, 3 figs.

Stresses. Web Stresses in Reinforced Concrete Beams. Surveyor (Lond.), vol. 74, no. 1911, Sept. 7, 1928, pp. 217-218.

BEARING METALS

Tin-Base. A Study of Tin-Base Bearing Metals, O. W. Ellis and G. B. Karelitz. Machine-Shop Practice (A.S.M.E. Trans.), vol. 50, no. 18, May-Aug. 1928, pp. 13-27 and (discussion) 27-28, 64 figs.

BEARINGS

Lubrication. A Theory of the Lubrication of Cylindrical Bearings, F. E. Cardullo. Am. Soc. Mech. Engrs.—Advance Paper, for mtg. Sept. 24-27, 1928, 14 pp., 6 figs. on supp. sheet.

Grooving Bearings in Machines, G. B. Karelitz. Am. Soc. Mech. Engrs.—Advance Paper, for mtg. Sept. 24-27, 1928, 9 pp., 30 figs. on supp sheet. Essentials of correct lubrication and conditions which it is desirable to establish by means of grooving are discussed; series of examples of grooving in classified number of applications; mechanism of lubrication briefly discussed; author concludes that large number of machine-bearing troubles would be eliminated and wear would be decreased were more attention paid to fundamentals of lubrication during design of machines.

The Friction of Journal Bearings with Insufficient Lubrication (Die Reibungsverhaeltnisse des Gleitlagers bei unvolkommener Schmierung), W. Koehler. Archiv fuer dans Eisenhuettenwesen (Duesseldorf), vol. 2, no. 3, Sept. 1928, pp. 159-168, 25 figs. Author discusses friction conditions of bearings with and without adequate lubrication; calculation of heat balance; predetermination of corresponding values for experimental bearing of Dettmar oil-testing machine; method and equipment for determination of coefficient of friction of journal bearing; friction of white-metal bearing with adequate and inadequate lubrication.

BELT DRIVE

Problems. Solutions of Some Difficult Belt Drives, J. E. Rhoads. Power, vol. 68, no. 23, Sept. 25, 1928, pp. 527-528, 2 figs. Solutions of six typical cases of problems of belt drives; in case of valuable machine which may become jammed, serious breakage may be saved through presence of belt which can slip, fly off pulley and break in such emergency; case of mixing machine in chemical industry; group drive direct from compound engine to shaft driving 16 beaters in paper mill; 200-gal. per mi. portable pump in tannery; centrifugal oil-clarifying machine, etc.

BLAST FURNACES

Pig Iron. Producing Victoria Pig Iron on the Welland Canal Bank, D. M. Duncan. Can. Machy. (Toronto), vol. 39, no. 19, Sept. 20, 1928, pp. 39-42, 9 figs. Description of Victoria furnace built by Canadian Furnace Co. at Port Colborne for purpose of manufacturing exclusively merchant pig iron for foundry; handling coke and ore; both ore bridges unload 10,000 tons in 24 hrs.; method of charging furnace; blast-furnace gases used in preheating air blast; slag principally used in reclamation from lake Erie.

Process, Theory of. A New Theory of the Blast-Furnace Process (Eine neue Theorie des Hochofenverfahrens), F. Wuest. Stahl und Eisen (Duesseldorf), vol. 48, no. 37, Sept. 13, 1928, pp. 1273-1287, 12 figs. Review of earlier research on oxidation zone in front of tuyeres and formation of pig iron in furnace; impossibility of reduction of silicon and manganese from slag; reduction of auxiliary elements by carbon obtained from carbon monoxide in shaft and bosh; confirmation of this theory by laboratory tests; injurious effect of oxidation zone in front of tuyere on economy of blast-furnace process.

BOILER FEEDWATER

Treatment. A Non-Chemical Method for the Prevention of Scale Accumulation in Boilers, Diesel-Jackets and Water Circulating Systems in General, A. T. Ridout. Domestic Eng. (Lond.), vol. 48, no. 9, Sept. 1928, pp. 163-165. Paper read before Inst. Mar. Engrs., previously indexed.

Treatment of Feedwater. Nat. Elec. Light Assn.—Serial Report, no. 278-81, Aug. 1928, 57 pp., 48 figs. Operation of evaporators under varying ranging of conditions; summarizes more recent results of research; covers briefly results of past reports; cites new cases on caustic embrittlement and covers experiments on new inhibitives, such as sodium phosphate, tannate and sodium acetate; data in connection with electrolytic processes are presented; statements by International Filter Co. on electro-osmosis describes process of purifying water by electrolyzing. Bibliography.

BOILER FURNACES

Pulverized Coal. Burning Crushed Coal in Suspension, J. F. O. Stratton. Power, vol. 68, no. 12, Sept. 18, 1928, pp. 486-487, 2 figs.

Design and Calculation of Combustion Chambers of Pulverized Coal Furnaces (Bau und Berechnung der Verbrennungsraeume von Kohlenstaubjeuerungen), 11. Ketz. Waerme (Berlin), vol. 51, no. 34, Aug. 25, 1928, pp. 619-625, 10 figs. Notes on combustion-chamber loads; development of new theory of design; thermal efficiency of heating surface of chamber.

BOILER PLATES

Alloy Materials. The Use of Alloy Steels for Boilers, J. V. Romer and W. W. Eaton. Boiler Maker, vol. 28, no. 9, Sept. 1928, pp. 261-262.

Basic Open-Hearth. The Properties of Basic Open-Hearth Steel at Various Temperatures, E. Pohl. Metallurgist (Supp. to Engineer, Lon.), Aug. 31, 1928, pp. 119-120. Author discusses mechanical properties of certain type of basic open-hearth steel; with increase in working pressure of boilers, 20- to 25-ton steels formerly used for boiler plates have become inadequate, and basic open-hearth steel of greater strength has assumed importance. Review of article translated from Stahl u. Eisen, May 17, 1928.

Testing. Boiler Plate at High Temperatures (Kesselbleche bei erhoehten Temperaturen), A. Pomp. V.D.I. Zeit. (Berlin), vol. 72, no. 36, Sept. 8, 1928, pp. 1262-1265, 12 figs. Abstract of 60-page report, by author and F. Koerber, on study made at Kaiser Wilhelm Institute for Iron Research; 14 specimens of steel and nickel-steel boiler plate were tested for effect of temperature up to 500 deg. Cent., effect of cold working age, crystallization, etc.

BOILERS

Design. Investigation of Loading Capacity of Evaporating Surface and Steam Space of Boilers and Pressure Vessels (Untersuchung ueber die Belastungsfaehigkeit der Verdampfungsoberflaeche und des Dampfraumes der Dampfkessel und Verdampfapparate), Eberle. Archiv fuer Waermewirtschaft (Berlin), vol. 9, no. 9, Sept. 1928, pp. 282-283, 2 figs. Brief account and results of investigations, followed by discussion.

Tendencies in Boiler Design. Power Plant Engr., vol. 32, no. 19, Oct. 1, 1928, p. 1029. Report by Nat. Elec. Light Assn.

High-Pressure. The Design and Construction of High-Pressure Water-Tube Boilers, H. E. Yarrow. Engineering (Lond.), vol. 126, no. 3270, Sept. 14, 1928, pp. 341-342, 2 figs. Paper read before Brit. Assn.

Inspection. The Activity and Experiences of the Heat Engineering Bureau of Central German Steam Boiler Inspection Association of Magdeburg in the Fiscal Year 1927 (Taetigkeit und Erfahrungen der Waermestelle der Mitteldeutschen Dampfkesselueberwachungsvereine Magdeburg im Geschaeftsjahr 1927), Berner. Waerme (Berlin), vol. 51, no. 30, July 28, 1928, pp. 556-561. Brief account of results of work covering different fields, including grates for lignite and bituminous-coal firing; boiler and boiler-furnace efficiencies; lignite coke; pulverized-coal firing; superheaters, economizers, air preheaters, reciprocating engines, turbines, Diesel engines, feedwater treatment, etc.

Vertical, Tubular. A New Steam Boiler, N. Forssblad. Nat. Elec. Light Assn.—Serial Report, no. 278, July 1928, p. 12. Details of internally fired single-drum sectional boiler with vertical tubes, designed for use in auxiliary steam plant connected with Swedish hydro-electric station; low installation cost and small space requirement; advantages are short heating-up time and low heating-up losses; disadvantages are small water surface and low water storage.

Waste-Heat. Factors Which Influence the Choice of Waste-Heat Boilers, J. B. Crane. Iron and Steel Engr., vol. 5, no. 9, Sept. 1928, pp. 407-412, including discussion, 10 figs. Economical possibilities of waste-heat boilers require a study of all problems where there is heat in gases above 1,000 deg. Fahr. being discharged to atmosphere; if pressures, weight and character of gases are suitable, return-tubular boiler will give maximum results at least outlay; otherwise vertical boiler is best; single-pass horizontal boiler is suitable for special conditions and may be used in some cases in place of vertical boilers.

Water-Tube, Design. Calculation of Wall Thickness of Water-Tube Boiler Sections (Berechnung der Wanddicke von Teilkammern [Sektionen] fuer Wasserrohrkessel), G. Kerff. Archiv fuer Waermewirtschaft (Berlin), vol. 9, no. 9, Sept. 1928, pp. 292-294, 7 figs.

BRASS FOUNDRY PRACTICE

Production. Producing Non-Ferrous Castings of Quality in Modern Foundry, E. G. Brock. Can. Machy. (Toronto), vol. 39, no. 18, Sept. 6, 1928, pp. 25-29, 8 figs.

BRIDGES

Approaches, Construction. Heavy Cut in Rock Cleaves Palisades for Hudson River Bridge Approach. Constr. Methods, vol. 10, no. 10, Oct. 1928, pp. 14-17, 16 figs. Methods and equipment usually associated with quarrying and mining operations rather than with bridge construction; approach cut for west end of bridge is approximately 800 ft. long and 146 ft. wide with maximum depth of 85 ft.; anchorage tunnels; air-compressor plant serving tunnels comprises two 800-cu. ft. per min. stationary Ingersoll-Rand machines electrically driven by General Electric synchronous motor; scheme of handling inclined tunneling operations.

Arch, Calculation. Calculations of Parabolic Arches With Two-Pin Supports Prolonged by Non-Articulated Beams Resting on Movable Supports (Calcul de l'arc parabolique à deux rotules prolongé par des poutres non articulées, reposant sur appuis mobiles), L. Légens. Génie Civil (Paris), vol. 93, no. 9, Sept. 1, 1928, pp. 214-216, 9 figs.

Concrete Arch, Testing. Experiments on the Reinforced Concrete Bridge at Corbeil (Expériences effectuées sur le pont en béton armé de Corbeil), Aubert. Annales des Ponts et Chaussées (Paris), vol. 1, no. 3, May-June 1928, pp. 234-244, 4 figs. partly on supp. sheet.

Concrete, Construction. Arthur Kill Bridges Paved With Joggled and Vibrated Concrete. Eng. News-Rec., vol. 101, no. 12, Sept. 20, 1928, pp. 427-429, 5 figs. To secure pavement of dense and strong concrete for two highway bridges across Arthur Kill, between mainland of New Jersey and Staten Island, engineers required concrete to be compacted by vibrating deck forms with pneumatic hammer; also use of traprock aggregates and special finish.

Concrete, Highway. Port Robinson Highway Bridge. Can. Engr. (Toronto), vol. 55, no. 12, Sept. 18, 1928, p. 315, 1 fig.

Design. What Is the Best Kind of Bridge to Build? J. A. L. Waddell. Contract Rec. (Toronto), vol. 42, no. 37, Sept. 12, 1928, pp. 968-971.

Highway, Surveys. Highway Bridge Surveys, C. B. McCullough. Contract Rec. (Toronto), vol. 42, nos. 38 and 39, Sept. 19 and 26, 1928, pp. 993-996 and 1013-1015, 4 figs.

Highway Bridge Surveys, C. B. McCullough. Contract Rec. (Toronto), vol. 42, no. 36, Sept. 5, 1928, pp. 942-945, 4 figs. Stream gradients and erosion; general factors controlling erosion; local conditions effecting erosion; five most commonly used methods for exploring foundations are: (1) sounding rod; (2) soil auger or boring machine; (3) wash boring or churn drilling; (4) core drilling, and (5) test pits; method to be used in any particular investigation will depend upon conditions encountered. (Continuation of serial.)

Railroad, Design. The Present Position as Regards the Question of Dynamic Influences on Railway Bridges, A. Ronsse and R. Desprets. Int. Ry. Congress Assn.—Bul. (Brussels), vol. 10, no. 9, Sept. 1928, pp. 717-723. Brief examination of present position of question of dynamic effects in railway bridges, taking into account particular points of view of Streletzky and of ordinary opinions most widely accepted at present time in Europe and in America; examination into organic condition of bridge; calculation of dynamic effect; balancing of locomotives and speed.

Steel. Endurance and Beauty in Steel Bridges, C. E. Fowler. Am. Inst. of Steel Constr.—Reprint, 19 pp., 28 figs.

Steel, Arch—Colorado River. Bridging the Colorado Across the Marble Gorge, A. S. Taylor. Compressed Air Mag., vol. 33, no. 10, Oct. 1928, pp. 2547-2548, 4 figs.

Steel, Construction. The Erection of Steel Bridges, D. G. Mackintosh. Structural Eng., vol. 6, no. 9, Sept. 1928, pp. 279-286, 8 figs.

Steel, Railroad and Highway Combined. Design and Construction of Railroad and Highway Bridge in Maine. Eng. and Contracting, vol. 67, no. 9, Sept. 1928, pp. 451-453, 3 figs.

Suspension, Design. Design of Great International Suspension Bridge Over Detroit River, J. Jones. Eng. News-Rec., vol. 101, no. 13, Sept. 27, 1928, pp. 460-466, 8 figs.

Suspension, Detroit River. The Ambassador Bridge, G. M. Bolton. Mich. Engr., vol. 46, no. 3, Sept. 1928, pp. 4-7, 2 figs. Links cities of Detroit, Mich., and Sandwich, Ont.; total length of bridge, including main span, approaches and terminals, is approximately 9,000 ft.; roadway 47 ft. in width; 8-ft. sidewalk; main span 1,850 ft.; each of main cables is 19 in. in diam.

BUILDING MATERIALS

Sound-Absorbing. The Absorption of Sound by Materials Used in Structures, F. R. Watson. Eng. and Contracting, vol. 67, no. 9, Sept. 1928, pp. 473-475. Results of investigation made by Engineering Experiment Station of University of Illinois; definition of acoustic absorption; action of sound in room; method of measurement; sources of sound; Rayleigh disk and its use; coefficients listed may be used in calculating reverberation in rooms.

C

CABLEWAYS

Buckets. Tipping Apparatus for Aerial Ropeways. Indus. Mgmt. (Lond.), vol. 15, no. 9, Sept. 1928, pp. 302-303, 3 figs. Description of device by which buckets can be tipped at predetermined positions in order to effect greatest possible economy and to utilize tipping area to fullest capacity; employed for disposal of coal-mine waste.

Dam Construction. Cableways for the Nag Hammadi Barrage. Engineer (Lond.), vol. 146, no. 3792, Sept. 14, 1928, pp. 284-285, 5 figs. partly on p. 288. Details of cableways, constructed by Henderson and Co. of Aberdeen, for handling materials in construction of dam being built across Nile river; cableways are erected across Nile at right angles to stream and are disposed so as to command practically whole area of barrage structure, which is about 3,000 ft. long by 340 ft. wide; each cableway has clear span of 3,100 ft.; each is designed to handle a load of 5 tons on hook.

Passenger, Italy. Aerial Suspension Passenger Cableway from Cortina to Ampezzo (Le funiculaire aerien de Cortina d'Ampezzo), F. Crestin. Génie Civil (Paris), vol. 93, no. 9, Sept. 1, 1928, pp. 212-214, 5 figs. Various regulations for passenger cableways; description of double-line cableway 1,921 mi. long in 3 unequal spans; cars hold 18 passengers each; safety devices; cable calculations; supporting cable 45 mm. diam.; traction cable 22.5 mm. diam.

CARS

Tank, Germany. Large Tank Cars in Germany and in United States (Grosskesselwagen in Deutschland und in den U.S.A.), O. Bondy. Glasers Annalen (Berlin), vol. 52, no. 4, Aug. 15, 1928, pp. 45-49, 9 figs. Data and descriptive notes on German tank cars by Krupp, Linke-Hofmann (for Russia), Hannover Waggonfabrik (for India), also of several types of American tank cars; capacities of 45 cu. m. and more.

Articulated, Street Railroad. Combined Drum and Bellows Connection Features Montreal's Articulated Car. Elec. Ry. Jl., vol. 72, no. 11, Sept. 15, 1928, pp. 450-454, 9 figs. Experimental units combine two types to maintain wide opening between two bodies at all times; designed for rush-hour service; car embodies several departures from previous designs of this type; result is noiseless and practically air-tight articulation; unit is 80 ft. long, front and rear bodies being of equal length; articulation coupling between two sections is designed on universal-joint principle. See also Can. Ry. and Mar. World (Toronto), no. 367, Sept. 1928, pp. 544-545, 3 figs.

CASE HARDENING

Nitration. Recent Developments in the Application of Nitrogen to the Surface Hardening of Steel, V. O. Homerberg. Fuels and Furnaces, vol. 6, no. 9, Sept. 1928, pp. 1153-1157, 9 figs.

The Process of Surface Hardening of Steel by Nitriding, W. J. Merten. Fuels and Furnaces, vol. 6, no. 10, Oct. 1928, pp. 1371-1376, 4 figs.

CASTINGS

Cleaning, Hydraulic. Hydraulic Method of Cleaning Castings, J. Prendergast and H. A. Lincoln. Iron Age, vol. 122, no. 12, Sept. 20, 1928, p. 734. Cleaning castings by water under pressure directed from nozzles in plant of Sullivan Machinery Corp., Claremont, N.H., is described.

Welded Steel vs. Costs. Welded Steel Equivalent of Castings, R. W. Capper. Welding Engr., vol. 13, no. 9, Sept. 1928, p. 45. Cost reductions made possible by use of welded steel in machinery construction and designs of parts suitable for this method; manufacture of specific pieces illustrated can be accomplished in any well-equipped steel fabricating shop which is operated in connection with machine shop; costs are based on manufacture in multiple of five pieces at a time, but without use of jigs or fixtures.

Centrifugal. Improvements in Moulds for Making Hollow Cylindrical Castings Whose Diameter Is Small with Respect to the Length by Centrifugal Force (Perfectionnements apportés aux moules pour la fabrication, par la force centrifuge, de corps creux cylindriques dont le diamètre est petit par rapport à la longueur). Fonderie Moderne (Paris), vol. 22, Mar. 25, 1928, pp. 106-108, 6 figs.

CHIMNEYS

Vibrations. Vibration of Chimneys (Schwingungen von Schornsteinen), E. Lehr. Beton u. Eisen (Berlin), vol. 27, no. 16, Aug. 20, 1928, pp. 301-306, 4 figs.

CITIES AND TOWNS

Planning. Modern Attitude to Town Planning, J. D. Craig. Can. Engr. (Toronto), vol. 55, no. 13, Sept. 25, 1928, pp. 339-340. Paper presented before Town Planning Inst. of Canada.

Citizenship and Town Planning. Can. Engr. (Toronto), vol. 55, no. 13, Sept. 25, 1928, p. 333.

Town Planning Developments in Ontario, A. E. K. Bunnell. Contract Rec. (Toronto), vol. 42, no. 39, Sept. 26, 1928, pp. 1040 and 1035.

Noulan Cauchon's Plan for City of Ottawa, N. Cauchon. Contract Rec. (Toronto), vol. 42, no. 39, Sept. 26, 1928, p. 1041, 2 figs.

Regional Engineering, Its Problems, Status and Future Requirements, W. W. DeBerard. Eng. News-Rec., vol. 101, no. 14, Oct. 4, 1928, pp. 496-501, 9 figs.

COAL HANDLING

Loading and. Loading and Storing of Friable Bulk Materials (Das Verladen und Lagern umladeempfindlicher Schuettgueter), E. H. H. Aumund. V.D.I. Zeit. (Berlin), vol. 72, no. 35, Sept. 1, 1928, pp. 1221-1224, 7 figs. Paper read at session of management section of 1928 annual meeting of Society of German Engineers (V.D.I.).

COAL MINES AND MINING

Steel Supports. The Use of Steel Arches in Supporting Underground Roadways, L. Frost. Can. Min. and Met.—Bul. (Montreal), no. 196, Aug. 1928, pp. 954-972, 11 figs. Paper presented before Min. Soc. of Nova Scotia, previously indexed from Iron and Steel of Canada, Aug. 1928.

Ventilation. Better Airways vs. New Fans, W. J. Montgomery. Min. Congress Jl., vol. 14, no. 10, Oct. 1928, pp. 777-782, 4 figs.

Recent Tendencies in Coal Mine Ventilation, G. S. Rice. Min. Congress Jl., vol. 14, no. 9, Sept. 1928, pp. 719-721.

COAL WASHING

Flotation. The Sand Flotation Process as Applied to the Washing of Coal, T. M. Chance. Min. Congress Jl., vol. 14, no. 9, Sept. 1928, pp. 724-727 and 732, 4 figs.

COFFERDAMS

Wrecking. Old Cofferdam Removed by Power Scraper Bucket. Eng. News-Rec., vol. 101, no. 11, Sept. 3, 1928, pp. 409-410, 2 figs.

COLUMNS, REINFORCED CONCRETE

Design. Reinforced Concrete Columns, L. Turner. Concrete and Constr. Eng. (Lond.), vol. 23, no. 9, Sept. 1928, pp. 597-602, 2 figs.

CONCRETE AGGREGATES

Gradation. Grading Aggregate for Concrete. Can. Engr. (Toronto), vol. 55, no. 12, Sept. 18, 1928, p. 317, 2 figs.

Moisture Content. New Moisture Content for Aggregates. Cement, Mill and Quarry, vol. 32, no. 13, Sept. 1928, pp. 33-34, 1 fig.

CONCRETE BLOCKS

Specifications. Specifications for Concrete Stone, C. Van Bogart. Contract Rec. (Toronto), vol. 42, no. 36, Sept. 5, 1928, pp. 952-953.

CONCRETE CONSTRUCTION

Reinforced, Testing. Tests of the Effect of Brackets in Reinforced Concrete Rigid Frames, F. E. Richart. U.S. Bur. of Standards—Jl. of Research, vol. 1, no. 2, Aug. 1928, pp. 189-250, 40 figs. Results of analyses and tests of rigid frames of reinforced concrete with and without enlargements (termed "brackets") at intersection of horizontal top member with vertical legs; all frames were of inverted U-form hinged at lower end of vertical legs; it is shown that relations between moments and size of brackets, determined exactly only by long-drawn-out computations, may be expressed by simple empirical equation with accuracy sufficient for many cases met with in practice.

Reinforcing Bars, Welding. Welding of Reinforcing Bars Effects Large Saving. Elec. World, vol. 92, no. 13, Sept. 29, 1928, p. 638, 2 figs. Several thousand dollars are saved by Pacific Gas and Electric Co. in construction of large concrete cooling-water intake by electric welding of reinforcing bars; job was of special nature in that square concrete piling was used for side walls of structure and roof was poured separately in place and joined to these side walls.

CONCRETE

Cost Calculation. Chart for Calculating Material Cost Per Cubic Yard of Concrete, C. M. Bull. Eng. News-Rec., vol. 101, no. 11, Sept. 13, 1928, p. 411, 1 fig.

Design. The Design of Pavement Concrete by the Water-Cement Ratio Method, F. H. Jackson. Pub. Roads, vol. 9, no. 6, Aug. 1928, pp. 124-128, 1 fig.

Mixing, Cost. Relation Between Output and Cost in Mixing Concrete, W. C. McNaughton. Eng. News-Rec., vol. 101, no. 13, Sept. 27, 1928, p. 472, 2 figs. Graph for calculating effect of curtailment of output on yardage costs of concrete; unit costs for various yardage outputs of two concrete plants of New York subway contractors.

Moisture Condensation. Preventing "Sweating" of Concrete, J. E. Foster. Nat. Engr., vol. 32, no. 9, Sept. 1928, pp. 415-416.

Proportioning. The Practical Application of the Water Cement Ratio Theory, J. Singleton-Green. Structural Eng., vol. 6, no. 9, Sept. 1928, pp. 265-278, 2 figs. Designing mix; Abrams' theory: water ratio and strength; amount of water for given strength; various cement; maximum density; bulking of sands; inundation; variation in quantity of coarse aggregate. Bibliography.

STRENGTH. Effect of Mixing Time on Concrete Strength. Am. Contractor, vol. 49. no. 35. Aug. 25, 1928. pp. 20-21. Conclusion from data secured is that strength of concrete is not increased by longer mixing periods; over 2,000 cylinders were broken; cylinders were prepared as required by A.S.M.E. standards; general summary of data secured on cylinders.

TESTING. Compression Test for Concrete. Can. Engr. (Toronto), vol. 55. no. 13. Sept. 25, 1928. p. 332, 2 figs. Description of tests, carried out at Portland Cement Assn.'s laboratory, in which compressive strength and wear of concrete are plotted against water-cement ratio. From Concrete Highways.

WORKABILITY. Workability and Durability of Concrete, R. W. Atwater. Can. Engr. (Toronto), vol. 55. no. 10, Sept. 4, 1928, pp. 279-281. Paper presented before Am. Concrete Inst., previously indexed from Eng. and Contracting, Mar. 1928.

COPPER ALLOYS

COPPER-CADMIUM. Notes on the Manufacture and Properties of Some Copper-Cadmium Alloys, W. Bannard. Brass World, vol. 24. no. 9, Sept. 1928, pp. 273-276. 8 figs.

COPPER DEPOSITS

MANITOBA. Island Lake, Manitoba, N. B. Davis. Can. Min. Jl. (Gardenvale, Que.), vol. 49. no. 37, Sept. 14, 1928, pp. 734-735.

COPPER MINES AND MINING

RHODESIA. Development of the N'Changa Copper Mines. S. African Min. and Eng. Jl. (Johannesburg), vol. 39. no. 1923, Aug. 4, 1928, pp. 646-648. Abstract of first annual report of N'Changa Copper Mines, Ltd.; history and review of progress; area 1½ by 3 mi., at altitude of 4,300 ft.; rainfall about 50 in. annually; geology; River Lode; Dambo Lode; new discovery in southwest corner of area; organization employs average of 90 white men and 850 natives; churn drilling and diamond drilling in progress during 1928. See also Min. and Indus. Mag. of South Africa (Johannesburg), vol. 6, no. 12, Aug. 8, 1928, pp. 559-560.

Roan Antelope, in Rhodesia, May Deliver Eight-Cent Copper, G. L. Walker. Eng. and Min. Jl., vol. 126, no. 11, Sept. 15, 1928, pp. 404-406, 2 figs. British corporation, in which Americans are interested, owns three copper ore deposits in Northern Rhodesia, Africa; outline map and cross-sections of ore-body, which is bed of feldspathic shale containing disseminated chalcocite; official of American Metal Co. estimates 30,000,000 tons averaging 3.4 per cent copper and calculates total cost of 8.15 cents per pound of copper delivered in Europe; indications are that 100,000,000 lb. annual productive capacity can be created by total capital expenditure of $15,000,000.

COPPER ORE TREATMENT

LEACHING, NATURAL—UTAH. Utah Copper's New Precipitating Plant, H. D. Keiser. Eng. and Min. Jl., vol. 126, no. 14, Oct. 6, 1928, pp. 534-537, 7 figs. Precipitation of copper from natural surface waters has been practised at Bingham Canyon properties of Utah Copper Co. since 1917, on small scale and largely experimental; operation of new plant began March 26, 1928; to June 1, average flow treated was 1,000,000 gal. in 24 hr.; plant heads average 20 lb. copper per 1,000 gal.; extraction 97.5 per cent; details of system for collection of waters and of precipitation boxes; detinned iron scrap used to precipitate copper metal from sulphate solution.

PLANTS, NEW MEXICO. Revision of the Coarse Crushing and Fine Crushing Departments of the Hurley Plant of the Chino Mines, Nevada Consolidated Copper Company, F. Hudges. Min. Congress Jl., vol. 14, no. 9, Sept. 1928, pp. 699-701, 4 figs.

COPPER SMELTERS

ARIZONA. Copper Smelting at Douglas, E. H. Robie. Eng. and Min. Jl., vol. 126, no. 13. Sept. 29, 1928, pp. 493-496. Describes some features of Copper Queen smelter of Phelps Dodge Corp.; largest roasting furnaces in world, with 11 interior hearths; hot calcine drops directly into reverberatory feed gins; two reverberatories in use were making 11,000,000 lb. copper per month; Great Falls type of converters still used; brief description of lead smelter; Calumet and Arizona smelter, on adjoining site, also partly described.

QUEBEC. The Noranda Enterprise, A. H. Hubbell. Eng. and Min. Jl., vol. 126, no. 11, Sept. 15, 1928, pp. 412-416, 6 figs. Smelter was blown in Nov. 21, 1927, and first copper produced Dec. 16; reverberatory furnaces, roasters, converters, casting machines and accessories; operating results; detailed log of procedure, Nov. 21 to Dec. 26, 1927. (Continuation of serial.)

The Noranda Enterprise, A. H. Hubbell. Eng. and Min. Jl., vol. 126, no. 12. Sept. 22, 1928, pp. 451-456, 6 figs. Recounts difficulties of smelter operation and their solution; crushing plants; sampling mill; adjustment of roasting and smelting capacities; reverberatories; converters; coal pulverizing and precipitation plants; Cottrell dust-precipitation plant; instruments for furnace control; outline of plant organization.

CULVERTS

DESIGN. How Long Should a Culvert Be for Safety and Economy? Highway Mag., vol. 19, no. 8, Aug. 1928, pp. 215-217, 7 figs.

CUPOLAS

TEMPERATURE MEASUREMENT. Accurate Temperature Measurements in Cupola Practice (Genaue Temperateuressungen im Kupolofenbetrieb), P. Rheinlaeder. Giesserei (Duesseldorf), vol. 15, no. 37, Sept. 14, 1928, pp. 911-917, 9 figs.

CUTTING TOOLS

DIAMOND. Metal-Cutting With Diamonds. Soc. Automotive Engrs.—Jl., vol. 23, no. 4, Oct. 1928, pp. 419-420, 3 figs. Slight pressure and small wear of diamond tool result in fine and accurate finish; finishing of bearing metal and bronze bushings in crankcases and connecting rods; accurate finishing rather than removal of large quantities of stock is greatest use for diamond tools in machining; very high speed possible; new requirements on machines; distinctive requirements for diamond-cutting machine tool.

D

DAMS

ARCH, DESIGN. Some Adjustments of Stresses in Arch Rings of Arch Dams, F. W. Hanna and T. L. E. Haug. West. Constr. News, vol. 3, no. 17, Sept. 1928, pp. 574-577, 2 figs.

EARTH, FAILURES. Uncompleted Lafayette Rolled-Fill Earth Dam Damaged by Movement, N. A. Bowers. Eng. News-Rec., vol. 101, no. 13, Sept. 27, 1928, pp. 483-485, 7 figs. About half of yardage in dam of East Bay Municipal Utility District, Oakland, Calif., shifted position; embankment had been built to 120 ft.; cause to be sought through foundation studies; cross-section of Lafayette dam showing stage of completion and downstream profile after slip; some joints in upstream paving opened, others were buckled or crushed. See editorial comment "Unstable Earth," on p. 457.

MULTIPLE DOME, CONSTRUCTION. Construction Features, Coolidge Multiple-Dome Dam. Eng. News-Rec., vol. 101, no. 12, Sept. 20, 1928, pp. 438-442, 13 figs.

UPLIFT PRESSURE. Uplift Under Dams, C. E. Pearce. West. Constr. News, vol. 3, no. 17, Sept. 10, 1928, pp. 569-571, 2 figs.

DIATOMACEOUS EARTH

CANADA. Development of Diatomaceous Earth in Nova Scotia, R. W. Burroughs. Can. Min. and Met.—Bul. (Montreal), no. 196, Aug. 1928, pp. 973-988, 6 figs. Diatomaceous or infusorial earth consists of silicious remains of minute aquatic plants; California deposits are largest, most extensively worked and best known; largest Canadian deposits are in British Columbia and Nova Scotia; smaller, impure deposits in Ontario, Quebec and New Brunswick; describes deposits of Scotia Diatom Products at Little River, near Digby, N.S.; plant for mining and preparation for market is being constructed. Paper presented before Min. Soc. of Nova Scotia.

DIE CASTING

COPPER ALLOYS. Die-Casting of Copper-Rich Alloys, R. Genders, C. R. Reader and V. T. S. Foster. Foundry Trade Jl. (Lond.), vol. 39, no. 629, Sept. 6, 1928, pp. 167-170 and 172. Abstract of paper read before Inst. of Metals.

DIESEL ENGINES

ANTE-CHAMBER TYPE. Studies of Diesel Engines. The Ante-Chamber Engine (Entersuchungen an der Dieselmaschine die Vorkammermaschine), K. Neumann. V.D.I. Zeit. (Berlin), vol. 72, no. 36, Sept. 8, 1928, pp. 1241-1248, 10 figs. Report from Department of Internal Combustion Engines and Engineering Thermodynamics of Hanover Institute of Technology on experimental studies of performance and mode of operation of 18-h.p. one-cylinder four-cycle engine of ante-chamber type; mathematical analysis of combustion phenomena; special merits of ante-chamber type for high-speed Diesel engines.

COMPRESSORLESS. The Sixty-Seventh Annual Meeting of the Society of German Engineers (V.D.I.), Essen, 1928 (Die 67 Hauptversammlung des Vereins Deutscher Ingenieure in Essen 1928). L. Hausfelder. Motorwagen (Berlin), vol. 31, nos. 18 and 20, June 30 and July 20, 1928, pp. 414-415 and 456-461, 5 figs. Abstracts of principal papers read at sessions on internal-combustion engines, marketing, paints and painting; extensive abstracts of Reinsch's paper on progress in design of compressorless Diesel engines and of Gosslav's paper on heat control of cylinders of air-cooled airplane engines.

DEUTSCHE WERKE. Double-Acting Air Injection Engines. Gas and Oil Power (Lond.), vol. 23, no. 276, Sept. 6, 1928, p. 243. Details of new 6-cylinder Deutsche Werke design of engine; bore 650 mm.; stroke 1,050 mm.; rating of 4,200 h.p. at 120 r.p.m.; four sets of ports of approximately equal height extend around entire cylinder periphery, two serving upper side of piston and two lower side; accessibility studied; controls placed at camshaft level instead of on floor level.

DOUBLE-ACTING (M.A.N.). 11,700 B.H.P. Double-Acting Oil Engine. Power Engr. (Lond.), vol. 23, no. 270, Sept. 1928, pp. 341 and 363, 1 fig. Notes on large new German engines built by M.A.N. intended for peak-load service; coupled to generator of Siemens-Schuckert makes operating at pressure of 6,000 volts; each engine has 10 cylinders 600 mm. in diam. with piston stroke of 900 mm., 11,700 b.h.p. being developed at 215 r.p.m.; power produced with brake mean effective pressure of 69.5 lb. per sq. in. and piston speed of 1,268 ft. per min.; loop system of port scavenging.

PULVERIZED FUEL. Operating Diesel Motors with Coal Dust Fuel, F. E. Bielefeld. Oil Eng. and Technology (Lond.), vol. 9, no. 8, Aug. 1928, pp. 216-218, 5 figs. Original Diesel engine was designed with view to using solid fuel in powder form; MacCallum coal-dust-fired motor, British patent No. 816 of 1891; development not continued, as relatively coarse coal dust caused difficulties; brown coal-dust now used will pass sieve of 8,000 to 10,000 mesh per sq. cm.; fine powder offers large surface of attack to combustion oxygen; Diesel can be fired without auxiliary ignition fuel; brief discussion of German patents. Abstract translated from Technische Blaetter, June 9, 1928.

VALVES, DESIGN OF. Contribution to the Design and Calculation of Fuel Cams and Fuel Valves for Diesel Engines, J. N. Basu. Nat. Advisory Committee for Aeronautics—Tech. Memorandums, no. 477, Aug. 1928, 32 pp., 22 figs.

DUST PRECIPITATION

ELECTRIC. Precipitation in Europe, G. Berg. Elec. World, vol. 92, no. 11, Sept. 15, 1928, pp. 499-503, 8 figs. It is estimated that there are at present about 2,000 electrical precipitation plants in world, of which 800 are situated in United States and 1,000 in Germany; types of electrifiers; modern electro-filter plants; industrial applications.

Notes on Electrical Dust Precipitation, D. H. Lewis. West of Scotland Iron and Steel Inst.—Jl. (Glasgow), vol. 35, part 6, Mar. 1928, pp. 98-99 and discussion) 99-100, 6 figs. on supp. plates. Problem of dust recovery comes under three heads: (1) prevention of nuisance; (2) collection of values; (3) cleaning of gases; all plants described are of type now handled by Lodge-Cottrell Co.; Oski plant was installed at Wishaw to treat gases from rotary cement kiln; main difference between Lodge-Cottrell and Oski types of plant; arrangement of plant.

E

ELECTRIC ARCS

ALTERNATING CURRENT. Extinction of an A-C Arc, J. Slepian. Am. Inst. Elec. Engrs.—Jl., vol. 47, no. 10, Oct. 1928, pp. 706-710, 8 figs.

ELECTRIC BUSBARS

SPACING. Spacing Busbars for Safe Voltage Clearance, M. Kushlan. Elec. World, vol. 92, no. 14, Oct. 6, 1928, pp. 681-682, 1 fig.

ELECTRIC CABLES

FAILURES. Cable Operation. Nat. Elec. Light Assn.—Serial Report, Sept. 1928, 16 pp.

SHEATH LOSSES. Reduction of Sheath Losses in Single-Conductor Cable, H. R. Searing and W. B. Kirke. Elec. World, vol. 92, no. 14, Oct. 6, 1928, pp. 685-688, 8 figs.

ELECTRIC CONDUITS

CONSTRUCTION. Conduit and Manhole Construction. Nat. Elec. Light Assn.—Serial Report, Sept. 1928, 9 pp., 14 figs.

ELECTRIC FURNACES

ANNEALING. Alloy Steel Castings Annealed in Car Type Electric Furnaces, M. Rock. Fuels and Furnaces, vol. 6, no. 10, Oct. 1928, pp. 1405-1407, 3 figs.

ELECTRIC NORMALIZING AND ANNEALING. Iron Age, vol. 132, no. 14, Oct. 4, 1928, pp. 818-821, 8 figs. Description of electric annealing installed by Timken Roller Bearing Co. for use in production of alloy steels; eight furnaces for slow cooling handle alloy steels at various heating cycles; large pit furnaces a feature; air blast for cooling; special furnace for normalizing chrome steel; two-car type furnaces for bar stock.

HEAT-TREATING. Electrically-Heated Pusher Type Furnaces Used in Carburizing Automobile Parts, I. S. Wishoski. Fuels and Furnaces, vol. 6, no. 10, Oct. 1928, pp. 1395-1398, 2 figs. Describes pusher type furnace built by Holcroft and Co., of Detroit, Mich., used by automobile company for carburizing ring gears, side gears, king pins, etc., on 10-12 hr. cycle and quenched direct from boxes; net production, 700 lb. per furnace per hr.; operating economy, 10-12 lb. gross or 3.7 lb. net per kw.-hr.

RESISTANCE. The Use of Nickel-Chromium Alloys in Electric Furnaces, A. G. Lobley. Foundry Trade Jl. (Lond.), vol. 39, no. 631, Sept. 20, 1928, pp. 209-210, 2 figs.

ELECTRIC FUSES

CRITICAL STUDY OF. A Critical Study of the Current Rating of Low-Pressure Ordinary-Duty Fusible Cut-Outs, P. D. Morgan. Instn. Elec. Engrs.—Jl. (Lond.). vol. 66, no. 381, Sept. 1928, pp. 926-939 and (discussion) 939-948, 18 figs. Present report reviews British, Continental and American practice, deduces a method of rating suitable for existing British designs and provides experimental data required for revised specification.

ELECTRIC GENERATORS

HYDRAULIC TURBINE DRIVE. Alternators for Water Turbines. World Power (Lond.), vol. 10, no. 58, Oct. 1928, pp. 441-444, 6 figs.

ELECTRIC LAMPS

INCANDESCENT. Temperature and Brightness of the New Standard Type of Incandescent Lamp, W. E. Forsythe and E. M. Watson. Gen. Elec. Rev., vol. 31, no. 10, Oct. 1928, pp. 532-534.

ELECTRIC LINES

GROUNDING. Overhead Transmission, W. T. Taylor. Electricity (Lond.), vol. 42, no. 1972, Aug. 23, 1928, pp. 14-15.

Effect of Ground Wire on Travelling Waves, J. H. Cox and J. Slepian. Elec. World, vol. 92, no. 12, Sept. 22, 1928, pp. 551-554, 2 figs.

INTERCONNECTED. Operating Problems of Interconnected Power Systems, W. R. Hamilton. Elec. Jl., vol. 25, no. 10, Oct. 1928, pp. 494-500, 7 figs.

LOSS CALCULATION. Relation Between Loss and Load Factors, R. C. Powell. Elec. World, vol. 92, no. 12, Sept. 22, 1928, p. 558, 1 fig. Author refers to article by F. H. Buller and C. A. Woodrow, published in July 14 issue of same journal entitled Load Factor—Equivalent Hour Values Compared, and gives results of similar study made by him some 15 years ago.

POLES, WOODEN—ONTARIO. Development of Pole Line Construction, E. F. Hinch. Can. Engr. (Toronto), vol. 55, no. 10, Sept. 4, 1928, pp. 275-278, 6 figs. Principal construction methods employed by Ontario Hydro-Electric Power Commission; eastern cedar poles have been standard material for pole-line construction; insular pins; solderless connectors; grounding. Paper presented before Assn. Elec. Utilities.

POLES, WOODEN, RECONSTRUCTION. Rehabilitating Wood Pole Lines Without Interrupting Service. Elec. World, vol. 92, no. 13, Sept. 29, 1928, pp. 618-619, 6 figs. Important steps in pole line reconstruction job in Connecticut are illustrated; by use of pole mounts, pole section above ground is saved for further long continued service after decayed butt has been removed; rehabilitation is accomplished without interrupting service on line.

SPAN WIRE SUSPENSION. Span Wire Suspension Replaces Steel Tower, A. Kankeberg. Elec. World, vol. 92, no. 13, Sept. 29, 1928, p. 613, 1 fig. Where transmission lines traverse rugged and mountainous country; Public Service Co. of Colorado uses span wire suspension cable consisting of ⅝ in. plow-steel strand attached to canyon walls; no trouble has been experienced with installations of this type.

SURGES. Surge Voltage Investigation on Transmission Lines, W. W. Lewis. Am. Inst. Elec. Engrs.—Paper, for mtg., June 25-29, 1928, 11 pp., 16 figs.

TOWERS. Semi-Flexible Tower Line to Meet Severe Conditions, C. A. Booker. Elec. World, vol. 92, no. 11, Sept. 15, 1928, pp. 507-509, 3 figs. New England Power Co. follows policy of constructing all its important lines with all conductors in horizontal plane; conductors in horizontal plane with single circuit per tower; line built in structural units with anchor and intermediate towers.

TOWERS, DESIGN. Stresses in Transmission-Line Towers Produced by Breaking of Suspended Wire (Die Beanspruchung der Leitungsmaste bei Seilriss), Kammueller. Bautechnik (Berlin), vol. 6, no. 39, Sept. 7, 1928, pp. 133-136 (supp. Stahlbau), 14 figs.

HIGH-TENSION, CANADA. Gatineau to Toronto, 230 Miles, 260,000-H.P., 220,000-V. Elec. News (Toronto), vol. 37, no. 19, Oct. 1, 1928, pp. 38-45, 16 figs. Two single-circuit transmission lines operating at 220,000 volts; Paugan Falls development; large transformers; 220-kv. line; locating of route for line by means of aerial photography; standard towers are of "A" frame construction; Toronto terminal station; largest transformers in existence which are 32 ft. in height to top of high-voltage terminal and tank is over 13 ft. in diameter.

HIGH-TENSION, ONTARIO. Hydro Terminal Station at Leaside, Ont. Can. Engr. (Toronto), vol. 55, no. 14, Oct. 2, 1928, pp. 343-346, 7 figs. Ontario Hydro-Electric Power Commission completes construction of 230-mi., 200,000-volt transmission line from Gatineau river to Toronto and builds new terminal station at Leaside; locating route for transmission line solved by means of aerial photography; procedure adopted; first of lines erected; terminal transformer station; size of transformers; largest single-phase water-cooled units in physical size ever built; total estimated cost of whole work, $14,000,000.

ELECTRIC LOCOMOTIVES

MOTOR-GENERATOR. Performance of Motor-Generator Locomotives, P. A. McGee. Ry. Age, vol. 85, no. 10, Sept. 8, 1928, pp. 443-447, 3 figs.

MINE. Super-Powerful Locomotives for Main Haulage Service, G. H. F. Holy. Coal Mine Mgmt., vol. 7, no. 8, Sept. 1928, pp. 17-21, 3 figs. Article previously indexed from Coal Min., Sept. 1928.

ELECTRIC MOTOR-GENERATORS

CHARACTERISTICS. Selecting Motor-Generator Characteristics, W. H. Colburn. Elec. World, vol. 92, no. 12, Sept. 22, 1928, pp. 555-556, 2 figs.

ELECTRIC MOTORS

ALTERNATING CURRENT. Changing a Two-Phase Motor for Three-Phase Operation, M. E. Wagner. Power, vol. 68, no. 12, Sept. 18, 1928, pp. 479-480, 3 figs. Author tells how two-phase, 100-h.p., 2,200-volt, 60-cycle, 8-pole induction motor was changed to operate on 440 volts, three-phase.

DIRECT CURRENT, SPEED ADJUSTMENT. How Adjusted Speed Is Obtained with Direct Current Motors, F. A. Annett. Power, vol. 68, no. 14, Oct. 2, 1928, pp. 561-564, 7 figs.

SINGLE-PHASE, DESIGN. Improvement in Single-Phase Motor Design, N. Currie, Jr. Gen. Elec. Rev., vol. 31, no. 10, Oct. 1928, pp. 535-536, 6 figs.

SQUIRREL-CAGE. Applications for Squirrel-Cage Motors Extended. Power, vol. 68, no. 23, Sept. 25, 1928, p. 522.

SYNCHRONOUS, BRAKING. The Dynamic Braking of Synchronous Motors, K. B. Spear. Elec. News (Toronto), vol. 37, no. 18, Sept. 15, 1928, p. 49.

ELECTRIC NETWORKS

LOAD DISPATCHING. Load Dispatching Problems and Procedure, F. R. George. Elec. World, vol. 92, no. 11, Sept. 15, 1928, pp. 505-506, 2 figs. Pacific Gas and Electric Co. adopted centralized control idea in about 1900; there was established in 1906 separate department for this phase of system operation under title of Load Dispatcher; authority and responsibility are centered in one office, and from this point emanate all orders regarding load, frequency and voltage regulation; disposition of stored waters; energy purchased from other companies; switching on all high-voltage lines and all tie lines between stations regardless of voltage and kindred matters.

SHORT CIRCUIT CALCULATION. Time-Saving Charts Facilitate Use of Calculating Table, R. C. R. Schulze. Elec. World, vol. 92, no. 12, Sept. 22, 1928, pp. 556-557, 5 figs.

STABILITY REGULATION. System Stability with Quick-Response Excitation and Voltage Regulators, J. H. Ashbaugh. Elec. Jl., vol. 25, no. 10, Oct. 1928, pp. 504-509, 8 figs.

ELECTRIC RESEARCH

PROGRESS. Electrical Research and Progress, W. R. Whitney. Nat. Elec. Light Assn.—Bul., vol. 15, no. 9, Sept. 1928, pp. 521-526

ELECTRIC RHEOSTATS

LIQUID. Liquid Rheostats for Extra High Voltage, W. Wilson. World Power, vol. 10, no. 57, Sept. 1928, pp. 237-246, 9 figs. Article investigates cause of past irregularities in liquid rheostats; liquid resistors for high circuits; electrolysis cause of variability; calculation of concentric liquid resistances; electrical design of earthing resistors; thermal considerations; water resistivity; advantage of liquid high-voltage resistors.

ELECTRIC TRANSFORMERS

CONNECTION. Two-Phase and Three-Phase Power from the Same Transformers, J. B. Gibbs. Power, vol. 68, no. 11, Sept. 11, 1928, pp. 448-449, 5 figs. Connection is shown which has been suggested as means of supplying 2-phase and 3-phase power simultaneously from 4-wire line, and is compared with other means for accomplishing same result.

TEMPERATURE MEASUREMENT. Transformer Temperature Indicator Records Temperature Range. Elec. World, vol. 92, no. 14, Oct. 6, 1928, p. 688, 2 figs.

VOLTAGE REGULATORS. Tap-Changing Equipment Controls Transformer Voltage, A. Palem. Power, vol. 68, no. 23, Sept. 25, 1928, pp. 519-522, 6 figs.

LARGE, HANDLING. Five Steps in Handling 25,000-Kva. Transformer at Edgar Station. Elec. World, vol. 92, no. 13, Sept. 29, 1928, pp. 634-635, 5 figs.

ELECTRIC WELDING METHODS

INDUSTRIAL. Industrial Methods of Electric Welding and the Equipment Used. Elec. News (Toronto), vol. 37, no. 18, Sept. 15, 1928, pp. 47-49, 1 fig. Outlines three industrial methods of welding electrically; briefly discusses resistance welding, atomic hydrogen welding, arc-welding equipment and atomic-hydrogen welding equipment. Presented in serial report of Indus. Heating Committee of Nat. Elec. Light Assn.

ELECTRICITY SUPPLY

COST DISTRIBUTION, REDUCTION. Reducing Distribution Expense. Elec. World, vol. 92, no. 12, Sept. 22, 1928, p. 563, 1 fig.

EXCAVATING MACHINERY

DRAGLINE. Advantages of the Boom Type Dragline. Brick and Clay Rec., vol. 73, no. 6, Sept. 11, 1928, pp. 378-381, 7 figs.

EXCAVATION

METHODS. Unusual But Effective Methods of Excavating. Contract Rec. (Toronto), vol. 42, no. 38, Sept. 19, 1928, pp. 1003-1004, 5 figs. Hamilton's $1,000,000 Canadian National Railway station now under way; contract involves removal of over 200,000 yards of materials and four new bridges to be built; description of methods and equipment used in excavating.

F

FANS

INDUCED DRAUGHT. Eliminating Inlet Loss in Induced Draught Fans, G. C. Derby. Power Plant Eng., vol. 32, no. 19, Oct. 1, 1928, pp. 1047-1050, 7 figs.

FIREBRICK

SILICA (DINAS). Tridymitization of Dinas Silica Brick, V. N. Shvetzov. Jl. Russkovo Metallurgicheskovo Obshchestva (Leningrad), no. 3, 1928, pp. 61-71, 15 figs. Author reports experimental study of Dinas silica firebrick made by Tartar quartzite at Zlatoustov ceramic plant.

FLOOD CONTROL

MISSISSIPPI RIVER. Some Hydraulic Problems Affecting Flood Prevention Work on the Mississippi, E. H. Schulz. Eng. and Contracting, vol. 67, no. 9, Sept. 1928, pp. 447-450. Paper published in West. Soc. of Engrs.—Tech Papers.

FLOORS, CONCRETE

CRAZING. Crazing of Concrete Floors, R. Kaufman. Concrete, vol. 33, no. 4, Oct. 1928, pp. 44-47, 3 figs.

FLOW OF LIQUIDS

PIPES. Flow of Brine in Pipes, R. E. Gould and M. I. Levy. Univ. of Ill. Eng. Experiment Station—Bul., vol. 26, no. 2, Sept. 11, 1928, 24 pp., 6 figs. Object of this investigation was to determine relation between friction factor and Reynold's number when commercial calcium-chloride factor and Reynold's number when commercial calcium-chloride brine is circulated in standard wrought-iron pipe under conditions encountered in refrigeration practice; fluids in pipes; types of flow; description of apparatus; methods of conducting tests; comparison of results with brass, steel and iron pipe; viscosity of commercial calcium-chloride solutions.

FLOW OF OIL

PIPE, HEAT TRANSMISSION. Heat Tranfer in Oils Flowing Through Pipes, M. Garcia. Indus. and Eng. Chem., vol. 20, no. 9, Sept. 1928, pp. 889-891. Logarithmic mean-temperature difference equation is based on assumptions which are wholly unjustified when dealing with oils, and may give misleading results in heat-transfer calculations; graphical methods are given for calculation of mean liquid temperatures and mean-temperature differences, to be used in correlation of experimental data or design of exchanges for heavy viscous oils involving large temperature ranges.

FORGING MACHINES

HIGH-DUTY. Internal Displacement Principle Aids Forging Practice. Iron Trade Rev., vol. 83, no. 13, Sept. 27, 1928, pp. 778-779, 5 figs. See also Iron Age, vol. 122, no. 13, Sept. 29, 1928, pp. 768 and 769.

FURNACES

FOUNDRY. Notes on a New Furnace for Steel Works Intending to Produce Small Castings, M. G. Lely. Foundry Trade Jl. (Lond.), vol. 39, no. 627, Aug. 23, 1928, p. 132.

G

GALVANIZING

Hot. The Estimation of Zinc Pickup in Hot Galvanizing, E. D. Timmerman. Can. Chem. and Met. (Toronto), vol. 12, no. 9, Sept. 1928. pp. 249-250.

GASES

Calorific Value vs. Combustion Temperature. The Relation Between Calorific Value of Gases and Their Combustion Temperature (Ueber den Zusammenhang zwischen dem Heizwert der Gase und ihrer Verbrennungstemperatur, bzw. die Herleitung und selbsttaetige Aufzeichnung des Heizwertes aus der Temperatur der Abgase), H. Fahrenheim. Waerme (Berlin), vol. 51, no. 33, Aug. 18, 1928, pp. 611-612, 1 fig.

GEARS AND GEARING

Hobs. New Type Gear Hob, G. A. Moore. Machy. (Lond.), vol. 32, no. 827, Aug. 16, 1928, pp. 633-635, 7 figs. Method of grinding hob with disk- and pencil-type wheels; semi-ground form hob of French manufacture; in longitudinal rows of teeth every second recess between two adjacent teeth has its walls and root ground to exact dimensions required, while alternate recesses in same row are all made to greater depth; space roots ground at same operation as flanks; high-production hob with spiral cutting action.

Reduction Gears. Reduction Gears at the 1928 Leipzig Fair (Die Reduktions-Getriebe auf der Leipziger Technischen Messe 1928), C. Bluethe. Schweizerische Bauzeitung Zurish, vol. 92, nos. 11 and 12, Sept. 15 and 22, 1928, pp. 139-142 and 148-152, 17 figs. Descriptive notes on Escher Wyss, Krupp, Flender constant-ratio and variable-ratio, friction or chain, speed-reducing gears; also notes on Lauf-Thoma, Enor, Energator and other hydraulic gears.

Tooth Modification. Hob Corrections for Gear Tooth Modifications, J. A. Hall. Am. Mach., vol. 69, nos. 11, 12 and 13, Sept. 13, 20 and 27, 1928, pp. 431-435, 462-472 and 491-493, 20 figs. Sept. 13: Analysis of straight-line correction are concluded and method for determination of entrance angle is given and illustrated by use of charts and formulas. Sept. 20: Charts are given and explained to simplify calculation of number of modified teeth in contact under worst conditions so that continuity of action is assured. Sept. 27: Method of analysis for hobs with circular corrections now in use; number of gear teeth in contact is constant for all sizes of gears; comparison of five systems of hob correction now in use.

GEODETIC SURVEYING

Levelling Rods. The Geodetic Level Rod—Its Design and Methods of Construction. Instruments, vol. 1, no. 8, Aug. 1928, pp. 347-350, 2 figs.

GEOLOGY

Quebec. The East Coast of Hudson Bay, A. P. Low. Can. Min. Jl. (Gardenvale, Que.), vol. 49, nos. 36 and 37, Sept. 7 and 14, 1928. pp. 712-717 and 736-739, 6 figs.

GEOPHYSICAL EXPLORATION, ELECTRIC

Civil Engineering. Electrical Prospecting Applied to Foundation Problems, I. B. Crosby and E. G. Leonardson. Am. Inst. Min. and Met. Engrs.—Tech. Publication, no. 131, Sept. 1928, 12 pp., 13 figs.

GOLD MINES AND MINING

Nova Scotia. The Montague Gold Mine, Halifax, N.S., S. C. Mifflen. Can. Min. Jl. (Gardenvale, Que.), vol. 49, no. 33, Aug. 17, 1928, pp. 660-661, 4 figs.

Placer, British Columbia. Hydraulic Mining, J. H. Robertson. Can. Min. Jl. (Gardenvale, Que.), vol. 49, no. 32, Aug. 10, 1928, pp. 639-641, 3 figs.

GOLD ORE TREATMENT

Amalgamation. Recovery of Fine Gold by Amalgamation, E. S. Leaver. U.S. Bur. Mines—Information Cir., no. 6081, Aug. 1928, 4 pp. Circular written in response to many requests for information on recovery, or reasons for poor recovery, of fine gold by amalgamation process; checking gold content; nature of gold; float and rusty gold; effect of impurities; placer gold; cyanidition is usual method for recovery of gold lost in amalgamation process.

Tailings Retreatment. Retreatment of Comstock Tailings, E. S. Leaver and J. A. Woolf. Eng. and Min. Jl., vol. 126, no. 12, Sept. 22, 1928. pp. 448-450. Article previously indexed from U.S. Bur. Mines—Report of Investigations, no. 2883, July 1928.

GRAIN ELEVATORS

Construction. New Grain Elevator and Malt House. Contract Rec. (Toronto), vol. 42, no. 36, Sept. 5, 1928, pp. 956-957, 4 figs. Description of new grain elevator and malt house costing $600,000 being erected for Canadian Malting Co.; 15 round tanks 100 ft. high, 25 ft. 6 in. in diameter centre to centre of wall, 5 square tanks 14 ft. by 10 ft. and warehouse all of reinforced concrete resting on wood piles; description of construction operation.

GRAPHITE ORE TREATMENT

Flotation. The Concentration of Flake Graphite Ores, C. S. Parsons. Can. Min. Jl. (Gardenvale, Que.), vol. 49, no. 39, Sept. 28, 1928, pp. 778-781, 3 figs.

GYPSUM DEPOSITS

Description of. Gypsum and Anhydrite, F. A. Wilder. Am. Mineralogist, vol. 13, no. 9, Sept. 1928, pp. 476-480, 3 figs. Gypsum is important in building industry; output in 1926 was 5,635,411 tons, including 200,000 tons of anhydrite; many important gypsum deposits were originally anhydrite; general notes of occurrences in Nova Scotia, New Brunswick, Newfoundland and Prince Edward Island, in Canada; at least half of gypsum deposits in United States are associated with anhydrite; latter lacks water of crystallization and cannot be changed to semi-hydrate by calcination.

H

HAMMERS

Power. Foundations of Power Hammers (Hammerfundamente). E. Rausch. Beton u. Eisen (Berlin). vol. 27. no. 17, Sept. 5. 1928, pp. 321-327. 8 figs.

HARDNESS

Measurements of. Apparatus and Methods for Measurement of the Hertzian Hardness. R. Esnault-Pelterie. Engineer (Lond.), vol. 146. nos. 3788, 3789 and 3790. Aug. 17. 24 and 31. 1928. pp. 180-181, 196-197 and 220-222, 9 figs. Paper read before Brit. Section of Société des Ingénieurs Civils de France.

HELIUM

Canada. Petroleum and Natural Gas in Ontario. R. B. Harkness. Petroleum Times (Lond.). vol. 20. no. 504. Sept. 8, 1928. p. 412. Abstract of paper read before Min. and Met. Congress.

HIGH BUILDINGS

Wind Bracing, Design. Practical Design of Wind Bracing, C. T. Morris. Am. Inst. of Steel Constr.—Reprint of paper presented Oct. 1927, 12 pp., 7 figs. Author enumerates uncertainties involved in proper design of wind bracing; approximate methods; Smith's method; slope-deflection method; Ross method; wind velocities and resulting pressures.

HOUSING

Industrial, Canada. The Housing of Industrial Classes in Canada, A. G. Dalzell. Town Planning (Ottawa), vol. 7, no. 5, Oct. 1928, pp. 123-126.

HYDRAULIC TURBINES

Design. Alignment Charts As An Aid in the Design of Hydraulic Turbines (Fluchtentafeln und Wanderkurvenblatt als Hilfsmittel beim Entwerfen von Wasserturbinen), E. Thomas. Seimens-Zeit. (Berlin), vol. 8, no. 7, July 1928, pp. 403-414, 5 figs.

Draught Tubes. Improvements in Draught Tube Result in Large Savings, J. Jacob. Power, vol. 68, no. 11, Sept. 11, 1928, pp. 440-441, 2 figs.

Impulse, Speed Control of. The Speed Control of Impulse Turbines. Engineer (Lond.), vol. 146, no. 3790, Aug. 31, 1928, p. 238, 5 figs.

Testing. Measurements of Hydraulic Turbine Gate Leakage, E. B. Strowger. Power Plant Eng., vol. 32, no. 19, Oct. 1, 1928, pp. 1051-1052, 2 figs. Abstract of N.E.L.A. Hydraulic Power Committee report.

HYDRO-ELECTRIC POWER DEVELOPMENTS

Progress and Trend. Progress and Trend in Hydraulic Power Development, H. A. Hageman. Mech. Eng., vol. 50, no. 10, Oct. 1928, pp. 765-766. Paper presented at Mid-West Power Conference, Chicago, Ill., Feb. 14-17, 1928.

British Columbia. The Bridge River Power Plant, F. H. Fullerton. Elec. Rev. (Lond.), vol. 103, no. 2653, Sept. 28, 1928, pp. 507-510, 8 figs. Undertaking of British Columbia Electric Railway Co. will be largest hydro-electric power development scheme in Canada, excepting that of Niagara Falls; it is expected to yield 600,000 h.p.; power is distributed over wide area by means of 16 major substations; initial dam will be overflow type; station No. 1 will provide for 60,000 k.w.

Alouette Hydro-Electric Development. Can. Engr. (Toronto), vol. 55, no. 10, Sept. 4, 1928, pp. 271-274, 6 figs. Principal construction features of development at Alouette Lake undertaken by British Columbia Electric Railway Co.; embankment built of dense clay; concrete dam and spillway; tunnel 3,539 ft. long connects Alouette and Slave Lakes.

Canada. Water Power and Industry in Canada. Elec. Times (Lond.), vol. 74, no. 1925, Sept. 13, 1928, pp. 341-342, 2 figs. Author touches upon remarkable way in which water power has transformed and is transforming Canadian industry; official figures given by Minister of Interior state that Canada had hydro-electric installations with total capacity of 4,777,921 h.p. in operation at close of 1927.

Nova Scotia. Mersey River Hydro-Power Development, H. W. Mahon. Can. Engr. (Toronto), vol. 55, no. 13, Sept. 25, 1928, pp. 325-328, 3 figs. Nova Scotia Power Commission will construct three hydro-electric power developments on Mersey River which will have total turbine capacity of 30,900 h.p., all stations being automatically controlled from substation at Big Falls; newsprint mill at Brooklyn, N.S.

Quebec. Paugan Development Takes Its Place Among Largest Hydro Plants in America. Power, vol. 68, no. 15, Oct. 9, 1928, p. 614, 1 fig.

Montreal Island Power Development Is In Full Swing. Contract Rec. (Toronto), vol. 42, no. 39, Sept. 26, 1928, pp. 1011-1012, 2 figs.

Sweden. Swedish Hydro-Electric Power on Increase. Power, vol. 68, no. 14, Oct. 2, 1928, pp. 577-578.

Washington. Many Novel Features Involved in Chelan Project, E. H. Collins. Elec. West, vol. 61, no. 3, Sept. 1. 1928. pp. 129-133, 12 figs.

HYSTERESIS

Elastic. Determination of Elastic Hysteresis of Construction Materials by Means of the Porsional Deflection Apparatus (Bestimmung der Werkstoffdaempfung mittels der Verdrehungs-Ausschwingmaschine), O. Foeppl. V.D.I. Zeit. (Berlin), vol. 72, no. 37, Sept. 15, 1928. pp. 1293-1296, 4 figs.

I

IMPACT TESTING

Notched-Bar The Notched-Bar Impact Test (Ueber die Kerbschlagprobe [Schlagbiegeprobe]). E. Honegger and M. Ros. Schweiz. Verband fuer die Materialpruefungen der Technik, Bericht no. 5, March 1927, 63 pp., including discussion, 69 figs. Theory of impact testing, general review of research work; description of Charpy, Izod, Amsler and Guillery impact-testing apparatus; examples from practice, microstructure of tested specimens.

INDUSTRIAL PLANTS

Design. Modern Practice in Location, Layout and Design, C. P. Wood. Chem. and Met. Eng., vol. 35, no. 9, Sept. 1928, pp. 528-530, 2 figs.

Enlargement. Enlarging the Factory on an Assured Profit-Paying Basis. W. W. Hay. Mfg. Industries, vol. 16, no. 5, Sept. 1928, pp. 333-336, 5 figs.

INTERNAL-COMBUSTION ENGINES

Design. Internal-Combustion Engines (Verbrennungsmotoren), F. Schultz, M. Seiliger, F. Romberg and R. Pawlikowski. V.D.I. Zeit. (Berlin), vol. 72, no. 37, Sept. 15, 1928, pp. 1279-1285, 21 figs. Abstracts of papers read and discussed at sectional session of 1928 annual meeting of German Society of Engineers (V.D.I.) on design of automotive Diesel engines, increasing speed of automotive engines; experiments with Diesel engine injection nozzles and pulverized coal engines.

Heavy Oil. New Methods of Using Fuel of High Boiling Point in Internal-Combustion Engines (Neue Wege zur Verarbetiung hochsiedender Kraftstoffe in Verpuffsmotoren), H. Ellerbusch. Motorwagen (Berlin), vol. 31, no. 24, Aug. 31, 1928. pp. 551-558, 5 figs. Greater economy and safety of heavy oils as fuel: description of vaporizing cylinder, manufactured by Gesellschaft fuer Kohlentechnik, which makes possible use of heavy fuel oils in ordinary internal-combustion engine without unfavorable effect on lubricating oil and other customary disadvantages; results of tests carried out on 4-cylinder motor-truck engine.

Supercharging. Supercharging for Sea-Level Conditions, C. F. Taylor and L. M. Porter. Soc. Automotive Engrs.—Jl., vol. 23, no. 4. Oct. 1928. pp. 359-361.

See also Aircraft Engines; Automobile Engines; Diesel Engines; Oil Engines.

IRON FOUNDRIES

Practice. Present and Future Problems of Iron Foundry Practice (Gegenwaertige und zukenftige Probleme im Eisengiessereiwesen), T. Geilenkirchen. Giesserei (Duesseldorf). vol. 15. nos. 35 and 36. Aug. 31 and Sept. 7, 1928, pp. 853-860 and 889-899, 16 figs.

L

LACQUERS

CELLULOSE TYPE. The Development of Duco Type Lacquers, M. J. Callahan. Chem. and Industry (Lond.), vol. 47, no. 34, Aug. 24, 1928, pp. 232T-239T, 3 figs.

LATHES

TESTING. Determination of the Efficiency of a Lathe (Wirkungsgradbestimmung an einer Drejbank), M. Coenen. Maschinenbau (Berlin), vol. 17, no. 7, Sept. 6, 1928, pp. 806-809, 6 figs. Author describes construction and method of testing efficiency of Reinecker constant-speed-drive lathe; tests made at testing laboratory of Chemnitz Gewerbeakademie.

LEATHER

TESTING. Some Comparative Data on Vegetable and Chrome-Retanned Sole Leather, R. W. Frey, I. D. Clarke and L. R. Leinbach. Am. Leather Chemists Assn.—Jl., vol. 23, no. 9, Sept. 1928, pp. 430-439 and (discussion) 440-441, 1 fig. on supp. plate.

LEVEES

CONSTRUCTION. Dredging As An Aid in Levee Construction, S. C. Godfrey. Military Engr., vol. 20, no. 113, part 1, Sept.-Oct. 1928, pp. 416-422, 9 figs. Notes refer to five different tasks of general character performed by Dredging District of the Mississippi River Commisson during past two years.

LOCOMOTIVES

ELECTRIC. *See Electric Locomotives.*

FUEL ECONOMY. Steam and Fuel Economy Devices on American Locomotives. Engineer (Lond.), vol. 146, no. 3789, Aug. 24, 1928, pp. 197-198.

INTERNAL-COMBUSTION. An Internal-Combustion Engined Locomotive. Gas and Oil Power (Lond.), vol. 23, no. 276, Sept. 6, 1928, pp. 237, 1 fig. Details of 6-cylinder vertical-type engine built by National Gas Engine Co. and locomotive built by Hudswell Clark and Co. for use on plantations in Australia where coal for fuel is not available; engine is designed to run on gasoline, paraffin or wood alcohol; easy starting attained by 3½-h.p. air-cooled engine; power unit is capable of developing 102 h.p. at 1,000 r.p.m.

PACKING RINGS, MACHINING OF. Device for Machining Locomotive Packing Rings, W. Salmon. Ry. Mech. Engr., vol. 102, no. 9, Sept. 1928, p. 520, 4 figs.

PULVERIZED COAL. The A.E.G. Pulverized Coal Locomotive (A locomotive A.E.G. de combustivel pulverisado), W. Kleinou. Revista Brasilieira de Engenharia (Rio de Janeiro), vol. 8, nos. 6 and 7, June and July 1928, pp. 210-220 and 249-259, 23 figs.

STEAM-TURBINE. Development of Boiler Design for Steam-Turbine Locomotives. Boiler Maker, vol. 28, no. 9, Sept. 1928, pp. 258-260, 6 figs. Boilers to carry 450 lb. pressure will be one-third of standard boiler weight; proposed design for 2,500-h.p. steam-turbine locomotive suitable for either heavy passenger or fast freight service; starting tractive force to be 100,000 lb. and maximum speed 65 mi. per hr.; boiler of water-tube type; pulverized coal burners; feedwater heater, pump and injector.

LOCOMOTIVE TENDERS

BRITISH. Tenders of British Locomotives Making Long Non-Stop Runs. Can. Ry. and Mar. World (Toronto), no. 367, Sept. 1928, p. 539, 1 fig.

LUBRICATING OILS

AUTOMOTIVE, VISCOSITY OF. Viscosity Most Important Property, H. C. Mougey. Oil and Gas Jl., vol. 27, no. 18, Sept. 20, 1928, pp. 149, 150 and 155.

LUMBER

DRYING BY SUPERHEATED STEAM. Drying by Means of Superheated Steam (Trocknung mittels ueberhitzten Dampfes), K. Heinrich. Waerme (Berlin), vol. 51, no. 35, Sept. 1, 1928, pp. 641-643, 1 fig.

M

MACHINERY

EXHIBITION, CANADA. Canadian National Exhibition Emphasizes the Latest in Engineering Practice, D. M. Duncan. Can. Machy. (Toronto), vol. 39, no. 19, Sept. 20, 1928, pp. 59-60 and 69, 5 figs.

MACHINE SHOPS

ENGLISH. The Edgwick Works of Alfred Herbert, Ltd. Engineer (Lond.), vol. 146, no. 3791, Sept. 7, 1928, pp. 248-251, 9 figs. Activities of Alfred Herbert, Ltd., machine-tool makers of Coventry, have been divided between two factories separated by distance of some three miles; two establishments have now been amalgamated and following notes give some idea as to how process of transference has been accomplished without any interference with programme of production, and indicate extent of firm's present equipment.

MACHINE DESIGN

FORKED ENDS. Standardized Forks and Motion Pins. Machy. (Lond.), vol. 32, no. 829, Aug. 30, 1928, pp. 686-687, 9 figs. Suggestion for standardized range of forked ends and motion pins, designed with view to facilitating cheap production; principal proportions of forks are based on diameter of motion pin and are easily remembered by draughtsmen.

MACHINE TOOLS

EXHIBITION, LONDON. Machine Tool Exhibition, Olympia. Engineer (Lond.), vol. 146, nos. 3791 and 3792, Sept. 7 and 14, 1928, pp. 251-256 and 274-280, 40 figs. Exhibition represents distinct advantage in general character of technical exhibitions in Great Britain; general impressions given; brief descriptions of exhibits according to makes. See also special 16-page supplement in issue of Sept. 7, 1928, giving descriptions of exhibits.

MALLEABLE IRON CASTINGS

PRODUCTION COSTS. Burden, Melting and Annealing Costs for High-Grade Malleable Castings (Gattierungs, Schmelz und Gluehkosten fuer hochwertigen Temperguss), R. Stotz. Giesseri (Duesseldorf), vol. 15, no. 37, Sept. 14, 1928, pp. 905-911, 5 figs.

MATERIALS HANDLING

CONSTRUCTION WORK. Materials Handling at Conowingo. Elec. World, vol. 92, no. 13, Sept. 29, 1928, p. 600, 3 figs. Illustrations are presented of unusual materials handling methods in construction of dam and power house at Conowingo, Md.; illustrations include specially constructed travelling derrick and construction bridge and gantry travellers for work on dam.

GRAB BUCKETS. Progress in the Design of Grab Winches. Demag News (Duisburg), vol. 2, no. 4, Oct. 1928, pp. 81-91, 24 figs.

MECHANISMS

MOTION ANALYSIS OF. How Motion of a Mechanism May Be Analyzed Geometrically, W. Samuels. Automotive Industries, vol. 59, nos. 11 and 12, Sept. 15 and 22, 1928, pp. 366-369 and 406-408 and 417, 3 figs.

MERCURY-VAPOR PROCESS

DEVELOPMENTS IN. Tendencies in Development of Vapor Engines Using One or More Working Fluids (Entwicklungsrichtung der Ein- und Mehrstoffdampfmaschinen), W. Gumz. Brennstoff und Waermewirtschaft (Halle), vol. 10, nos. 12 and 13, June 2 and July 1, 1928, pp. 223-227 and 241-247, 10 figs.

METALS

FATIGUE. Fatigue Phenomena, With Special Reference to Single Crystals, H. J. Gough. Roy. Soc. of Arts—Jl. (Lond.), vol. 76, nos. 3955 and 3956, Sept. 7 and 14, 1928, pp. 1025-1044 and 1045-1062, 9 figs. Sept. 7: Fatigue strength of metals related to external straining forces (stress effects); stress systems employed in laboratory and some typical testing machines; effect of frequency of applied cycle of stress upon endurance limit; influence of mean stress of cycle on limiting range of stress. Sept. 14: Influence of sudden changes of section and of surface defects upon fatigue strength of metals.

TESTING. On Thermal Brittleness in Metals, T. Inokuty. Tohoku Imperial Univ.—Sci. Reports (Sendai), vol. 17, no. 4, July 1928, pp. 817-842, 18 figs.

MILLING MACHINES

HIGH-SPEED STEEL. The Influence of Degree of Elongation and Upsetting on Efficiency of High-Speed Steel Milling Machines (Ueber den Einfluss des streckungs und Stauchungsgrades auf die Leisteungsfaehigkeit von Schnellstahlfraesern), R. Hohage and R. Rollett. Stahl und Eisen (Duesseldorf), vol. 48, no. 36, Sept. 6, 1928, pp. 1243-1247, 14 figs.

HYDRAULIC FEED. Hydraulic Drive for Milling Machines (Hydraulischer Fraesmaschinenantrieb), H. Narath. Maschinenbau (Berlin), vol. 17, no. 7, Sept. 6, 1928, pp. 818-821, 8 figs.

MINE TIMBER

PRESERVATION. Timber Treatment Plants, Where and How to Operate Them, L. D. Tracy. Coal Age, vol. 33, no. 9, Sept. 1928, pp. 537-539, 4 figs.

MINES AND MINING

BRITISH COLUMBIA. British Columbia Is Expanding Its Mining Activities, T. A. Rickard. Eng. and Min. Jl., vol. 126, no. 13, Sept. 29, 1928, pp. 486-490, 3 figs. Review of recent progress; 1927 mineral output was largest recorded; value lower, because of market conditions; Sullivan mine, of Consolidated Mining and Smelting Co. of Canada, important factor; smelter at Trail; Premier Gold Mining Co. in Portland canal district; Granby Consolidated; Duthie silver-lead-zinc mine in northeastern district; Britannia mine, biggest copper producer in British Empire; Coast Copper on Quatzino island; comment of lack of old-time prospector.

CAVING. Comparison of Branch Raise and Combined Shrinkage and Caving Methods, C. A. Mitke. Am. Inst. Min. and Met. Engrs.—Tech. Publication, no. 136, Sept. 1928, 11 pp. Full text of paper previously indexed from Min. and Met., Sept. 1928.

LAWS, CANADA. Notes on Mining Laws in Canada, W. B. McPherson. Can. Min. Jl. (Gardenvale, Que.), vol. 49, nos. 37 and 38, Sept. 14 and 21, 1928, pp. 740-744 and 761-763. Sept. 14: Notes to give general view of legislation applicable to mining in various parts of Canada; outline of Dominion regulations regarding coal, petroleum and natural gas, dredging; alkali, carbon-black production from natural gas and quarrying; details of procedure by separate provinces. Sept. 21: Mining laws of British Columbia, Manitoba, Alberta, Saskatchewan, Yukon and Northwest Territories.

NOVA SCOTIA. The Mining Industry of Nova Scotia, J. P. Messervey. Min. and Met., vol. 9, no. 262, Oct. 1928, pp. 433-439, 5 figs.

STRATIFIED DEPOSITS. The Working of Coal and Other Stratified Minerals, H. F. Bulman. Nature (Lond.), vol. 122, no. 3072, Sept. 15, 1928, pp. 394-396.

MINING GEOLOGY

NEWFOUNDLAND. The Geology of the Central Mineral Belt of Newfoundland, A. K. Snelgrove. Can. Min. and Met.—Bul. (Montreal), no. 197, Sept. 1928, pp. 1057-1127, 8 figs. Bibliography, with 77 items.

MOTOR CARS (RAILROAD)

STEAM. Articulated Steam Rail Cars. Modern Transport (Lond.), vol. 20, no. 498, Sept. 29, 1928, pp. 5 and 18, 7 figs. Clayton twin coaches for Egyptian state railways; two carriages with trailer truck at each end and driving trucks in middle; total seating accommodation for 115 passengers; articulation; engine is Clayton standard rail-car type carried horizontally between two axles, and is mounted in bearings on one axle; designed to maintain speed of 60 km. in service with full load.

MOTOR TRUCK REGULATIONS

ONTARIO. Ontario Motor Truck Operation Regulation Put Into Effect. Can. Ry. and Mar. World (Toronto), no. 367, Sept. 1928, pp. 553-555, 1 fig. Public Commercial Vehicle Act goes into force on Sept. 17, 1928; act is given in full; regulations for motor truck operation.

N

NATURAL RESOURCES

CANADA. The Natural Resources of the Hudson Bay Basin, R. B. Stewart. Can. Min. and Met.—Bul. (Montreal), no. 196, Aug. 1928, pp. 1002-1014.

O

OIL ENGINES

DOUBLE-ACTING MARINE. A 4,000-B.H.P. Double-Acting Two-Stroke Oil Engine. Engineer (Lond.), vol. 146, no. 3790, Aug. 31, 1928, pp. 234-236, 3 figs. Engine, constructed for submarine repair and depot ship Medway, differs in some respects from standard design of licensees, mainly with regard to auxiliaries and special provisions made in order to meet Admiralty practice; there are four working cylinders, with bore of 27 ft. 6 in. and stroke of 47.25 in., which are arranged in two pairs, with three-stage air-injection compressor between second and third cylinders.

OIL FIELDS

ALBERTA, CANADA. The Oil Industry of Alberta. Petroleum Times (Lond.), vol. 20, no. 505, Sept. 15, 1928, pp. 457-458 and 460, 2 figs. Drilling began in Medicine Hat (Redcliff) gas fields in 1888; renewed activity in 1908 and 1914; many wild-cat ventures during Calgary boom; remarkable development since 1925, when Alberta produced 143,134 bbl. of Canada's total of 332,001; Imperial Oil Co., Ltd., controls chief workings; proven areas in Turner Valley, Irma-Wainwright and Skiff oil fields; some details of Turner Valley wells.

CANADA. Petroleum and Natural Gas in Ontario, R. B. Harkness. Petroleum Times (Lond.), vol. 20, no. 504, Sept. 8, 1928, p. 412. Abstract of paper read at Min. and Met. Congress.

OIL SHALE MINES AND MINING

OPEN PIT. Can Oil Shale Be Mined by Stripping Methods? F. E. Cash and M. W. von Bernewitz. Min. Congress Jl., vol. 14, no. 9, Sept. 1928, pp. 665-668 and 733, 10 figs.

OPEN-HEARTH FURNACES

DESIGN. Information on Construction of Open-Hearth Furnaces in United States (Données sur la construction des four Martin aux Etats-Unis), F. Leperonne. Revue Universelle des Mines (Liège), vol. 19, no. 3, Aug. 1, 1928, pp. 109-123, 9 figs. Types and capacities of furnaces; description of stationary furnaces, their foundations and lining; doors; brick lining and lining of clay of magnesia; cooling of masonry; recuperators and dust chambers; mean life of different parts of furnaces.

ORE DEPOSITS

THEORY. Our General Metalogenic Theories (Nuestras teorias generales metalogenicas) J. Hereza y Ortunyo. Revista Minera Metalurgica y de Ingenieria (Madrid), vol. 79, nos. 3135, 3136 and 3137, Sept. 8, 16 and 24, 1928, pp. 421-422, 434-436 and 448-450, 3 figs.

ORE TREATMENT

FLOTATION. Flotation Separation Tests, B. W. Holman. Min. Mag. (Lond.), vol. 39, no. 3, Sept. 1928, pp. 150-161, 10 figs.

P

PAINT

TESTING. Wear of Protective Paints of Vehicles (Beanspruchung von Schutzanstrichen an Fahrzeugen). O. Koenig. V.D.I. Zeit. (Berlin), vol. 72, no. 35, Sept. 1, 1928, pp. 1213-1219 and (discussion) 1219-1220, 31 figs. Paper read at session of paint section of 1928 annual meeting of Society of German Engineers (V.D.I.).

PAVEMENT CONCRETE

BRITISH COLUMBIA. Concrete Pavements in B.C. Can. Engr. (Toronto), vol. 55, no. 9, Aug. 28, 1928, p. 263, 4 figs.

PETROLEUM GEOLOGY

ALBERTA, CANADA. Two Interesting Boulders in the Glacial Deposits of Alberta, R. L. Rutherford. Jl. of Geology, vol. 36, no. 6, Aug.-Sept. 1928, pp. 558-563, 1 fig.

PIPE LINES

WELDING. The Strength of Welds in Pipe Lines, J. B. Graham. Oil and Gas Jl., vol. 27, no. 15, Aug. 30, 1928, pp. T-148, T-151, T-153 and T-156, 17 figs.

PLATES

RECTANGULAR. Experiments with Simply Supported Rectangular Plates Carrying Single Concentrated Loads (Versuche mit frei aufliegenden rechteckigen Platten unter Einzelkraftbelastung), M. Bergstraesser. Forschungsarbeiten auf dem Gebiete des Ingenieurwesens (Berlin), vol. 302, 1928, 25 pp., 55 figs. Report from department of applied mechanics of University of Goettingen; fundamental equations of theory of plates; Nadai solution; details of experimental equipment and methods for testing square and rectangular glass plates; results of tests compared with computations based on Nadai theory.

POWER

COSTS. Costs of Effective Horse Power-Hour for Various Types of Prime Movers for Powers Less Than 200-H.P. (Prix de revient du cheval-heure effectif pour divers types de force motrice pour des puissances inférieures à 200 chevaux), Géronimi. Chaleur et Industrie (Paris), vol. 9, no. 100, Aug. 1928, pp. 459-462, 10 figs.

POWER PLANTS, DIESEL

WOODWORKING PLANTS. Why Diesel Engines Were Selected and the Results, W. G. Schaphorst. Indus. Woodworking, vol. 28, no. 12, Sept. 1928, pp. 56 and 58, 1 fig. Why New York City woodworking concern abandoned use of central station electric current and what it saved by installing Diesel engines to drive its own electric generators.

POWER PLANTS, ELECTRIC

SUBSTATIONS. Lightpipe 200-Kv. Substation, R. B. Pollock. Elec. World, vol. 92, no. 12, Sept. 22, 1928, pp. 559-563, 5 figs. Southern California Edison Co. establishes important steam and hydro power distribution point.

SUBSTATIONS, DESIGN. Layout of a Hypothetical Substation. Nat. Elec. Light Assn.—Bul., vol. 15, no. 9, Sept. 1928, pp. 544-554, 10 figs. Paper presents several solutions of problem in design of hypothetical substations, as submitted by certain members of Electrical Apparatus Committee, Engineering National section, N.E.L.A.; statement of problem; high-tension switching; 4,000-volt layout; oil circuit breakers; feed to large customers; transmission; substation transformer capacity.

POWER PLANTS, STEAM

ASH HANDLING. Ash Handing in Boiler Houses (Die neuzeitlichen Mittel zur Abfoerderung der Asche in Kesselhaeusern). Wintermeyer. Foerdertechnik u. Frachtverkehr (Wittenberg), vol. 21, no. 13, June 22, 1928, pp. 243-247, 8 figs. See brief translated abstract in Eng. and Boiler House Rev. (Lond.), vol. 42, no. 3, Sept. 1928, p. 145.

COMBINED HEATING AND POWER. Combined Power and Heat (Kupplung von Kraft und Waerme), A. G. Ernst. Archiv fuer Waermewirtschaft (Berlin), vol. 9, no. 9, Sept. 1928, pp. 299-300, 1 fig.

EUROPE. Summary of European Developments, A. G. Christie. Nat. Elec. Light Assn.—Serial Report, No. 278-77, uly 1928, pp. 1-2. Developments in high-pressure boilers; pulverized coal; air heaters; furnaces; prime movers; peak loads.

FLUE-GAS RECORDERS. Power House Measurements. World Power, vol. 10, no. 57, Sept. 1928, pp. 271-274, 6 figs.

HIGH-PRESSURE. The Economy of High-Pressure Power Plants (Die Wirtschaftlichkeit von Hochdruckdampfanlagen). W. Schultes. Waerme (Berlin), vol. 51, no. 30, July 28, 1928, pp. 546-555, 14 figs. Notes on heat and economy balance; calculation of overhead; permissible initial costs for high-pressure plants.

OPERATION SCHEDULES. Scheduling Units in the Power Plant, D. C. Zimmermann. Power, vol. 68, no. 23, Sept. 25, 1928, pp. 515-518, 12 figs.

TEXTILE MILLS. Power Practically a By-Product in New Steam Plant Development in Cone Mills, D. G. Woolf. Textile World, vol. 74, no. 10, Sept. 8, 1928, pp. 15-16, 2 figs. Unit based on quantity of steam required for process and heating purposes; two new Heine boilers are replacing 35 boilers; each boiler is 863 h.p.; pulverized coal is used as fuel; General Electric Co. double-extraction type turbine, 3,500-kw.; transportation of steam.

POWER PLANTS, STEAM-ELECTRIC

GERMANY. Three Continental Stations, W. H. Fulweiler. Nat. Elec. Light. Assn. Serial Report, No. 278-77, July 1928, pp. 2-6, 3 figs. Details of Langerbrugge and Rummelsburg central stations; Benson boiler installation at Cable Works of Siemens-Schuckert Co.; operation of this boiler.

LONG BEACH, CALIF. Provision Made for Three Fuels at Long Beach, G. A. Fleming. Elec. World, vol. 92, no. 14, Oct. 6, 1928, pp. 672-679, 13 figs. New building, plant No. 3, has been started adjacent to two older stations for ultimate of eight large units; turbine is General Electric tandem-compound unit with 18 high-pressure and 3 low-pressure double-flow stages; steam is bled at four points; 3 Babcock and Wilcox boilers are provided for 90,000-kw. unit; oil and natural gas are used as fuels, burned in combination Peabody burners. See also editorial comment on p. 671.

POWER TRANSMISSION

MECHANISMS. Development of Oscillating Power-Transmitting Mechanisms (Die Entwicklung schwingender Leistung ueber tragender Mechanismen), H. Schieferstein. Maschinenbau (Berlin), vol. 17, no. 7, Sept. 6, 1928, pp. 809-814, 17 figs.

PROTECTIVE COATINGS

LEAD. Homogeneous Lead Coating. Can. Chem. and Met. (Toronto), vol. 12, no. 9, Sept. 1928, pp. 256-258. Abstract translated from V.D.I. Zeit.

PUMPS

SCREW VISCOSITY. Screw Viscosity Pumps, H. S. Rowell and D. Finlayson. Engineering (Lond.), vol. 126, nos. 3268 and 3272, Aug. 31 and Sept. 28, 1928, pp. 249-250 and 385-387, 13 figs. Aug. 31: Pump, which was first demonstrated by J. Dewrance in 1922, consists of rotor on which are cut right- and left-hand screw threads; rotor turns within closely-fitting sleeve and is forced by viscous drag to delivery port. Sept. 28: Discussion of experimental results.

SELECTION. Selection of Waterworks Pumps to Fit Service Conditions, F. G. Cunningham. Contract Rec. (Toronto), vol. 42, no. 38, Sept. 19, 1928, pp. 997-999 and 1004. Paper presented before Am. Water Works Assn. and published in Aug. 1928 issue of Journal, previously indexed. (To be continued.)

PUMPS, CENTRIFUGAL

VELOCITY HEAD. Velocity Head on Centrifugal Pumps, G. H. Gibson. Can. Engr. (Toronto), vol. 55, no. 11, Sept. 11, 1928, pp. 297-298, 2 figs.

PUNCH PRESSES

TOOLS FOR. Double-Production Press Tools. Machy. (Lond.), vol. 32, no. 828, Aug. 23, 1928, pp. 661-663, 8 figs.

R

RAILROADS

SWITCHES, SPRING. South Shore Line Uses Spring Switches on Heavy Traffic Line, B. L. Smith. Ry. Age, vol. 85, no. 10, Sept. 8, 1928, pp. 455-456, 3 figs. See also Ry. Signalling, vol. 21, no. 8, Sept. 1928, pp. 331-332, 3 figs.

TRACKS, VIBRATION. Dynamics and Vibrations in Railroad Track (Dynamik und Schwingungen des Eisenbahnoberbaues), Saller. V.D.I. Zeit. (Berlin), vol. 72, no. 38, Sept. 22, 1928, pp. 1323-1329, 19 figs. Paper read at Darmstadt conference on vibrations of Society of German Engineers (V.D.I.) on effect of vibrations on railroad track and its bearing on selection of materials and type of construction for ties and rail joints; methods of measuring vibration stresses; description of Okhuizen and Geiger instruments; comparison of simultaneous vibration records, obtained by Geiger and Okhuizen instruments, for trains moving with velocities of from 22 to 90 km. per hr.

SWITCHES, REMOTE CONTROL. The Economic Value of Remote Power Switch Machines. Ry. Age, vol. 85, no. 11, Sept. 15, 1928, pp. 501-503. Abstract of report presented before Am. Ry. Assn.

TRACKS, MAINTENANCE AND REPAIR. Roadmasters View Problems as Cogs in Transportation Machine. Ry. Age, vol. 85, no. 13, Sept. 29, 1928, pp. 619-625. See also Ry. Eng. and Maintenance, vol. 24, no. 10, Oct. 1928, pp. 425-446.

TRACKS, RELOCATION. Grand'Mere-Shawinigan Track Diversion. Can. Engr. (Toronto), vol. 55, no. 9, Aug. 28, 1928, pp. 253-255, 5 figs. Principal features of construction of 8 miles of track for diversion near Shawinigan Falls, Que.; 40 concrete culverts provide outlet for numerous springs and drain roadbed; total cost over $2,000,000.

WELDING PRACTICE. Autogéneous Welding, S. Lewis. Ry. Jl., vol. 34, no. 9, Sept. 1928, pp. 27-30. Address before Int. Railroad Master Blacksmiths Assn.

RAILS

JOINTS, WELDING. Recent Developments in Arc Welding of Rail Joints, H. C. Heaton. Elec. Ry. Jl., vol. 72, no. 13, Sept. 29, 1928, pp. 577-578. Abstract of address before Am. Elec. Ry. Eng. Assn.

RECLAMATION OF LAND

HOLLAND. Engineering Features of the Zuyderzee Works, J. W. Thierry. Engineering (Lond.), vol. 126, no. 3269, Sept. 7, 1928, pp. 305-308, 9 figs. General scheme consists in enclosing Zuyderzee by large enmbankment along Waddenzee; of enclosed area (915,000 acres) four parts or polders of total area of 550,000 acres will be reclaimed separately; in centre will be left fresh-water lake of 270,000 acres, in which solid matter from Yssel will settle without any danger of silting it up; problems arising in connection with enclosing area; embankment and dam construction; pumping stations. Paper read before Brit. Assn.

RECTIFIERS

MERCURY-ARC. High-Power Mercury-Vapor Rectifiers (Redresseurs à vapeur de mercure de grande puissance). Industrie Electrique (Paris), vol. 37, no. 869, Sept. 10, 1928, pp. 394-403, 11 figs.

MERCURY-ARC, SUBSTATIONS, ONTARIO. Hamilton's New Automatic Mercury-Arc Rectifier Substation, C. E. Hutton. Elec. News (Toronto), vol. 37, no. 18, Sept. 15, 1928, pp. 29-32, 6 figs.

REFRIGERATION

EVAPORATING SYSTEMS. Modern Refrigeration Evaporating Systems, G. Hilger. Refrig. Eng., vol. 16, no. 4, Oct. 1928, pp. 99-106 and (discussion) 106-109, 14 figs.

The Evaporating System, F. P. MacNeill. Ice and Cold Storage (Lond.), vol. 31, no. 366, Sept. 1928, pp. 225-228, 1 fig.

RESERVOIRS

GATE TOWERS, ICE THRUST. Gate Towers, Tilted by Ice, Returns to Position, G. N. Carter. Eng. News-Rec., vol. 101, no. 14, Oct. 4, 1928, p. 502, 1 fig.

ROAD MATERIALS

TAR SANDS. Roads from Athabaska Tar Sands, H. O'Hagan. Am. City, vol. 39, no. 3, Sept. 1928, pp. 121-122, 3 figs. Bituminous sand deposits in western Canadian province have long been thought to possess interesting possibilities for road building; practical test, under supervision of Canadian National Parks, has recently been made in Jasper National Park with satisfactory results claimed; method of quarrying.

ASPHALT SURFACING, ENGLAND. Road Surfacing with Cold Asphalt. Surveyor (Lond.), vol. 74, no. 1912, Sept. 14, 1928, pp. 241-242, 3 figs.

Construction, Canada. Reconstruction of the Old Caribou Road in Canada, P. Philip. Eng. and Contracting, vol. 67, no. 9, Sept. 1928, pp. 463-467, 7 figs.

Curve Layouts. Transition Curves and Superelevation, F. G. Royal-Dawson. Roads and Road Constr. (Lond.), vol. 6, no. 68, Aug. 1, 1928, pp. 252-254, 3 figs.

Improvement, Great Britain. Road Improvement and Finance, W. J. Hadfield. Surveyor (Lond.), vol. 74, no. 1914, Sept. 28, 1928, pp. 277-279. Increased traffic causes increased cost of roads; expenditure per mile; new and widened roads and bridges; new methods of road construction; gradients; concrete roads; effect of new methods upon finance. Extracts from paper presented before World Motor Transport Congress.

Reconstruction, Toronto. Highway Improvements in Toronto District. Contract Rec. (Toronto), vol. 42, no. 38, Sept. 19, 1928, pp. 987-988, 6 figs. Negotiations recently concluded insure widening of Toronto-Hamilton Highway, Kingston Road and St. Clair Avenue; several new bridges called for.

Resurfacing. Two Methods of Resurfacing Old Roads, A. H. Hinkle. Can. Engr. (Toronto), vol. 55, no. 12, Sept. 18, 1928, pp. 311-314. Paper presented before Annual Purdue Road School, previously indexed.

Surface Treatment. The Oil Mix Treatment of Gravel Roads, C. H. Bowman. Good Roads, vol. 71, no. 9, Sept. 1928, pp. 496-499. Abstract of paper presented at 1928 Highway Conference.

Asphalt, Foundations. Recent Researches in Portland Cement Concrete and Their Application to the Design of Bases for Asphalt Pavements, R. M. Green. Asphalt Assn.—Circular, no. 52, 10 pp., 5 figs.

Concrete, Construction. Obtaining Efficiency in Concrete Road Construction. Roads and Streets, vol. 68, no. 9, Sept. 1928, pp. 457-459.

Concrete, Gravel Requirements. Requirements of Gravel for Concrete Roads, C. R. Waters. Cement, Mill and Quarry, vol. 32, no. 13, Sept. 1928, pp. 75-76. Address delivered at Empire State Sand and Gravel Producers Assn.

ROCKET PROPULSION

Engines for Automotive Vehicles. Economy of Rocket Engines for Vehicles (Zur Frage der Wirtschaftlichkeit des Raketenantriebes fuer irdische Fahrzeuge), H. S. Senftleben. Zeit. fuer Flugtechnik und Motorluftschiffahrt (Muenchen), vol. 19, no. 16, Aug. 28, 1928, p. 367, 1 fig. Short theoretical note on variation of efficiency of rocket drive with speed of gas expulsion from rocket cylinders.

Theory. Rocket Propulsion by Means of the Explosion Wave (Der Raketenantrieb durch die Explosionswelle), K. Baetz. Maschinen-Konstrukteur (Leipzig), vol. 61, no. 16-17, Aug. 15 and Sept. 1, 1928, pp. 370-373, 1 fig.

ROLLING MILLS

Equipment. Increasing the Output of a Small-Section Rolling Mill. Demag News (Duisburg), vol. 2, no. 4, Oct. 1928, pp. 92-94, 5 figs.

Metal Flow in Rolling. Experimental Investigations on Metal Flow in Rolling, N. Metz. Rolling Mill Jl. (formerly Iron and Steel World), vol. 2, nos. 8 and 9, Aug. and Sept. 1928, pp. 307-310 and 363-366, 19 figs. Aug.: Tensile stresses on side planes caused by lowering of elongation; determination of amount of spread. Sept.: Flow of metal in gripping angle and oval pass; spread diagrams of flats can be used to advantage in calculation of spread in oval.

Strip Mills, Germany. Design and Operation of Strip Mills, R. W. Deimel. Blast Furnace and Steel Plant, vol. 16, no. 9, Sept. 1928, pp. 1183-1186, 7 figs. Translated from Stahl und Eisen. (To be continued.)

Four-High. Calculation of Efficiency of Rolling Processes in Relation to Diameter of Roll and Its Application to Four-High Mills (Die Leistungsberechnung des Walzvorganges in Abhaengigkeit vom Walzendurchmesser, ihre Anwendung auf das Vierwalzengeruest), L. Weiss. Zeit. fuer Metallkunde (Berlin), vol. 20, no. 8, Aug. 1928, pp. 280-282, 2 figs.

S

SAND AND GRAVEL PITS

Excavators. Slackline Cableway Excavators and Power Drag Scrapers in the Sand and Gravel Industry, M. R. Elden and H. A. Roe. Nat. Sand and Gravel Bul., vol. 9, no. 9, Sept. 15, 1928, pp. 9-16, 8 figs.

SCREW THREADS

Measurements. Rational Measurement of Elements of a Screw Thread with Wires (Détermination rationelle des éléments d'un filetage à l'aide de "piges"), L. Fraichet. Génie Civil (Paris), vol. 93, no. 10, Sept. 8, 1928, pp. 238-240, 3 figs.

Gauges, Taper Gauges, Measurement of. The Measurement of Taper-Screw Thread Gauges, J. E. Baty. Machy. (Lond.), vol. 32, no. 827, Aug. 16, 1928, pp. 617-621, 13 figs.

SEWAGE ANALYSIS

Residual Chlorine Determination. Determination of Residual Chlorine, L. H. Enslow. Can. Engr. (Toronto), vol. 55, no. 11, Sept. 11, 1928, pp. 293-294. Comments on methods of estimating residual chlorine; practical methods are (1) starch-iodide method (colorimetric); (2) starch-iodide method (volumetric); (3) benzidine-hydrochloride method (colorimetric); (4) orthotolidin hydrochloride method (colorimetric); compensating for turbidity, colour, manganese, etc,; period of contact between chlorine and treated water.

SEWAGE DISPOSAL

Activated Sludge. A New Coagulant Discovered for Activated Sludge Prior to Filtration. Contract Rec. (Toronto), vol. 42, no. 37, Sept. 12, 1928, pp. 971-974, 4 figs. Chlorinated copperas is better than anything tried before, according to studies carried out by Sanitary District of Chicago; details of research work; discovery was made by J. R. Palmer that ferric salts, particularly ferric chloride, greatly facilitated filtrations; composition and cost of iron salts.

SEWAGE DISPOSAL PLANTS

Defects. Common Defects at Sewage Disposal Works, H. C. H. Shenton. Surveyor (Lond.), vol. 74, no. 1912, Sept. 14, 1928, pp. 223-224.

SEWAGE DISPOSAL, RURAL

Saskatchewan. Sewage Disposal for Rural Homes in Cold Climates, R. M. Starbuck, Jr. Domestic Eng. (Chicago), vol. 124, no. 9, Sept. 1, 1928, pp. 26-27, 71-72 and 75-76, 4 figs.

SEWAGE TANKS

Comparison. The Advantages of Different Types of Sewage Tanks, W. Clifford. Water and Water Eng. (Lond.), vol. 30, no. 357, Sept. 20, 1927, pp. 428-430 and (discussion) 430-432.

SEWAGE TREATMENT

Germany. Sewage Treatment Abroad, W. Rudolfs. Pub. Works, vol. 59, no. 9, Sept. 1928, pp. 266-369.

Research. Sewage Purification and Disposal Studies Outlined at Lawrence Experimental Station, H. W. Clark. Hydraulic Eng., vol. 4, no. 9, Sept. 1928, pp. 556-557, 566-567 and 580-582.

SPRINGS

Machine for Testing. The Elasticometer. Machy. (Lond.), vol. 32, no. 831, Sept. 13, 1928, p. 786, 2 figs. Details of spring-testing machine put on market by Coats Machine and Tool Co.; object of machine is to provide means whereby large range of springs can be rapidly tested by unskilled labour; machine is suitable for compression tests on springs of diameters from 1/8 to 2½ in. and lengths from ¼ to 6 in., and on springs from 6 to 8½ in. long of diameters from 1/8 to 7/8 in.

STEAM CONDENSERS

Arc Welding of. Building Surface Condensers by Arc Welding, B. H. Nichols. Power, vol. 68, no. 11, Sept. 11, 1928, pp. 436-437, 2 figs. Article submitted in Lincoln Arc Welding Prize Contest.

STEAM ENGINES

Thermal Analysis. Thermal Analysis of Internal Combustion or Steam, Piston Engines (Analyse thermique des moteurs à piston, à explosion ou à vapeur), M. Bouffart. Revue Universelle des Mines (Liége), vol. 19, no. 5, Sept. 1, 1928, pp. 197-229, 4 figs. Discusses 2- and 4-stroke engines and closed thermodynamic cycle; for internal combustion and steam; action of cylinder walls; comparison and steam engines.

STEAM GENERATORS

Electric. Electric Steam Generators Popular in Switzerland, C. J. Webb. Power Plant Eng., vol. 32, no. 19, Oct. 1, 1928, p. 1032, 1 fig.

STEAM HEATING

Central, Coke Firing in. Heat Utilization in Coke-Fired Boilers of Central Heating Plants (Die Waermeausnuetzung in koksgeheizten Sammelheizungskesseln). Gesundheits-Ingenieur (Munich), vol. 51, no. 33, Aug. 18, 1928, pp. 529-537, 18 figs. Report from department of heat engineering of Darmstadt Institute of Technology describing elaborate experimental study; also test of central heating plant of Geissen University clinics showing that efficiency of coke-fired plants with variable load may be in excess of 70 per cent.

STEAM METERS

Orifice. Measuring Steam Flow by Means of Diaphragm Orifices (Stauring-Mengenmessung von stroemendem Dampf), W. Pflaum. V.D.I. Zeit. (Berlin), vol. 72, no. 37, Sept. 15, 1928, pp. 1297-1301, 18 figs. Report from mechanical laboratory of Danzig Institute of Technology treating of correct construction of diaphragm orifice meters; condensing steam and other factors interfering with precision of effect of various factors; results compared with those of other investigators. See also Forschungsarbeiten auf dem Gebiete des Ingenieurwesens, no. 298, previously indexed.

STEAM PIPE LINES

Flexibility. The Flexibility of Plain Pipes, J. R. Finniecome. Engineer (Lond.), vol. 146, nos. 3790 and 3791, Aug. 31 and Sept. 7, 1928, pp. 218-219 and 246-248, 11 figs. Aug. 31: Analysis of tests on pipe bends on basis of Karman theory. Sept. 7: Deflection-stress correction factor; comparison of actual longitudinal stress obtained from tests with Karman longitudinal stress.

STEAM TURBINES

Design. The General Trend of Modern Development in Steam Turbine Practice, H. L. Guy. Metropolitan-Vickers Gaz. (Manchester), vol. 11, no. 185, Aug. 1928, pp. 46-48.

Operation. Shutting Down Steam Turbines with Sinking Boiler Pressure (Auslauf von Dampfturbinen mit sinkendem Kesseldruck), Schlicke. Waerme (Berlin), vol. 51, no. 37, Sept. 15, 1928, pp. 679-680, 1 fig.

STEEL

Cold Rolling. Influence of Cold Rolling and Annealing at Different Temperatures on the Strength and Structure of High-Grade Sheets (Der Einfluss des Kaltwalzens und Gluehens bei verschiedenen Temperaturen auf die Festigkeitseigenschaften und das Gefuege von Qualitaetsfeinblechen), E. Marke. Archiv fuer das Eisenhuettenwesen (Duesseldorf), vol. 2, no. 3, Sept. 1928, pp. 177-183 and (discussion) 183-184, 16 figs. Results of tests to determine mechanical properties and structure of cold-rolled sheet, and cold-rolled sheet subsequently annealed; practical application of results in sheet mills.

Heat Treatment. Effect of Quenching Temperature Change on the Properties of Quenched Steel, O. W. McMullan. Am. Soc. Steel Treating—Trans., vol. 14, no. 4, Oct. 1928, pp. 477-501, 24 figs.

Fundamentals in the Art of Heat Treatment, D. K. Bullens. Fuels and Furnaces, vol. 6, no. 10, Oct. 1928, pp. 1359-1369, 2 figs.

Notes on the Relation of Design to Heat Treatment, F. R. Palmer. Am. Soc. Steel Treating—Trans., vol. 14, no. 4, Oct. 1928, pp. 469-476, 11 figs.

Facts and Principles Concerning Steel and Heat Treatment, H. B. Knowlton. Am. Soc. Steel Treating—Trans., vol. 14, no. 4, Oct. 1928, pp. 580-608.

Manufacture, Purification. Purifying Steel with Sodium Compounds, J. R. Miller. Blast Furnace and Steel Plant, vol. 16, no. 9, Sept. 1928, pp. 1204-1205, 7 figs.

STOKERS

Travelling-Grate. Tests on Furnaces, with Special Reference to Furnace Grates (Versuche an Fuerungen, insvesondere an Rost Feuerungen), Koeniger. Archiv fuer Waermewirtschaft (Berlin), vol. 9, no. 9, Sept. 1928, pp. 274-277, 24 figs.

STORAGE BATTERIES

Utilization. Electric Storage Battery Aids in Hauling Heavy Cable, O. W. Cooley. Wire, vol. 3, no. 9, Sept. 1928, pp. 303 and 313-314, 2 figs.

T

TEMPERATURE CONTROL

Automatic. The Development of Automatic Temperature Control for Industrial Heating Apparatus, A. N. Otis. Fuels and Furnaces, vol. 6, no. 10, Oct. 1928, pp. 1387-1394 and 1398, 7 figs.

TOPOGRAPHIC MAPPING

Chicago. Mapping the City of Chicago and Vicinity, O. H. Nelson. West Soc. of Engrs.—Tech. Papers, vol. 33, no. 1, Jan. 1928, pp. 7-22, 13 figs. Account of field work for topographic map of Chicago and vicinity recently completed by co-operation of U.S. Geological Survey and Illinois State Geological Survey.

TUBES

Manufacture. Manufacture of Tubes (La fabrication des tubes), G. deLattre. Technique Moderne (Paris), vol. 20, no. 17, Sept. 1, 1928, pp. 581-585, 3 figs. Treats of different processes of machine work; compares them and shows relative advantages of processes for size and quality of products to be obtained; Mannesmann, Ehrhardt and Stiefel processes especially described.

TUNNELS

SURVEYING. Graphical Cross-Sections Recorded by Tunnel Pantograph. Eng. News-Rec., vol. 101, no. 13, Sept. 27, 1928, p. 481, 1 fig.

TURBO-BLOWERS

CONSTANT-VOLUME REGULATION. Constant-Volume Regulation for Turbo-Blowers, A. Baumann. Brown Boveri Rev. (Baden, Switz.), vol. 15, no. 9, Sept. 1928, 269-271, 6 figs. Description of Brown-Boveri system of regulation; shows diagrammatic arrangement of blower driven by d.c. motor and provided with volume regulation.

V

VIADUCTS

STEEL, RECONSTRUCTION. Revamping Steel Viaduct to Carry Street Over Railroad, T. Doll and J. Singleton. Eng. News-Rec., vol. 101, no. 13, Sept. 27, 1928, pp. 473-475, 3 figs. Remodelling structural steel railroad overcrossing by taking it down, refabricating two-thirds of old steel and then re-erecting it with this steel and 70 tons of new steel was required in modernizing Branner St. viaduct in Topeka, Kan.; viaduct consists of three 100-ft. trusses and 52-ft. girder span.

W

WATER ANALYSIS

CHLORINE DETERMINATION. A New Indicator for Chlorine, K. Alfthan. Am. Water Works Assn.—Jl., vol. 20, no. 3, Sept. 1928, pp. 407-411.

WATER CHLORINATION

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WATER FILTRATION PLANTS

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